UNIVERSIDADE FEDERAL DA BAHIA
INSTITUTO DE SAÚDE COLETIVA
PROGRAMA DE PÓS-GRADUAÇÃO EM SAÚDE COLETIVA

ANDRÊA JACQUELINE FORTES FERREIRA

EFEITO DOS PROGRAMAS DE PROTEÇÃO SOCIAL NA SAÚDE CARDIOVASCULAR EM PAÍSES DE BAIXA E MÉDIA RENDA

SALVADOR – BA

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Tese apresentada ao Programa de Pós-graduação em Saúde Coletiva, do Instituto de Saúde Coletiva, da Universidade Federal da Bahia, como requisito para obtenção do título de Doutora em Saúde Pública.

Área de concentração: Epidemiologia

Orientadora: Profa. Dra. Rita de Cássia Ribeiro Silva

SALVADOR – BA

2021

Ficha catalográfica elaborada pelo Sistema Universitário de Bibliotecas (SIBI/UFBA),
com os dados fornecidos pelo(a) autor(a).

Fortes Ferreira, Andrêa Jacqueline
EFEITO DOS PROGRAMAS DE PROTEÇÃO SOCIAL NA SAÚDE CARDIOVASCULAR EM PAÍSES DE BAIXA E MÉDIA RENDA / Andrêa Jacqueline Fortes Ferreira. -- Salvador, 2021.
160 f.

Orientadora: Rita de Cássia Ribeiro Silva.
Tese (Doutorado - Saúde Pública) -- Universidade Federal da Bahia, Instituto de Saúde Coletiva - Universidade Federal da Bahia, 2021.

1. Políticas de Proteção Social. 2. Habitação . 3. Doenças cardiovasculares . 4. Mortalidade. 5. Minha Casa Minha Vida. I. Ribeiro Silva, Rita de Cássia. II. Título.

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Aprovado em 22/03/2021

BANCA EXAMINADORA:

Profa. Dra. Rita de Cássia Ribeiro Silva – Orientadora

Escola de Nutrição, Universidade Federal da Bahia (ENUFBA)

Profa. Dra. Estela Maria Mota Lima Leão de Aquino

Instituto de Saúde Coletiva, Universidade Federal da Bahia (ISC/UFBA)

Profa. Dra. Dandara de Oliveira Ramos

Instituto de Saúde Coletiva, Universidade Federal da Bahia (ISC/UFBA)

Dra. Julia Moreira Pescarini

Centro de Integração de Dados e Conhecimentos para a Saúde (CIDACS/FIOCRUZ)

Prof. Dr. Mauro Niskier Sanchez

Núcleo de Medicina Tropical, Universidade de Brasília (NMT/UnB)

Aos Guias Espirituais e à minha família.

Às mães que a vida me deu, Fátima, Zinha e Fernanda, fontes de força e exemplo.

Aos meus avós, Alexandre e Rosa *(in memorian)*, por serem minha base e meu porto seguro, nesta e em outras vidas.

Às amigas e amigos, fontes inesgotáveis de amor e serenidade.

AGRADECIMENTOS

Aos Guias Astrais pela proteção e força para seguir.

A minha avó Rosa (*in memoriam*) e meu avô Alexandre, faróis que a vida me presenteou. Palavras e ações nunca serão suficientes para descrever o quanto vocês são importantes e necessários na minha vida.

À minha mãe, fonte de inspiração, que sempre acreditou na educação como instrumento de transformação e liberdade.

As minhas tias, por tudo o que elas representam na minha vida e na minha formação acadêmica. Sem elas, nada disso seria possível.

Ao meu irmão, Jamilson, e minha irmã, Iucy, parceiros maravilhosos. Sou grata por tê-los sempre por perto.

Ao meu companheiro Jackson, fonte de calmaria e aconchego, que viveu comigo todos os momentos deste ciclo.

À minha família (pai, primas (os), tias e tios) que sempre acreditou em mim, mesmo quando sonhar não era permitido.

A minha orientadora Rita Ribeiro pela confiança, oportunidade, ensinamentos e parceria nesta jornada. Navegamos por mares desconhecidos, atravessamos tempestades, e vimos o sol nascer, sempre na certeza que poderíamos chegar a um bom porto.

A Emanuelle Goes, fonte inesgotável de afeto e cuidado ancestral. Na encruzilhada da vida te conheci, e na imensidão do mar você me resgatou, abrindo caminhos, iluminando os dias e me cobrindo com seu manto de cuidado. Asé pela sua existência em todos os planos.

Aos meus amigos de jornada, Michaela, Camila, Natanael, Flávia e Aline. Gratidão pela amizade, companheirismo e afeto. Sem vocês tudo seria mais difícil.

A todas, todes e todos que fazem parte do CIDACS, meu agradecimento pelos aprendizados e pelas partilhas.

As mestras e mestres, pelos ensinamentos, indagações e espaço de diálogo. Um especial agradecimento a professora Rosemeire Fiaccone, parte fundamental deste ciclo.

Aos professores que se disponibilizaram para integrar a banca da qualificação e da defesa. Meu agradecimento antecipado.

Ao Programa de Pós-Graduação do Instituto de Saúde Coletiva, ao ISC e as/os funcionárias/os que estão conosco no dia a dia.

Ao CNPq pela Bolsa do doutorado.

A todos os cabo-verdianos, que assim como eu, saem do país em busca de uma oportunidade. Ao som dos ventos, na ondulação do mar, e na aridez da areia quente do deserto, seguimos, amparados pela *"morabeza das gentes das Ilhas"*.

A todas (os) que me apoiaram até aqui.

*“*Muito mais do que eu, é Oya que lhe dá ar
constante para que você possa respirar sempre,
as vezes brisas, outras horas ventania, mas
sempre vento e mesmo embaixo d'água com
Oxum você não se afoga”

Emanuelle Aduni

RESUMO

Introdução: As Doenças cardiovasculares (DCV) são as principais causas de óbito no Brasil e estão intimamente relacionadas as condições de vida, afetando particularmente, os indivíduos em situação de vulnerabilidade social. Neste sentido, programas de proteção social, como os programas de transferência de renda, alimentos e insumos, e as habitações sociais têm sido apontadas como intervenções capazes de reduzir as iniquidades sociais e de saúde, entre elas as associadas à saúde cardiovascular. São escassas as evidências relativas aos efeitos dos programas sociais na saúde cardiovascular, e mais ainda são os estudos relativos aos efeitos dos programas de habitação social na mortalidade por DCV, em especial nos países de baixa e média renda. Desta forma, **o presente trabalho teve como objetivo geral e**studar o efeito dos programas de proteção social na saúde cardiovascular em países de baixa e média renda. O tema central desta Tese foi abordado por meio de 2 artigos e um protocolo de pesquisa. O artigo intitulado *"Impact of social protection policies on cardiovascular health in low-and-middle-income countries: a systematic review"* corresponde a uma revisão sistemática dos efeitos dos programas de proteção social na saúde cardiovascular nos países de baixa e média renda; o protocolo corresponde a descrição da pesquisa, intitulada *"Evaluating the health effect of a Social Housing programme, Minha Casa Minha Vida, using the 100 million Brazilian Cohort: a natural experiment study protocol"* com vista a estudar, por meio de um estudo quase-experimental, o impacto do programa MCMV em desfechos em saúde, usando os dados da Coorte de 100 milhões de Brasileiros. Este protocolo subsidiou a elaboração do terceiro artigo, intitulado *"Effect of social housing programme, Minha Casa Minha Vida, on the risk of premature cardiovascular mortality among vulnerable and underprivileged: a population based nested case-control study".* Neste, investigamos a influência do programa MCMV na mortalidade por DCV. **Métodos**: Considerou-se para o estudo de revisão sistemática artigos publicados até 31 de julho de 2020 no *MEDLINE, Scopus, Lilacs, Web of Science e Google Scholar,* observando o o efeito dos programas de proteção social nos comportamentos em saúde (dieta, atividade física e consumo de álcool e tabaco), fatores de risco cardiometabólico (hipertensão, diabetes mellitus tipo 2, dislipidemia, e excesso de peso) e mortalidade por DCV. Foram incluídos e sintetizados em tabelas, todos os estudos revisados por pares, publicados entre 1990 e 2020, conduzidos em qualquer LMIC, que avaliam quantitativamente o efeito de qualquer política ou programa de proteção social na saúde

cardiovascular de adultos. O artigo de revisão foi conduzido de acordo o documento de referência *Preferred Reporting Items for Systematic Reviews and Meta-analyses (*PRISMA). Para o protocolo, delineou-se um estudo quase-experimental, no período de 2007 a 2015, após vinculação dos dados da coorte com os dados da base do programa MCMV (2009-2015), e da mortalidade por DCV (2007-2015), hanseníase (2007-2015) e registros de tuberculose (2007–2015). A população exposta foi definida como indivíduos que assinaram o contrato para receber o benefício social do MCMV, e o grupo não exposto, incluí os indivíduos comparáveis dentro da coorte que não assinaram um contrato de recebimento de uma habitação social. O impacto do MCMV sobre os resultados em saúde será estimado utilizando diferentes abordagens de escore de propensão para controlar os confundidores observados. Os indivíduos serão acompanhados até à ocorrência do desfecho específico, data do óbito ou término do acompanhamento (31 de dezembro de 2015). As análises serão estratificadas por tempo de acompanhamento, faixa etária, raça/etnia, gênero e posição socioeconômica. O protocolo foi elaborado de acordo com as diretrizes sugeridas pelo *Template for Intervention Description and Replication for Population Health and Policy (TIDieR-PHP).* Para o artigo empírico da Tese, o óbito prematuro por DCV foi o único desfecho estudado. Além disso, optamos por um desenho de estudo caso-controle pareado e aninhado à Coorte, com 102,882 indivíduos com idades entre 30-69 anos. Os casos, óbitos prematuros por DCV, foram definidos considerando a data de ocorrência do óbito e pareado com dois controles, selecionados de forma aleatória e sem reposição no período de ocorrência do óbito. Variáveis como a idade, sexo, raça, educação, região e recebimento do Bolsa Família foram usadas para parear os casos e os controles. O recebimento da habitação social proveniente do programa MCMV foi a principal exposição do estudo. Esta foi definida, considerando a data de assinatura do contrato da nova habitação, sendo necessário ser anterior à data do óbito. Modelos de regressão logística condicional, ajustado pelas características familiares do domicilio e pelo porte do município, foram utilizadas para modelar a razão de chances da mortalidade prematura por DCV. Análises de sensibilidade considerando apenas os indivíduos residentes nos municípios com elevado Índice de Desenvolvimento Humano (IDH) foram realizadas. **Resultados:** Para o artigo de revisão sistemática foram incluídos 34 estudos, distribuídos em 15 países de baixa e média renda. Em vinte e dois estudos foram identificados resultados sobre comportamentos de saúde (61,8%), 12 sobre fatores de risco cardiometabólico (35,3%) e um sobre mortalidade por DCV (2,9%). Resultados apontam que programas de proteção social estão associados a dieta saudável (N = 17/26, 65,3%), aumento

da atividade física (N = 2/2, 100%), menor prevalência de hipertensão (N = 2/3, 66, 6%) e diabetes do tipo 2 (N = 1, 100%). Esses programas se associaram ao excesso de peso corporal (N = 8/11, 72,7%), principalmente entre beneficiários de programas incondicionais de transferência de alimentos. Não encontramos associação entre programas de proteção social e uso de tabaco e álcool (N = 4/7, 57,1%) ou mortalidade por DCV (N = 1, 100%). Com relação ao artigo empírico, os resultados apontaram que durante o tempo de acompanhamento (2010-2015), registrou-se na Coorte de 100 milhões de Brasileiros, 34.294 casos de óbitos prematuros por DCV, com mediana de idade de 58 anos (50-63), que foram pareados com 68.588 controles, mediana de idade de 55 anos (50-61). A maioria dos casos (59,72%) e controles (57,14%) são provenientes de municípios de grande porte, com mais de cem mil habitantes. No entanto, aqueles que morreram por DCV (casos) apresentaram maiores proporções de acesso inadequado ao abastecimento de água (9,02 vs 8,77%) e à domicílios sem eletricidade ou contador (7,21% vs 6,11%), quando comparado com o grupo controle. Os beneficiários de habitação social apresentaram maior risco de óbito prematuro por DCV em comparação aos não beneficiários do programa social, após ajuste dos modelos pelas condições familiares de moradia e pelo porte do município (OR = 1,18; IC95% = 1,07-1,30). O mesmo padrão de associação permaneceu após análise dos casos e controles residentes em municípios com IDH elevado (ORaj = 1.16; IC95% = 1.03-1.30). **Conclusões**: Os programas de proteção social influenciam positivamente na melhoria da qualidade e diversidade da dieta. Porém, foram associadas ao aumento da prevalência de excesso de peso, em especial entre os beneficiários de programas não condicionais de transferência de alimentos. Evidências limitadas sobre seus efeitos nos demais indicadores de saúde cardiovascular (diabetes tipo 2, hipertensão, atividades físicas e dislipidemia) e mortalidade por DCV, ressaltam a importância de mais estudos sobre o tema. Além disso, não encontramos estudos relativos aos efeitos de intervenções habitacionais em desfechos cardiovasculares, sobretudo mortalidade, nos países de baixa e média renda, apesar da habitação ser um importante determinante social da saúde. No que se refere aos resultados do estudo empírico, de forma não esperada, foi observado um maior risco de óbito prematuro entre os beneficiários do programa MCMV em comparação aos não beneficiários. Contudo, os achados devem ser interpretados com cautela. A construção de empreendimento em áreas desprovidas, em particular, de serviço de promoção de saúde, área de lazer, alimentação saudável e transporte público adequado, aliado a perda ou enfraquecimento das redes de apoio e suporte social, associados à realocação das famílias em novos territórios, pode ter contribuídos com tais resultados desfavoráveis. Por

outro lado, alguns limites do estudo precisam ser considerados, a exemplo do curto tempo de exposição ao programa, a sub-notificação de casos e a condição prévia de saúde dos beneficiários (não temos tais informações), o que pode ter influenciado os resultados. Argumenta-se ainda o fato de que o PMCMV foi projetado inicialmente para atender apenas demandas habitacionais, não se atendo a questões associadas as características da vizinhança e o acesso aos empreendimentos habitacionais. É importante ressaltar que outras análises estão previstas (ver protocolo), o que torna os resultados apresentados aqui ainda preliminares.

Palavras-chave: Programas de proteção social; Programas sociais de habitação; Programa Minha Casa Minha Vida, Doenças cardiovasculares

ABSTRACT

Introduction: Cardiovascular diseases (CVD) are the main causes of death in Brazil and are closely related to living conditions, particularly affecting individuals in situations of social vulnerability. In this sense, social protection programs, such as income, food and input transfer programs, and social housing have been identified as interventions capable of reducing social and health inequities, including those associated with cardiovascular health. Evidence regarding the effects of social programs on cardiovascular health is scarce, and even more so are studies on the effects of social housing programs on CVD mortality, especially in low- and middle-income countries (LMICs). Thus, **the present work had the general objective** of studying the effect of social protection programs on cardiovascular health in low and middle-income countries. The central theme of this Thesis was approached through two articles and a research protocol. The article entitled "Impact of social protection policies on cardiovascular health in low-and-middle-income countries: a systematic review" corresponds to a systematic review of the effects of social protection programs on cardiovascular health in low-and-middle-income countries; the protocol corresponds to the research description, entitled "Evaluating the health effect of a Social Housing programme, *Minha Casa Minha Vida*, using the 100 million Brazilian Cohort: a natural experiment study protocol" to study, through a quasi-experimental study, the impact of *Minha Casa Minha Vida* (MCMV) program on health outcomes, using data from the 100 Million Brazilian Cohort. This protocol supported the elaboration of the third article, entitled "Effect of social housing programme, *Minha Casa Minha Vida*, on the risk of premature cardiovascular mortality among vulnerable and underprivileged: a population based nested case-control study". In this, we investigate the influence of the MCMV program on CVD mortality. **Methods**: For the systematic review study, articles published until July 31st, 2020, in MEDLINE, Scopus, Lilacs, Web of Science and Google Scholar were considered, observing the effect of social protection programs on health behaviours (diet, physical activity and use of alcohol and tobacco), cardiometabolic risk factors (hypertension, type 2 diabetes, dyslipidemia, and excess weight) and CVD mortality. All peer-reviewed studies published between 1990 and 2020, conducted in any LMICs, that quantitatively assess the effect of any social protection policy or program on the cardiovascular health of adults were included and synthesized in tables. The review article was conducted according to the reference document *Preferred Reporting Items for Systematic Reviews and Meta-analyses (*PRISMA). For the protocol, a quasi-experimental study was

designed, from 2007 to 2015, after linking the cohort data with the base data of the MCMV program (2009-2015), and of CVD mortality (2007-2015), leprosy (2007-2015) and tuberculosis records (2007–2015). The exposed population was defined as individuals who signed the contract to receive the MCMV social benefit, and the unexposed group included comparable individuals within the cohort who did not sign a contract to receive social housing. The impact of MCMV on health outcomes will be estimated using different propensity score approaches to control observed confounders. Individuals will be followed up until the occurrence of the specific outcome, date of death or end of follow-up (December 31st , 2015). The analyzes will be stratified by follow-up time, age group, race/ethnicity, gender and socioeconomic status. The protocol was developed according to the guidelines suggested by the *Template for Intervention Description and Replication for Population Health and Policy (TIDieR-PHP)*. For the empirical article of the Thesis, premature death from CVD was the only outcome studied. Also, we opted for a case-control study design paired and nested with the Cohort, with 102,882 individuals aged 30-69 years. The cases, premature deaths due to CVD, were defined considering the date of occurrence of death and paired with two controls, selected at random and without replacement in the period of death`s occurrence. Variables such as age, sex, race, education, region and receipt of Bolsa Família programme were used to match cases and controls. Receiving social housing from the MCMV program was the main exposure of the study. This was defined, considering the date of signature of the new housing contract, being necessary to be before the date of death. Conditional logistic regression models, adjusted for household characteristics and the size of the municipality, were used to model the odds ratio for premature CVD mortality. Sensitivity analyzes considering only individuals residing in municipalities with a high Human Development Index (HDI) were performed. **Results**: For the systematic review article, 34 studies were included, distributed in 15 low and middle-income countries. In twenty-two studies, results on health behaviours (61.8%), 12 on cardiometabolic risk factors (35.3%) and one on CVD mortality (2.9%) were identified. Results point out that social protection programs are associated with a healthy diet (N = 17/26, 65.3%), increased physical activity (N = 2/2, 100%), lower prevalence of hypertension (N = 2/3, 66, 6%) and type 2 diabetes (N = 1, 100%). These programs were associated with excess body weight (N = 8/11, 72.7%), especially among beneficiaries of unconditional food transfer programs. We found no association between social protection programs and the use of tobacco and alcohol (N = 4/7, 57.1%) or mortality from CVD (N = 1, 100%). Regarding the empirical article, the results showed that during the follow-up period

(2010-2015), 34,294 cases of premature deaths from CVD were registered in the Cohort of 100 Million Brazilians, with a median age of 58 years (50- 63), who were paired with 68,588 controls, with a median age of 55 years (50-61). Most cases (59.72%) and controls (57.14%) are from large municipalities, with more than one hundred thousand inhabitants. However, those who died from CVD (cases) had higher proportions of inadequate access to water supply (9.02 vs 8.77%) and households without electricity or meter (7.21% vs 6.11%), when compared to the control group. Beneficiaries of social housing had a higher risk of premature death from CVD compared to non-beneficiaries of the social program, after adjusting the models for family housing conditions and the size of the municipality (OR = 1.18; 95% CI = 1.07- 1.30). The same pattern of association remained after analyzing the cases and controls residing in municipalities with a high HDI (ORaj = 1.16; 95% CI = 1.03-1.30). **Conclusion**: Social protection programs have a positive influence on improving the quality and diversity of the diet. However, they were associated with an increase in the prevalence of overweight, especially among beneficiaries of non-conditional food transfer programs. Limited evidence on its effects on other indicators of cardiovascular health (type 2 diabetes, hypertension, physical activities and dyslipidemia) and mortality from CVD, highlight the importance of further studies on the subject. Besides, we have not found studies on the effects of housing interventions on cardiovascular outcomes, especially mortality, in low and middle-income countries, despite housing being an important social determinant of health. The results of the empirical study, unexpectedly, a greater risk of premature death was observed among beneficiaries of the MCMV program compared to non-beneficiaries. However, the findings should be interpreted with caution. The construction of an enterprise in areas devoid, in particular, of health promotion service, leisure area, healthy food and adequate public transport, combined with the loss or weakening of the support and social support networks, associated with the relocation of families in new territories may have contributed to such unfavourable results. On the other hand, some study limits need to be considered, such as the short time of exposure to the program, the undereporting deaths, and the beneficiaries' previous health condition (we do not have such information), which may have influenced the results. It is also argued that the PMCMV was initially designed to meet only housing demands, not addressing issues associated with the characteristics of the neighbourhood and access to housing developments. It is important to note that other analyzes are planned (see protocol), which makes the results presented here still preliminary.

Key-words: Social protection Programmes; Social Housing; Minha Casa Minha Vida programme; Cardiovascular Disease.

LISTA DE FIGURAS

LISTA DE QUADROS E TABELAS

LISTA DE ABREVIATURAS E SIGLAS[1]

AHOME	*Cardiovascular Health Outcomes of Latinos in the Affordable Housing as an Obesity Mediating Environment*
AVE	Acidente Vascular Encefálico
CNI	*Choice Neighborhood Initiative*
CID-10	Código Internacional de Doença, versão 10
DCB	Doenças Cerebrovasculares
DCI	Doenças Coronarianas Isquêmicas
DCV	Doenças Cardiovasculares
DM	Diabetes Mellitus
FAR	Fundo de Arredamento Residencial
FDS	Fundo de Desenvolvimento Social
FGTS	Fundo de Garantia por Tempo de Serviço
GBD	*Global Burden of Disease*
GoWell	*Glasgow Community Health and Wellbeing*
HAS	Hipertensão Arterial Sistêmica
IAM	Infarto Agudo do Miocárdio
IMC	Índice de Massa Corporal
MCMV – E	Programa Minha Casa, Minha Vida, modalidade Entidades
MCMV – FAR	Programa Minha Casa, Minha Vida, modalidade FAR
MTO	*Moving to Oportunity*
OMS	Organização Mundial da Saúde

[1] Ordenadas por ordem alfabética

ODS	Objetivos do Desenvolvimento Sustentável
PMCMV	Programa Minha Casa, Minha Vida
SM	Salário Mínimo
PNH	Política Nacional de Habitação
UH	Unidades Habitacionais

SUMÁRIO

1 INTRODUÇÃO

As doenças cardiovasculares (DCV) são as principais causas de óbito no mundo (WANG et al., 2016). Segundo o *Global Burden of Disease (GBD)*, em 2016, as DCV foram responsáveis por 17,9 milhões de óbitos, das quais 85,1% foram atribuídas as Doenças Coronarianas Isquêmicas e as Cerebrovasculares (WANG et al., 2016). Destes óbitos, um terço ocorreu em indivíduos com idade entre 30 e 69 anos, caracterizando a mortalidade prematura por DCV (WANG et al., 2016). O Brasil segue o mesmo padrão mundial, onde as DCV são as principais causas de óbito geral desde a década de 60 (BRASIL, 2018). De acordo com o GBD, as taxas de mortalidade padronizadas por idade, no país, reduziram 40,5% no período de 1990 a 2015 (WANG et al., 2016). As taxas de mortalidade prematura seguiram o mesmo padrão, com uma tendência de decréscimo até 2015, seguindo-se de uma inversão dessa tendência nos anos seguintes (BRASIL, 2018; MORAES DE OLIVEIRA et al., 2020). Atualmente, no Brasil, as DCV são responsáveis por 27,3% dos óbitos nacionais (MORAES DE OLIVEIRA et al., 2020).

Diversos fatores estão associados a ocorrência das DCV na população. Além dos fatores comportamentais, a exemplo das dietas inadequadas, sedentarismo, uso de tabaco e consumo e excessivo de álcool – fatores de risco que contribuem para o desenvolvimento de hipertensão, diabetes, dislipidemia, sobrepeso e obesidade -, a literatura tem apontado o papel dos determinantes sociais, em particular dos socioeconômicos, na gênese e distribuição da morbimortalidade por eventos cardiovasculares, em especial entre os mais vulneráveis, e com maior impacto nos países de baixa e média renda (HARPER; LYNCH; SMITH, 2011; HAVRANEK et al., 2015; ROSENGREN et al., 2019). Piores condições socioeconômicas estão associadas a maior acumulo de fatores de risco cardiovascular, exposição crônica à piores condições de vida, e consequentemente maior estresse psicossocial, que tendem a se acumular ao longo dos ciclos de vida, influenciando de forma negativa à saúde cardiovascular (HAVRANEK et al., 2015; ROSENGREN et al., 2019).

A condição de moradia é um importante determinante socioeconômico de saúde (OMS, 2018; THOMSON; THOMAS, 2015). Esta influencia a condição de saúde mediante três domínios principais: a casa, o lar e a vizinhança (BONNEFOY, 2007). Estes domínios têm o potencial de influenciar a saúde dos indivíduos de forma isolada ou sinérgica, mediante

mecanismos físicos e psicossociais (BONNEFOY, 2007; GIBSON et al., 2011; THOMSON; THOMAS, 2015). Residir em domicílios com estrutura física adequada – saneamento básico, conforto térmico e acústico, ventilação e espaço físico ajustado a composição familiar, contribui para melhorias na saúde física e mental dos seus residentes (BONNEFOY, 2007; THOMSON; THOMAS, 2015). Estudos apontam que indivíduos que detém a posse da casa referem melhores indicadores de saúde mental quando comparados àqueles que vivem em casas alugadas (KAVANAGH et al., 2016; SENG et al., 2018; ZUMBRO, 2014). Viver em vizinhanças com adequadas condições estruturais e físicas – presença de parques, espaços verdes e de lazer, disponibilidade de alimentos saudáveis e com acesso a serviços básicos, como educação, saúde, segurança pública, bem como em comunidades coesas, onde os residentes dispõe de redes de apoio social, também contribuem para a saúde e bem-estar dos seus residentes (BARBER et al., 2016; CHUM; O'CAMPO, 2015; DIEZ-ROUX et al., 2016; GELORMINO et al., 2015).

No entanto, segundo a Organização Mundial de Saúde (OMS), uma parcela significativa da população, em especial aquela que vive em situação de vulnerabilidade social, não dispõe de acesso à moradia com adequadas condições, dado o elevado custo associado à aquisição da casa própria, sendo obrigada a viver em precárias condições de habitabilidade (BONNEFOY, 2007; DUNN, 2000; OMS, 2018). A exposição a esse contexto inadequado tende a influenciar, de forma negativa, à saúde física e mental dos seus residentes (CAIRNEY; BOYLE, 2004; SANBONMATSU et al., 2011; THOMSON et al., 2013b).

Considerando a relação entre os determinantes socioeconômicos e à saúde cardiovascular, estratégias de proteção social têm sido propostas como intervenções públicas capazes de reduzir as disparidades socioeconômicas no adoecimento e morte por eventos cardiovasculares, em especial nos países de baixa e média renda (NORTON; CONWAY; FOSTER, 2002; PULLAR et al., 2018). Entre essas intervenções, destacam-se aquelas que melhoram diretamente a renda dos indivíduos, a exemplo de programas sociais de transferência de renda (NORTON; CONWAY; FOSTER, 2002; PULLAR et al., 2018), o incentivo à políticas de salário mínimo universal e de pensões sociais, ou aquelas que modificam as condições de vida dos indivíduos de baixa renda (PULLAR et al., 2018). Existe uma expectativa política e social, de que políticas e programas habitacionais possam contribuir para melhorias na saúde dos seus beneficiários e reduzir as iniquidades sociais, principalmente entre os mais vulneráveis (THOMSON; THOMAS, 2015). Porém, ressalta-se a escassez de evidências robustas sobre os efeitos dessas intervenções na promoção da saúde,

sobretudo cardiovascular (CHAMBERS; ROSENBAUM, 2014; RIBEIRO; BARROS, 2020; THOMSON; THOMAS, 2015).

No Brasil, em 2009, foi implementado o Minha Casa, Minha Vida (MCMV), o maior programa de habitação social na América Latina (BRASIL, 2009). Até a presente data, o MCMV já entregou mais de quatro milhões de habitações às famílias em situação de vulnerabilidade social (BRASIL, 2019). Apesar de sua abrangência nacional, poucos estudos têm investigado os seus efeitos na saúde. Por isso, esse tema será explorado neste trabalho usando os dados da "Coorte de 100 Milhões de Brasileiros", disponibilizados pelo Centro de Integração de Dados e Conhecimentos para Saúde (CIDACS/Fiocruz). Essa coorte é composta por integrantes da população mais pobre e extremamente pobre do país, que tiveram acesso a algum programa de proteção social, disponibilizado pelo Governo Federal; um grupo conhecido por estar particularmente em maior risco para desfechos adversos em saúde. Decerto, estudos que possam avaliar os efeitos de programa sociais nos principais agravos a saúde de população em situação de vulnerabilidade, são importantes para reduzir a lacuna de conhecimento sobre a temática e contribuir para o corpo de evidências relativas à relação entre habitação e saúde, em especial nos países de baixa e média renda.

2 OBJETIVOS

2.1 GERAL

Estudar o efeito dos programas de proteção social na saúde cardiovascular em países de baixa e média renda.

2.2 ESPECÍFICOS

a) Sumarizar sistematicamente as evidências relativas aos efeitos dos programas de proteção social na saúde cardiovascular nos países de baixa e média renda;

b) Delinear um protocolo de estudo quase-experimental para avaliação do impacto do programa MCMV em desfechos em saúde, usando os dados da Coorte de 100 milhões de Brasileiros.

c) Investigar a influência do programa MCMV na mortalidade por DCV em integrantes da Coorte de 100 milhões de Brasileiros.

3 REVISÃO BIBLIOGRÁFICA

3.1 DOENÇAS CARDIOVASCULARES

3.1.1 Epidemiologia e determinantes sociais das doenças cardiovasculares

As DCV compreendem um grupo de alterações do coração e dos vasos sanguíneos, definidos no capítulo IX do Código Internacional de Doença, na sua versão 10 (CID-10), e que inclui: as doenças coronarianas isquêmicas, as cerebrovasculares, a doença cardíaca reumática, a insuficiência cardíaca, a cardiopatia congênita, a trombose profunda e a embolia pulmonar (OMS, 2016). As DCV são a primeira causa de morte no mundo, responsáveis por 31% de todos os óbitos, e atingem anualmente cerca de 17,9 milhões de pessoas (WORLD HEALTH ORGANIZATION, 2017). Segundo a Organização Mundial da Saúde (OMS), 85% das mortes por DCV são devido a ataques cardíacos e acidentes vasculares encefálicos, e um terço desses óbitos ocorrem prematuramente entre pessoas com menos de 70 anos de idade (WORLD HEALTH ORGANIZATION, 2017). Esses óbitos prematuros, ou seja, aqueles que acontecem em indivíduos com idade entre 30 e 69 anos, tem sido apontados como um marcador importante para mensurar a carga dos eventos cardiovasculares na população, dado que estes óbitos são considerados evitáveis nesta faixa etária (OMS, 2016; ROTH et al., 2015). No Brasil, a semelhança do que acontece em outros países, as DCV, em especial as DCI e as DCB, são as principais causas de morte (FARO et al., 2018; RIBEIRO et al., 2016), apesar da tendência decrescente das taxas de mortalidade padronizada por idade entre os anos de 1990 (429,5/100 mil habitantes) e 2015 (256,0/100 mil habitantes) (WANG et al., 2016). Este cenário de declínio é observado em todas as regiões do país, em especial para as DCB (BRASIL, 2018). Atualmente, as DCV são responsáveis por 27,3% dos óbitos no pais, considerando todas as faixas etárias (MORAES DE OLIVEIRA et al., 2020).

Contudo, alguns autores ressaltam à necessidade de se ter cautela na interpretação da tendência das taxas padronizadas de mortalidade por DCV (RIBEIRO et al., 2016), considerando as mudanças na qualidade do Sistema de Informação sobre a Mortalidade (SIM), e consequentemente na captação do número de óbitos no país. Este é uma das principais ferramentas para o monitoramento das estatísticas de mortalidade no país, uma vez que todos os municípios brasileiros devem registrar seus óbitos. Sua consolidação tem ocorrido de forma paulatina ao longo dos anos, passando de uma cobertura nas unidades

federativas de 86% em 2000 para 98% em 2017, apesar de ainda existir diferenças na qualidade e completude dos registros de óbitos em algumas regiões do país, com destaque para o Norte e o Nordeste, que ainda mantêm coberturas inferiores a 95%, e em municípios pobres (BRASIL, 2018; MALTA et al., 2020b).

Diversos problemas podem influenciar a qualidade e completude do SIM, e consequentemente enviesar as estimativas das taxas de mortalidade padronizada. Entre eles destacam-se, a subnotificação do número de óbitos, em particular nos municípios de pequeno porte (MALTA et al., 2020b), o preenchimento inadequado da idade na declaração de óbito (DO), em especial entre os extremos etários (crianças e idosos) (BRASIL, 2018; ISHITANI et al., 2006) e inconsistências na definição da causa básica de óbito, campo muitas vezes preenchido com causas que não podem ou não devem ser consideradas causas básicas de óbito, os chamados códigos *garbage* (BRASIL, 2018; ISHITANI et al., 2006).

A correção desses códigos é um desafio importante para os sistemas de mortalidade, em particular no Brasil, um país continental e heterogêneo. Assim, faz-se necessário a implementação de metodologias que possibilitem a reclassificação desses códigos *garbage*, erroneamente atribuídas como causas básicas. Porém, essa correção esbarra ainda em alguns problemas, nomeadamente a ausência de uma lista de causas padronizadas para cada país e de uma metodologia única para a sua implementação, em especial quando se trata de dados individuados (VOS et al., 2016; WANG et al., 2016). Além disso, melhorias na cobertura do SIM nos municípios de pequeno porte e nas regiões do país com subnotificação de óbitos devem ser asseguradas, no intuito de melhorar a qualidade da informação do SIM, e reduzir potenciais interpretações erróneas associadas a não correção dos dados (MALTA et al., 2020b).

Uma combinação de fatores tem sido associados ao risco de adoecimento e morte por DCV (HARPER; LYNCH; SMITH, 2011; HAVRANEK et al., 2015). Entre eles, destacam-se o envelhecimento da população, em adição a mudanças comportamentais, a exemplo dos hábitos alimentares inadequados, sedentarismo e inatividade física, tabagismo e consumo excessivo de álcool – que aumentam o risco de hipertensão arterial, diabetes do tipo 2, dislipidemia, e excesso de peso; os principais fatores de risco para a morbimortalidade por eventos cardiovasculares (HARPER; LYNCH; SMITH, 2011; HAVRANEK et al., 2015; YUSUF et al., 2004). Porém esses fatores se distribuem de forma desigual entre os diferentes grupos sociais, sendo mais comuns entre os mais vulneráveis (HAVRANEK et al., 2015; ROSENGREN et al., 2019), e com maior impacto entre os países de baixa e média renda

(ROSENGREN et al., 2019), reforçando o papel dos determinantes sociais, em particular dos socioeconômicos, no desenvolvimento, adoecimento e morte por DCV (HARPER; LYNCH; SMITH, 2011; HAVRANEK et al., 2015).

Segundo a Organização Mundial da Saúde (OMS), os determinantes socioeconômicos são definidos como "as circunstâncias em que as pessoas nascem, crescem, vivem, trabalham e os sistemas implantados para lidar com as enfermidades" (WORLD HEALTH ORGANIZATION, 2011). Assim se apresentam, em particular, a educação, ocupação e renda (WORLD HEALTH ORGANIZATION, 2011). Estudos apontam que esses fatores condicionam os contextos sociais de vida, influenciando as características socioeconômicas, físicas e sociais da habitação; aspectos importantes associados à saúde (CHAIX, 2009; DIEZ-ROUX et al., 2016; FERRER, 2018). Assim, à adoção de intervenções populacionais capazes de modificar esses determinantes sociais podem auxiliar na melhoria das condições de vida das pessoas, reduzindo à exposição aos fatores de risco cardiovascular (MALTA et al., 2020a).

Dado os impactos negativos da morte prematura por DCV, em particular, no aumento dos custos hospitalares e na redução da força de trabalho da população economicamente ativa, os estados-membros das Nações Unidas pactuaram entre si a redução de 25% do total de óbitos prematuros atribuídos as DCV até o ano de 2025 (ROTH et al., 2015; WANG et al., 2016). Esta iniciativa está incluída nas metas dos Objetivos do Desenvolvimento Sustentável (ODS), reafirmando o posicionamento da OMS, que considera inaceitável as elevadas taxas atuais de morte prematura por DCV, visto que intervenções custo-efetivas para prevenir e tratar as DCV estão disponíveis, em especial nos países desenvolvidos (ROTH et al., 2015; WANG et al., 2016). Assim, o alcance das metas dos ODS é de extrema importância para todos os países, na tentativa de reduzir as elevadas taxas de mortalidade prematura associada as DCV, bem como evitar as previsões da OMS, que apontam que, em 2030, as DCV serão responsáveis por 23,6 milhões de óbitos (OMS, 2016).

3.2 HABITAÇÃO E SAÚDE

A habitação é um direito humano consagrado pelo artigo 25 da Declaração Universal dos Direitos humanos de 1948 e ratificado por diversos países, inclusive pelo Brasil, apesar de apenas no ano 2000, após a aprovação da Emenda Constitucional nº 26, o país reconheceu à

habitação como um direito social básico. Habitação é também considerada um importante determinante socioecônomico de saúde, e que não se restringe apenas a garantia de abrigo, mas também a sua adequação - saneamento básico, conforto térmico, ventilação e espaço físico ajustado a composição familiar, segurança fundiária, localização em área segura, com estrutura física e social ajustado as demandas da comunidade, entre outros aspetos determinados pela OMS (OMS, 2018). A relação entre inadequadas condições de moradia e desfechos negativos em saúde está bem estabelecida na literatura, com estudos abordando os três domínios da habitação e seus efeitos na saúde: a casa, o lar e a vizinhança (GIBSON et al., 2011; OMS, 2018; SHAW, 2004; THOMSON et al., 2013a).

A primeira dimensão da habitação, a casa, concentra o maior número de evidências acerca da relação entre habitação e saúde (BONNEFOY, 2007; HOWDEN-CHAPMAM, 2004; OMS, 2018). Nesta dimensão, destaca-se os efeitos das características estruturais e físicas da casa na saúde, com destaque para os fatores de risco: i) químico, a exemplo da presença do chumbo e do amianto; ii) biológico, como umidade, mofo, ácaros da poeira, infestação de parasitas e insetos; e iii) físico, como a ventilação inadequada, temperaturas extremas, densidade e aglomeração populacional e o tipo de construção (BONNEFOY, 2007; HOWDEN-CHAPMAM, 2004; OMS, 2018).

Os materiais que compõe a estrutura da casa são importantes determinantes da saúde dos seus residentes, dado o seu potencial para influenciar a qualidade interna do ar e a contaminação da água (HWANG et al., 1999). Entre esses fatores, destaca-se o papel do chumbo, presente em tintas e tubulações de água e do amianto, presente em telhas e construções antigas. Estes tem o potencial de ocasionar intoxicações, alergias e problemas respiratórios, especialmente em crianças e idosos (HOWDEN-CHAPMAM, 2004; JACOBS et al., 2002). Os casos de intoxicação por chumbo e amianto tem reduzido ao longo dos tempos, devido ao reconhecimento do papel negativo destes agentes químicos na saúde. Porém, em algumas regiões do mundo, a exemplo do Brasil, a utilização destes compostos na estrutura das casas ainda é uma realidade, em especial nas áreas rurais (HOWDEN-CHAPMAM, 2004; JACOBS et al., 2002).

Ambientes domiciliares com elevada concentração de umidade e mofo estão associadas a maiores riscos de infestação por ácaros e baratas, reduzindo a qualidade do ar e as condições higiênicas das habitações (EVANS, 2000). Estes aspetos têm sido associados à maior ocorrência de asma, alterações respiratórias, febre e dores de cabeça, sendo as crianças

e os idosos os mais susceptíveis a estas enfermidades (EVANS, 2000; THOMSON; THOMAS, 2015; ZOCK et al., 2002).

Os aspetos estruturais da casa são importantes fatores que influenciam a saúde, e entre eles destaca-se a ventilação e o conforto térmico (HOWDEN-CHAPMAM, 2004). Domicílios com reduzida ventilação, contribuem para a redução da qualidade do ar e aumento da concentração de mofo e umidade, exacerbando o risco de doenças respiratórias, como à asma, e infeciosas como à tuberculose (CLARK; RIBEN; NOWGESIC, 2002; EVANS, 2000; ZOCK et al., 2002). O conforto térmico da casa é importante na manutenção do bem-estar e qualidade de vida dos seus residentes. Segundo a OMS, a zona de conforto térmico no interior da residência varia entre os 15 e os 25 graus em média, a depender da estação do ano (OMS, 2018). Mudanças substanciais de temperatura no interior da moradia afetam a saúde e estão associadas ao aumento da morbidade, em especial no inverno, aumento da severidade da asma, insuficiência respiratória e morbimortalidade por eventos cardiovasculares (FOWLER et al., 2015; OMS, 2018). As famílias de baixa e média renda e os residentes em moradias antigas e com isolamento térmico insuficiente, no inverno, tendem a utilizar fontes de energia poluentes, como combustíveis fosseis e madeira, para elevar a temperatura domiciliar, exacerbando os riscos à saúde respiratória e a ocorrência de acidentes domésticos e incêndios (GEMMELL, 2001; HOWDEN-CHAPMAM, 2004; LIDDELL; MORRIS, 2010).

Além disso, em termos estruturais, a concepção física e funcional da moradia influencia a densidade e aglomeração domiciliar e poderá limitar, em algum grau, a mobilidade de idosos e residentes com deficiências físicas e necessidades especiais (BONNEFOY, 2007; SHAW, 2004; THOMSON et al., 2013b). A densidade e a aglomeração domiciliar são dois aspetos que geralmente coexistem com situações de baixa renda, sistemas inadequados de fornecimento de água e esgotamento sanitário, impactando negativamente na saúde dos residentes (BONNEFOY, 2007; DUNN, 2000, 2002). Esses dois aspetos foram os primeiros fatores associados a habitação; alvo de ações na área de saúde pública, dado a potencialidade que indivíduos residentes em locais com elevada densidade e aglomeração domiciliar tem de transmitir doenças infectocontagiosas, como diarreia, hanseníase e tuberculose (CLARK; RIBEN; NOWGESIC, 2002)

O tipo de construção também tem sido associado a desfechos negativos em saúde (EVANS; WELLS; MOCH, 2003; ROHDE; AAMODT, 2016). Estudos apontam que moradias verticais ou prediais, em especial as residências situadas em andares elevados, estão associadas a depressão e a ansiedade, e as DCV, em especial entre crianças, idosos,

indivíduos com redução de mobilidade e aqueles que apresentam necessidades especiais (EVANS; WELLS; MOCH, 2003; ROHDE; AAMODT, 2016). Aspectos associados ao isolamento social imposto pelas moradias situadas nos andares mais altos dos prédios, a falta de espaços de lazer e recriação nos prédios e a estigmatização relacionada à aparência do prédio são alguns dos fatores que possivelmente explicam a relação entre o tipo de construção e desfechos negativos em saúde (BONNEFOY, 2007; EVANS; WELLS; MOCH, 2003; ROHDE; AAMODT, 2016).

A segunda dimensão da habitação, o lar, concentra um número limitado de evidências da sua relação com a saúde. Este fato está associado as dificuldades que os pesquisadores têm de avaliar as características subjetivas associadas ao lar, a exemplo do sentimento de pertencimento, estabilidade familiar, controle e a posse da habitação (EVANS; WELLS; MOCH, 2003; GREEN; EVANS; SUBRAMANIAN, 2017). Neste domínio, um dos fatores que tem sido mais estudo é o acesso à habitação adequada e a garantia da sua posse. Ambos estão condicionados aos elevados custos associados ao aluguel de uma moradia digna e à aquisição de uma casa própria (HISCOCK et al., 2003; KAVANAGH et al., 2016). O valor pago pelo aluguel da moradia onera de forma substancial no orçamento familiar, podendo comprometer o acesso a outros serviços básicos, como alimentos de qualidade, fontes seguras de energia, água potável e conforto térmico (HISCOCK et al., 2003; MAQBOOL; VIVEIROS; AULT, 2015; MOLOUGHNEY, 2004). Além disto, o ônus com o aluguel compromete a estabilidade familiar, fazendo com que muitas famílias mudem de residência constantemente, gera preocupação excessiva e aumenta o estresse psicossocial. Estes fatores em conjunto tendem a repercutir de forma negativa na saúde mental e física dos indivíduos (CLAIR; HUGHES, 2019; HISCOCK et al., 2003; KAVANAGH et al., 2016).

Ao mesmo tempo, alguns estudos demonstraram que proprietários de imóveis apresentam melhores condições de saúde geral e mental em relação aos indivíduos que vivem em moradias alugadas (CHAMBERS et al., 2019; CLAIR; HUGHES, 2019; HISCOCK et al., 2003; MAQBOOL; VIVEIROS; AULT, 2015; MEANEY; CORCORAN; SPILLANE, 2017), enquanto outras evidências sugerem o contrário (POPHAM; WILLIAMSON; WHITLEY, 2015). Outros estudos demonstram que proprietários de moradias hipotecadas ou condicionadas a pagamentos de parcelas mensais à instituições financeiras, poderão apresentar pior estado de saúde em relação aos indivíduos que vivem em casas alugadas (CAIRNEY; BOYLE, 2004; CANNUSCIO et al., 2012).

A relação da vizinhança, terceira dimensão da habitação, com a saúde há muito tem sido estudada, dada a associação com diversos desfechos em saúde (DIEZ-ROUX, 2003; DIEZ-ROUX et al., 2004, 2017; EGAN et al., 2013; HANIBUCHI, 2013; HUSSEIN et al., 2018; WANG et al., 2017b). Vizinhanças que dispõe de serviços básicos, a exemplo das redes viárias e de transporte público, escolas, parques e espaços verdes ou de lazer, além dos pontos de vendas de alimentos saudáveis, contribuem para a adoção de estilos de vida saudáveis, reduzindo a exposição a riscos ambientais e melhorando o acesso dos residentes a serviços que atendem as suas necessidades de saúde, segurança e educação. Estes aspetos contribuem para interação social dos residentes e fortalece as redes de apoio e suporte social. Além disso, reduz o estresse psicossocial e melhora o bem-estar e à saúde dos residentes (CHAIX et al., 2008; DIEZ-ROUX; MAIR, 2010; SHAW, 2004; WANG et al., 2017b).

Por outro lado, a ausência destes serviços estão associadas a maiores índices de criminalidade e violência, redução nos níveis de atividade física e mobilidade social dos residentes (CHUM; O'CAMPO, 2015; COHEN; CELEDÓN, 2016; DIEZ-ROUX; MAIR, 2010). Estes fatores reduzem o bem-estar dos residentes, contribuindo para a ocorrência de desfechos negativos em saúde, a exemplo da obesidade, hipertensão, depressão e ansiedade (DIEZ-ROUX et al., 2017; HOWARD et al., 2016; ROBINETTE et al., 2016; WANG et al., 2017b).

A sensação de insegurança na vizinhança, caracterizada por elevados índices de criminalidade, violência e sinais visíveis de desordem social – presença de lixo nas ruas, pichações, edifícios abandonados, ausência de iluminação pública, falta de conectividade entre as ruas, brigas entre vizinhos, comércio ilegal de estupefacientes e ruídos –, são exemplos de aspetos estruturais e sociais associados a saúde física e mental dos residentes (CHAIX et al., 2008; CHUM; O'CAMPO, 2015; GEIS; ROSS, 1998; STAFFORD et al., 2003). Estudo de Cohen & Celedón (2016) demonstra uma associação positiva entre elevados índices de violência na vizinhança e à ocorrência de asma em crianças e adultos (COHEN; CELEDÓN, 2016). Vizinhanças com estas características tendem a influenciar, de forma negativa, a prática de atividade física dos residentes, o uso dos parques e espaços de lazer, além de contribuir para a adoção de comportamentos de risco em saúde, como o sedentarismo, o tabagismo e o alcoolismo, em especial entre os mais jovens (DIEZ-ROUX; MAIR, 2010; OU et al., 2016; ROBINETTE et al., 2016; WANG et al., 2017a). Somando-se a isto, ocorre também a degradação física e social do ambiente/vizinhança de residência,

contribuindo ainda mais para a fragmentação social da comunidade residente (DIEZ-ROUX; MAIR, 2010; WANG et al., 2017b).

Vizinhanças degradadas em termos estruturais e sociais, concentram, em sua grande maioria, uma parcela importante de indivíduos e agregados familiares em situação de vulnerabilidade social, dado os preços mais acessíveis dos domicílios localizados nestes ambientes (BONNEFOY, 2007). Este fato inicialmente foi tratado como uma forma de segregação residencial, de base econômica. A segregação racial tem sido associada a resultados adversos à saúde, podendo variar de acordo com o grupo racial/étnico analisado (RILEY, 2018). No caso de grupos sociais marginalizados, a exemplo dos negros, nos EUA, Brasil e África do Sul, a segregação racial é acompanhada de menores investimentos nas comunidades nas quais esses grupos residem (KERSHAW et al., 2015; RILEY, 2018). Isto limita o acesso a serviços básicos de promoção da saúde, educação e segurança pública, repercutindo de forma negativa na saúde no bem-estar dos residentes (HUSSEIN et al., 2018; KERSHAW et al., 2015). A segregação residencial racial tem sido associada a maior incidência de obesidade, homicídios e violência e menor acesso a serviços básicos, como escolas, saúde, segurança e iluminação pública e oportunidades de emprego, em especial entre os afro-estadunidenses, onde a maior parte dos estudos são realizados (COCKERHAM et al., 2017; KERSHAW; PENDER, 2016; WILLIAMS; COLLINS, 2001).

3.2.1 Habitação e saúde cardiovascular

Ao longo dos anos diversas pesquisas têm avançado no estudo da relação entre a habitação e desfechos em saúde (BONNEFOY, 2007; SHAW, 2004; THOMSON et al., 2013a; THOMSON; THOMAS, 2015). Porém, poucos têm abordado os efeitos da habitação, em particular da habitação social, na saúde cardiovascular. As primeiras pesquisas relativas à temática focaram-se nos efeitos estruturais da casa na saúde cardiovascular, seguindo-se do estudo da vizinhança nestes desfechos (BAXTER et al., 2019; CHAMBERS; ROSENBAUM, 2014; RECIO et al., 2016).

Inadequadas condições estruturais de moradia, em especial aquelas associadas ao isolamento térmico e a ventilação, impactam de forma negativa na saúde cardiovascular dos residentes, mediante mecanismos de ação diversos e potencialmente sinérgicos (FOWLER et al., 2015; GEMMELL, 2001; OMS, 2018). No verão, altas temperaturas no interior dos domicílios contribuem para a elevação da morbimortalidade por eventos cardiovasculares,

dado o aumento da pressão arterial sistêmica e a piora da circulação sanguínea (FOWLER et al., 2015; GEMMELL, 2001; OMS, 2018). No inverno, o inadequado isolamento térmico do domicílio contribui para o isolamento social dos indivíduos, em especial dos idosos, além de aumentar o uso de energia proveniente da combustão de combustíveis poluentes, como carvão e madeira, para aquecimento da casa (FOWLER et al., 2015; GEMMELL, 2001; OMS, 2018). Estes combustíveis reduzem a qualidade do ar domiciliar, aumentando a concentração de gases tóxicos e de material particulado, que contribuem para a morbimortalidade por doenças cardiovasculares e respiratórias (BROOK et al., 2010; DORANS et al., 2016; SMITH; HALL, 2003; SØRENSEN et al., 2012). A ventilação inadequada das moradias pode piorar ainda mais a qualidade do ar domiciliar (SMITH; HALL, 2003).

Diversos estudos têm sugerido que as características socioeconômicas da vizinhança, mensurados através de marcadores de privação socioeconômica, influenciam a saúde cardiovascular (DIEZ-ROUX et al., 2001, 2004, 2017; DIEZ-ROUX, 2003; HOWARD et al., 2016; TANG et al., 2015). Residir em vizinhanças ou ambientes de residência socioeconomicamente desfavorecidos, no geral, tem sido associado à maior incidência, prevalência e mortalidade por DCI (DIEZ-ROUX et al., 2001, 2004, 2017; SUNDQUIST et al., 2004) e DCB (BROWN et al., 2013; HOWARD et al., 2016), apesar de algumas divergências relatadas na literatura (TANG et al., 2015).

Estudo com adultos estadunidenses aponta que indivíduos brancos e de baixa renda, residentes em vizinhanças mais desfavorecidas têm um risco de DCI três vezes maior (RR: 3,1; IC95%: 2,1 a 4,8) em comparação aos brancos e com renda elevada, residentes em vizinhanças mais favorecidas socioeconomicamente. Entre os negros, o risco de DCI foi 2,5 (IC95%: 1,4 a 4,5) maior entre aqueles residentes em bairros desfavorecidos quando comparados aos seus pares, residentes em vizinhanças socioeconomicamente mais favorecidas. As associações permaneceram inalteradas após ajuste por fatores de risco socioeconômicos individuais, como ocupação, renda e escolaridade (DIEZ-ROUX et al., 2001). Diez-roux et al. (2004) em seu estudo de acompanhamento nos EUA observaram maior risco de óbito por DCV entre idosos da raça branca, residentes em ambientes socioeconomicamente desfavorecidos (RR: 1,5; IC95%: 1,2-1,9), após ajuste pelas características socioeconômicas individuais e prevalência de DCV na linha de base do estudo. Também nos EUA, pesquisadores observaram que indivíduos residentes em setores censitários economicamente mais desfavorecidos apresentavam maiores chances de mortalidade um ano após o primeiro AVE (OR:1,77; IC95% 1,17-2,68), quando comparado

aos demais (BROWN et al., 2013). Não houve diferenças de acordo com a raça, idade, sexo, renda e nível de escolaridade individual (BROWN et al., 2013).

As características físicas e estruturais da vizinhança também têm sido associadas a morbimortalidade cardiovascular (DIEZ-ROUX, 2003; DIEZ-ROUX; MAIR, 2010). A saúde cardiovascular tem sido associada, de forma positiva, a vizinhanças que dispõe de instalações recreativas, parques, espaços verdes, calçadas, ciclovias de qualidade, ruas com conectividade, iluminação pública e saneamento básico, com coleta de lixo e esgotamento sanitários adequados (DIEZ-ROUX, 2003; DIEZ-ROUX; MAIR, 2010). Melhorias no bem-estar e na qualidade de vida dos residentes, mediante influencia na prática de atividade física de lazer, mobilidade e, em parte, o sentimento de segurança e coesão social na vizinhança, são apontados como justificativas desta relação (CHAIX et al., 2008; DIEZ-ROUX, 2003).

O acesso a rede viária e ao transporte público é outro elemento importante da vizinhança, dado o seu papel na melhoria da mobilidade urbana dos residentes, reduzindo o tempo dispendido em deslocamentos, e contribuindo para a conexão da comunidade com os demais locais da cidade (DIEZ-ROUX, 2003; DIEZ-ROUX et al., 2016). Isto permite o acesso a serviços (hospitais, escolas, postos de saúde, mercados, etc) e oportunidades de emprego, melhorando a renda, o poder de compra e a posição socioeconômica dos residentes (DIEZ-ROUX, 2003; DIEZ-ROUX et al., 2016). Porém, quando o acesso à rede viária e ao transporte público é inadequado, a rotina dos residentes destas áreas se altera, podendo influenciar negativamente o poder econômico das famílias, sua posição socioeconômica, o acesso a serviços essências e o bem-estar, aumentando o estresse psicossocial e comprometendo a saúde cardiovascular dos residentes (DIEZ-ROUX, 2003; DIEZ-ROUX et al., 2016). Por outro lado, residir próximo às rodovias contribui para a maior exposição à poluição do ar, que aliado aos ruídos, interferem na qualidade do sono, aumentando a morbimortalidade por IAM e AVE, em especial entre os idosos (CAI et al., 2018; CHUM; O'CAMPO, 2015; DORANS et al., 2016; SØRENSEN et al., 2012). O material particulado presente no ar poluído agrava os processos ateroscleróticos, mediante ativação do sistema nervoso simpático e inflamação sistêmica (BROOK et al., 2010; DORANS et al., 2016).

A qualidade e o tipo de serviço disponível na vizinhança também se relacionam com a saúde cardiovascular. A ausência ou a precariedade de equipamentos de saúde na vizinhança, como unidades básicas, farmácias e hospitais, podem reduzir o acesso dos residentes às ações e serviços de saúde, como a triagem precoce dos fatores de risco cardiometabólico e as ações educativas de promoção de estilo de vida saudável (CHAIX, 2009; DIEZ-ROUX et al., 2016).

Além disso, a precariedade no acesso a medicamentos de uso contínuo e no atendimento de agravos ou hospitalizações advindas de eventos cardiovasculares agudos, como o IAM e o AVE, poderá influenciar tanto o curso e a progressão como a própria sobrevida dos pacientes após esses eventos (CHAIX, 2009; DIEZ-ROUX, 2003; DIEZ-ROUX et al., 2016). Além disso, a disponibilidade e o custo de alimentos saudáveis, consequência da ausência de mercados e feiras na vizinhança, podem afetar os padrões alimentares dos residentes (DIEZ-ROUX, 2003; ROBINETTE et al., 2016).

Os aspetos sociais da vizinhança também têm sido associados a saúde cardiovascular, apesar do número limitado de estudos disponíveis na literatura (ALCARAZ et al., 2019; BRUMMETT et al., 2001; CHAIX et al., 2008; EVERSON-ROSE; LEWIS, 2005; LOCHNER et al., 2003). As evidências apontam que indivíduos que não dispõem de redes sociais de apoio ou que vivenciam situações de isolamento social, definido como viver sozinho, ter pouco contato social com parentes, amigos ou grupos sociais, tendem a apresentar maiores taxas de morbimortalidade por DCV (ALCARAZ et al., 2019; BRUMMETT et al., 2001; VALTORTA et al., 2016). Resultados de uma metanálise apontaram que o risco de desenvolvimento de DCV, no geral, aumenta 30% entre os indivíduos solitários ou socialmente isolados (VALTORTA et al., 2016). Para causas específicas, como DCI e AVE, o risco aumenta 32% e 29%, respectivamente (VALTORTA et al., 2016). Além disso, as evidências demonstram que indivíduos que residem em vizinhanças com elevado nível de capital social apresentam taxas inferiores de mortalidade por DCV em relação àqueles com baixo nível de capital social (SUBRAMANIAN; LOCHNER; KAWACHI, 2003).

Outras características sociais da vizinhança, a exemplo dos conflitos sociais, tem sido associado a morbimortalidade cardiovascular (CHAIX et al., 2008; CHUM; O'CAMPO, 2015). Resultados de um estudo realizado nos EUA demonstrou uma associação positiva entre a exposição a elevadas taxas de crimes violentos na vizinhança e à ocorrência de eventos cardiovasculares, apesar da atenuação da magnitude da associação após ajuste pelo IMC e pelo nível de atividade física dos moradores (CHUM; O′CAMPO; O'CAMPO, 2013). O baixo nível de coesão social da vizinhança e elevados índices de criminalidade tem sido associado, de forma positiva, a mortalidade por DCI, mesmo após ajuste pelas condições socioeconômicas individuais e do estilo de vida dos residentes (CHAIX et al., 2008).

O aumento da tensão social e do estresse psicossocial e a redução do acesso a serviços de saúde e educação, bem como da mobilidade dos residentes são apontados como justificativas para a associação entre conflitos sociais e a saúde cardiovascular (CHUM;

O'CAMPO, 2015; ROBINETTE et al., 2016). Além disso, a criminalidade e a insegurança contribuem para o aumento da rotatividade dos indivíduos que residem na vizinhança, ocasionando o enfraquecimento das redes de apoio e suporte social, bem como do capital e da coesão social da comunidade (AUGUSTIN et al., 2008; CHUM; O'CAMPO, 2015; WANG et al., 2017b). Estes fatos retroalimentam o estresse psicossocial associado a ambientes de residência degradados social e fisicamente (WANG et al., 2017b).

Outro fator que tem sido associado a saúde cardiovascular é a segregação racial (BARBER et al., 2018; HUSSEIN et al., 2018; KERSHAW; ALBRECHT, 2015). Estudo realizado nos EUA demonstra que, para indivíduos da raça/cor negra, residir em bairros racialmente segregados se associa a maior risco cardiometabólico (MAYNE et al., 2019). Já Kershaw et al. (2015) observaram uma associação positiva entre segregação racial e o risco de DCV entre indivíduos da raça/cor negra, após 10 anos de seguimento, e ajustando o modelo para as variáveis demográficas, cardiometabólicas e pelas condições socioeconômicas da vizinhança. Para os indivíduos brancos e para os hispânicos não foram observadas diferenças após os ajustes (KERSHAW et al., 2015). No Brasil, estudo de Barber et al. (2018), utilizando uma amostra da pesquisa ELSA-Brasil, avaliou a relação entre segregação residencial, hipertensão e diabetes. Os resultados apontam que negros e pardos eram mais propensos a viver em vizinhanças economicamente segregados. Além disso, indivíduos residentes nesta vizinhança tinham 26% mais chance de ter hipertensão e 50% mais chance de ter diabetes, quando comparados aos indivíduos que viviam em áreas mais ricas (BARBER et al., 2018).

A exposição continuada a esses fenômenos sociais e suas consequências ao longo do curso de vida contribuem tanto para a concentração dos fatores de risco cardiometabólico, como da morbimortalidade por DCV em vizinhanças desestruturadas, justificando as disparidades observadas em alguns estudos (BARBER et al., 2016; DIEZ-ROUX et al., 2017; HUSSEIN et al., 2018; WANG et al., 2017b). Neste sentido, o estudo do papel das características físicas e sociais da vizinhança, na etiologia e no padrão de morbimortalidade cardiovascular se faz importante, dada a sua capacidade de expor os indivíduos a ambientes estressores, na maioria das vezes de forma crônica (CHAIX, 2009; DIEZ-ROUX, 2003; DIEZ-ROUX et al., 2016). Além disso, é necessária uma atenção especial a certos grupos, que tendem a residir em inadequadas condições de moradia. Entre eles, destacam-se às famílias que vivem em situação de pobreza, as mulheres, as crianças e os idosos, em especial nos países de baixa e média renda (FATMI; COGGON, 2016; LIDDELL; MORRIS, 2010).

3.2.2 Intervenções habitacionais e Saúde

O crescente reconhecimento da importância da habitação na saúde e do seu papel como uma via nas quais outros determinantes sociais atuam, aumentou o interesse de gestores públicos em intervenções que possibilitam melhorias nas condições de moradia dos indivíduos (DIEZ-ROUX; MAIR, 2010; PEASGOOD et al., 2017; THOMSON; MORRISON; PETTICREW, 2007). Investimentos que objetivam essas melhorias se constituem em uma alternativa positiva para aprimorar as condições de vida da população, em especial dos grupos socioeconomicamente vulneráveis, sendo um meio potencial pelo qual a política pública pode melhorar a saúde e também reduzir as iniquidades sociais e de saúde (BRAUBACH; JACOBS; ORMANDY, 2011; HOWDEN-CHAPMAN; CHAPMAN, 2012).

Algumas intervenções, pontuais ou sob a forma de políticas públicas, têm sido adotadas como estratégias para melhorar as condições de moradia de famílias em situação de vulnerabilidade (Quadro 1). Entre elas, destacam-se: i) os programas de reformas da casa e da vizinhança; ii) a oferta de subsídios ou vouchers para pagamento de alugueis de moradias em vizinhanças com melhores condições socioeconômicas; e iii) a oferta de domicílios e incentivos sociais para aquisição de casa própria, mediante pagamento de parcelas mínimas mensais (BAXTER et al., 2019; BOND et al., 2013; LUDWIG et al., 2011; MCTARNAGHAN et al., 2016; OAKLEY; RUEL; WILSON, 2008; SCHWANSE, 2014).

A regeneração física e estrutural do ambiente de vizinhança e assistência financeira para pagamento de aluguel em vizinhanças com melhores condições são iniciativas que há muitos anos têm sido adotadas no Reino Unido e nos EUA (GRAVES, 2019; LEE; MCNAMARA, 2017; THOMSON; MORRISON; PETTICREW, 2007). Estas visam melhorias no ambiente de residência, redução da concentração de indivíduos em situação de vulnerabilidade social no mesmo ambiente e realocação de famílias em vizinhanças com maior qualidade, em termos físicos e sociais (GRAVES, 2019; LEE; MCNAMARA, 2017; THOMSON; MORRISON; PETTICREW, 2007). O *Glasgow Community Health and Wellbeing* (GoWell), o *Moving to Opportunities* (MTO), o *Choice Neighborhood Initiative* (CNI) e o *Cardiovascular Health Outcomes of Latinos in the Affordable Housing as an Obesity Mediating Environmen*t (AHOME) são exemplos de iniciativas deste tipo (EGAN et al., 2013; HOWELL; HARRIS; POPKIN, 2005; SANBONMATSU et al., 2011; THOMSON; MORRISON; PETTICREW, 2007; WEBB et al., 2017).

O GoWell, iniciado em 2005, é um programa habitacional implementado em diversas comunidades na cidade de Glasgow (Escócia), cujo objetivo é a melhoria do bem-estar e da saúde dos residentes, mediante alterações nas suas condições de moradia (BOND et al., 2013). Estudos analisando os efeitos da intervenção habitacional na saúde demonstram que as melhorias habitacionais beneficiaram a saúde mental dos residentes a curto prazo (EGAN et al., 2013; THOMSON; MORRISON; PETTICREW, 2007). Melhorias na aparência externa da casa, o sentimento de controle e progresso pessoal conferidos pela reforma da casa se associaram a maiores escores de bem-estar mental (EGAN et al., 2013).

Donley & Nicholson (2019), analisando os efeitos da realocação de indivíduos participantes do programa CNI, na Florida, observaram que os moradores realocados nas habitações sociais relataram piores condições de saúde física e mental. Também relataram maiores ocorrências de diabetes, hipertensão arterial, ganho de peso e asma, em comparação aos indivíduos que já residiam na comunidade. A coesão social foi uma das variáveis que influenciou a relação entre a realocação e as piores condições de saúde (DONLEY; NICHOLSON, 2019).

O MTO, um dos programas habitacionais pioneiros nos EUA, visa a realocação de famílias de baixa renda em novas vizinhanças, com melhor estrutura e com menores níveis de pobreza (LUDWIG et al., 2013; SANBONMATSU et al., 2011). O programa atua mediante a oferta de habitação social ou de auxilio-aluguel para moradias no setor privado às famílias em situação de vulnerabilidade social (LUDWIG et al., 2013; SANBONMATSU et al., 2011). Os efeitos do MTO na saúde física e mental dos beneficiários variaram de acordo com o sexo e a faixa etária (LUDWIG et al., 2011, 2013; SANBONMATSU et al., 2011). Entre os adultos, observou-se uma redução da prevalência de obesidade e diabetes, dois importantes fatores de risco para as DCV (LUDWIG et al., 2011). Entre os adolescentes, as meninas reduziram o consumo de álcool e tabagismo, melhoraram a frequência escolar e a percepção de bem-estar mental a longo prazo, enquanto que, entre os meninos, a prevalência de fatores comportamentais de risco, como tabagismo e alcoolismo, aumentaram e a frequência escolar reduziu ao longo do tempo (LUDWIG et al., 2013). A composição da vizinhança é apontada, em parte, como um dos responsáveis pelos resultados observados no MTO (LUDWIG et al., 2011, 2013; SANBONMATSU et al., 2011). Os autores apontam o retorno de muitas famílias aos seus bairros de origem, devido ao ônus associado ao pagamento de alugueis no mercado privado – entre aqueles que receberam o voucher –, e a mudança de outras famílias para vizinhanças com características semelhantes às de origem –, no caso dos beneficiários de

habitações sociais –, como as responsáveis por tais resultados (LUDWIG et al., 2013; RUEL et al., 2010; SANBONMATSU et al., 2011). Segundo Oakley et al. (2010), em Atalanta, uma das cidades participantes do MTO, o recebimento do voucher de assistência ao pagamento de aluguel, em substituição a residência em habitações sociais, contribuiu para uma nova segregação das famílias. Esta nova segregação residencial mantém o seu carácter econômico, visto que essas famílias são realocadas em bairros ainda considerados pobres, e assume um caráter racial, dado que o novo bairro é composto na sua grande maioria pela comunidade afro-estadunidense (OAKLEY et al., 2010).

Programas habitacionais, pautados pela realocação de famílias em novos ambientes, têm sido associados a potenciais danos à saúde e ao bem-estar dos residentes (DONLEY; NICHOLSON, 2019; EGAN et al., 2013; MCCARTNEY et al., 2017; OAKLEY et al., 2010). A estratificação social, o aumento da segregação econômica e racial, enfraquecimento ou destruição de redes de apoio e suporte social, desestabilização das organizações comunitárias existentes na comunidade e perda da coesão social, são exemplos de fenômenos associados a realocação de famílias no âmbito de programas habitacionais (DONLEY; NICHOLSON, 2019; EGAN et al., 2013; MCCARTNEY et al., 2017; OAKLEY et al., 2010). Além disso, a realocação das famílias em residências localizadas em regiões afastadas dos grandes centros urbanos, em vizinhanças geralmente marginalizadas e desestruturadas, em termos econômicos e sociais, podem influenciar a saúde dos residentes (CHAMBERS; ROSENBAUM, 2014; OAKLEY et al., 2010; OAKLEY; RUEL; WILSON, 2008; RUEL et al., 2010).

Apesar dos avanços no estudo dos efeitos de intervenções habitacionais na saúde, pouco se tem explorado a relação entre estas intervenções e a saúde cardiovascular. As poucas evidências sobre este tópico são provenientes da pesquisa *Affordable Housing as an Obesity Mediating Environment* (AHOME), realizado na comunidade de Bronx (EUA). O estudo é composto por adultos hispânicos com as mesmas características socioeconômicas e elegíveis para o recebimento de benefícios habitacionais por parte do governo estadunidense (CHAMBERS; ROSENBAUM, 2014). Três grupos de estudo foram criados, de acordo com o recebimento ou não de benefício habitacional: i) beneficiário de domicílio social; ii) beneficiário de subsídio para pagamento de aluguel; e iii) aqueles que não receberam nenhum tipo de intervenção habitacional (CHAMBERS; ROSENBAUM, 2014). Os autores demonstraram que a prevalência de DCV autorrelatada, como IAM e AVE, foi maior entre os indivíduos residentes em domicílios sociais, quando comparados aos indivíduos que receberam o auxílio aluguel e aqueles que não receberam nenhuma assistência habitacional do

governo, após ajuste pelos fatores de risco cardiometabólicos individuais (CHAMBERS; ROSENBAUM, 2014). A prevalência de DCV autorrelatada foi semelhante entre o grupo de indivíduos que recebeu auxilio aluguel e aqueles que não receberam nenhum tipo de benefício habitacional (CHAMBERS; ROSENBAUM, 2014). Segundo os autores, os resultados podem ser justificados, em parte, pela importância das características da vizinhança. Programas habitacionais que propiciam a realocação das famílias em vizinhanças com melhores contextos socioeconômicos, estruturais e de serviço em relação a vizinhança de origem – a exemplo do recebimento do auxílio aluguel ofertado pelo governo, contribui para melhorias na saúde cardiovascular. Por outro lado, o grupo que não recebeu nenhum tipo de benefício habitacional e que se manteve na mesma vizinhança, aufere do efeito positivo associado as redes de apoio, suporte e coesão (CHAMBERS; ROSENBAUM, 2014).

Na América Latina, alguns estudos têm demonstrado os efeitos das intervenções habitacionais na saúde, em especial no México, Argentina, Colômbia e Chile (MCTARNAGHAN et al., 2016). No México, pesquisadores avaliaram os efeitos do Programa Piso Firme na saúde dos beneficiários (CATTANEO et al., 2000). O programa fornece assistência técnica e materiais para a construção de pisos de concreto em domicílios com piso de terra (CATTANEO et al., 2000). Os resultados do estudo demonstram que o programa se associou à redução da incidência de diarreia, anemia e doenças parasitárias entre menores de 5 anos. Entre as mães, observou-se melhorias nos indicadores de saúde mental, a exemplo da satisfação e dos níveis de estresse, e qualidade de vida (CATTANEO et al., 2000). Na Argentina, pesquisadores observaram melhorias na saúde dos beneficiários do programa habitacional TECHO (MITCHELL; MACCIÓ; MARIÑO FAGES, 2019). Os resultados demonstram que o programa melhorou a privacidade da família, o sentimento de segurança, as relações interpessoais, o bem-estar psicológico e a percepção da qualidade de vida dos beneficiários em relação aos não beneficiários do programa (MITCHELL; MACCIÓ; MARIÑO FAGES, 2019). Os aspetos mais importantes dos estudos aqui descritos estão disponíveis no Quadro 1.

Quadro 1: Sumarização dos estudos sobre intervenções habitacionais de carácter público e seus desfechos em saúde.

Autor e ano	Tipo de estudo (ano)	Grupos de comparação	Desfechos pesquisados	Principais resultados
GoWell: Reforma de domicílios/ vizinhanças (Escócia, 2005)				
Egan et al., (2013)	Estudo quase-experimental	*Grupo 1:* indivíduos residentes em vizinhanças precarizadas e marcadas por demolições. *Grupo 2*: indivíduos que receberam melhorias na estrutura física da casa. *Grupo 3:* não receberam nenhum tipo de suporte ou melhoria habitacional.	Saúde mental e física – mensurado por um escore padronizado (*Medical Outcomes Study Short Form Health Survey version 2*).	Os escores médios de saúde mental e física dos residentes em bairros parcialmente demolidos foram semelhantes ao grupo controle. Os escores médios de saúde mental para os residentes que experimentaram melhorias na habitação foram maiores do que no grupo controle.
CNI: Oferta de habitação social – realocação de famílias (EUA)				
Donley e Nicholson (2019)	Transversal	*Grupo 1* – indivíduos residentes em uma histórica comunidade afro-estadunidense (n = 92) *Grupo 2* – indivíduos procedentes de domicílios sociais em inadequadas condições de moradia, que foram realocados em novos domicílios na comunidade acima referida (n = 86)	Índice de saúde física (composto por peso elevado, hipertensão arterial, diabetes e asma). Índice de saúde mental (composto pela presença de depressão e ansiedade). Escores elevados (pior índice de saúde física e mental).	Residentes realocados apresentavam maiores índices de ansiedade, estresse e depressão. Indivíduos realocados apresentam os maiores escores nos índices de saúde física e mental em comparação com os atuais moradores da comunidade. A coesão social é apontada como uma variável que moderou as diferenças em saúde, comparando-se os residentes e os realocados na comunidade, em especial em relação à saúde mental.
MTO: Oferta de auxilio-aluguel para que famílias residentes em domicílios sociais possam mudar para vizinhanças com menores níveis de pobreza (EUA/1994)				
Sanbonmatsu et al., (2011)	Randomizado[a]	Grupo 1: controles (indivíduos que não receberam auxilio-aluguel, apesar de sua elegibilidade. Grupo 2: experimento MTO. Inclui famílias beneficiadas com auxilio-aluguel, que só poderiam ser realocadas em setores censitários com níveis de pobreza inferior a 10% (no primeiro ano). Essas famílias receberam aconselhamento habitacional e suporte na procura do novo domicilio de residência	Saúde (asma, hipertensão, diabetes, dor crônica e uso de drogas) Qualidade da moradia, nível socioeconômico da residência,	As famílias dos grupos experimentais residem, em média, em vizinhanças com menores níveis de pobreza (18% para grupo MTO e 11% para setor 8), em relação aos que não foram beneficiados. Nem todos os indivíduos contemplados com o auxílio-aluguel mudaram de vizinhança. Os que mudaram eram, em média, mais insatisfeitos com a vizinhança,

		(grupo MTO). Grupo 3: setor 8. Inclui as famílias que receberam auxilio-aluguel e que poderiam residir em qualquer setor censitário, independem ente do nível de pobreza.		mais jovens e com menos filhos. O MTO melhorou a qualidade da moradia das famílias (diferença média de 5%). Não foram observadas diferenças entre os grupos para outros indicadores de saúde física (asma, hipertensão arterial, diabetes, dor crônica e uso de drogas) e mental.
Ludwig et al., (2013)	Randomizado[a]	*Idem ao estudo anterior*	Obesidade (IMC) DM (hemoglobina glicada)	Os beneficiários do programa apresentaram diferenças em relação a prevalência de excesso de peso e diabetes, apesar de não ser significativa entre os grupos (diferença média de 5%). As prevalências de obesidade e diabetes foram menores entre os indivíduos do grupo experimento. Não houve diferença entre o grupo do setor 8 e o grupo controle.
AHOME: Intervenção mista, com oferta de habitação social ou auxílio-aluguel (EUA/2011)				
Chambers e Rosenbaum (2014)	Transversal	Grupo 1: indivíduos que receberam auxilio-aluguel. Grupo 2: indivíduos que residentes em domicílios sociais. Grupo 3*:* indivíduos que não receberam nenhum tipo de auxilio habitacional.	IAM e AVE autorrelatadas HAS e DM aferidas	Indivíduos residentes em domicílios públicos tem os piores indicadores de saúde (tabagismo, alcoolismo). São os que apresentam a maior prevalência de DCV (53%). Aqueles que que receberam o auxílio-aluguel e os não assistidos por programas governamentais tem menor chance de relatar alteração cardiovascular
Programa Piso Firme: Reforma do piso dos domicílios com pisos de terra (México/2000)				
Cattaneoet al., (2000)	Experimento natural	Grupo 1: indivíduos beneficiados com o programa piso de concreto (2000 e 2003). Grupo 2: indivíduos com características observáveis semelhantes ao grupo 1, nas quais os domicílios não receberam a intervenção.	Saúde infantil (diarreia, doenças parasitárias e anemia e desempenho cognitivo). Satisfação com a moradia Saúde materna (depressão).	Melhores médias de indicadores de satisfação e qualidade de vida no grupo beneficiado, em relação aos não beneficiados. O programa reduziu a incidência de casos de diarreia (18% a 20%), parasitoses (10%) e anemia (20%) entre as crianças, no grupo tratado. Aumento do desenvolvimento cognitivo de crianças

				entre dois e cinco anos de idade em 7% no grupo intervenção. Mulheres beneficiadas pelo programa apresentam melhores indicadores de saúde mental em relação as não beneficiadas (redução de estresse e ansiedade).
TECHO: Oferta de domicílio emergencial, de caráter transitório (Argentina)				
Mitchell; Macció; Marino Fages (2019)	Quasi-experimental	*Grupo 1:* indivíduos contemplados no programa habitacional. *Grupo 2*: indivíduos selecionados pelo programa, mas que ainda não receberam o benefício.	Sentimento de segurança, privacidade e satisfação com o lar; Aglomeração domiciliar. Qualidade do sono. Episódios de tosse e congestão nasal.	Melhorias na satisfação com a casa, redução da aglomeração domiciliar, aumento da privacidade no grupo intervenção. Redução do relato das dificuldades para adormecer e melhoria da qualidade do sono no grupo intervenção. Redução do relato de sentimentos negativos (tristeza, ansiedade e depressão), do estresse devido a conflitos em casa e dos episódios de tosse ou congestionamento nasal entre os membros da família, com redução de 37 para 25% no grupo intervenção.

Legenda: GoWell - G*lasgow Community Health and Wellbeing; MTO - Moving to Opportunities* (MTO); CNI - *Choice Neighborhood Initiative*; Cardiovascular Health Outcomes of Latinos in the Affordable Housing as an Obesity Mediating Environment (AHOME) Study (AHOME); IAM – Infarto Agudo do Miocárdio; AVE – Acidente Vascular Encefálico; HAS – Hipertensão Arterial Sistêmica; DM – Diabetes Mellitus, mensurada através da glicemia sérica; IMC – índice de massa corporal; [a] experimento social randomizado; ;

3.3 POLÍTICAS PÚBLICAS DE HABITAÇÃO NO BRASIL

3.3.1 O Programa Minha Casa, Minha Vida

O Brasil tem um longo histórico de iniciativas públicas no campo da habitação social, sendo o Programa Minha Casa, Minha Vida (PMCMV), lançado em 2009, uma das maiores intervenções públicas neste setor no país. O Programa, definido pela Lei nº 11.977, no seu lançamento, objetivava atender dois objetivos principais: i) estimular a economia do país, mediante o aquecimento do mercado imobiliário e de construção civil, e a consequente geração de emprego e renda, atendendo a política anticíclica instituída, à época, no país; e ii) facilitar o acesso à aquisição de UH novas ou a requalificação de imóveis urbanos e produção ou reforma de imóveis rurais para famílias de diversos extratos sociais, em especial as de baixa renda (BRASIL, 2009). Este último objetivo visava à redução do déficit habitacional no país e o reforço do leque de políticas de proteção social em vigor no país, a exemplo do programa Bolsa Família e do Benefício de Prestação Continuada (BRASIL, 2009; MACEDO; BIJOS; SANTOS, 2017; VALENÇA; BONATES, 2010).

Para alcance dos seus objetivos, o programa opera mediante a construção de UH singulares ou prédios, com o máximo de 4 andares, organizados em condomínios edilícios (partes comuns e partes exclusivas), em especial na área urbana (BRASIL, 2009; OLIVEIRA, 2014). As UH devem garantir acessibilidade a todas as áreas comuns, no caso dos prédios, sustentabilidade e qualidade dos materiais utilizados nas construções, podendo-se utilizar painéis solares para fornecimento de energia (BRASIL, 2009). A legislação também prevê, no âmbito do PMCMV, que pelo menos, 3% das UH construídas nas áreas urbanas e rurais sejam adaptadas ao uso de indivíduos com deficiência, na ausência de legislação especifica nos Municípios (BRASIL, 2009).

O PMCMV já está na sua terceira fase desde o seu lançamento. Na fase I, de 2009 a 2010, a meta do programa era a contratação de 1 milhão de UH. Na fase II (2011 a 2015) e na fase III (2016 a 2018), o Governo propôs como meta, a contratação de 2 milhões de UH. Até a presente data, dados do Ministério da Economia apontam que o Programa contratou cerca de 5,5 milhões de UH, das quais 4,1 milhões já foram entregues, a um custo de 463,7 bilhões de reais (BRASIL, 2019).

O PMCMV é composto por subprogramas – o Programa Nacional de Habitação Rural (PNHR) e o Programa Nacional de Habitação Urbana (PNHU) (BRASIL, 2009). Estes, por

sua vez, contemplam diferentes faixas de renda e modalidades do benefício habitacional, na tentativa de beneficiar famílias em diferentes faixas de renda no país (BRASIL, 2009). O primeiro subprograma, o PNHR, é destinado às famílias de agricultores com renda mensal até 10 salários-mínimos (SM), devidamente comprovado pelos órgãos competentes (BRASIL, 2009). O programa tem duas finalidades principais: i) subsidiar a produção ou reforma de imóveis residenciais para agricultores familiares e trabalhadores rurais; e ii) subsidiar a aquisição de imóveis residenciais financiados por outros agentes financeiros, nos casos em que os subsídios não estejam vinculados a financiamentos com recursos da União, para às famílias com renda até 6 SM (BRASIL, 2009).

A subvenção econômica do PNHR é concedida uma única vez por imóvel e por beneficiário. Para este subprograma, além dos recursos do FGTS podem ser utilizados subsídios advindos de outros programas habitacionais incluídas no Orçamento de Estado da União (BRASIL, 2009). Dado o seu caráter rural, o PNHR, conta desde 2013, com recursos disponibilizados pelo governo Federal para construção de cisternas de água, afim de melhorar o acesso das famílias a água potável e dinamizar as atividades agrícolas e pecuárias dos agricultores (BRASIL, 2009).

O segundo subprograma, o PNHU, destina-se a construção de UH inseridas nas malhas urbanas dos grandes centros urbanos ou em áreas de expansão das cidades que atendam aos requisitos mínimos de infraestrutura básica (BRASIL, 2009). Entre esses requisitos, destaca-se a presença de vias de acesso as UH, iluminação pública, esgotamento sanitário e drenagem de águas pluviais adequadas, ligações domiciliares para abastecimento de água e energia elétrica, bem como à garantia de instalação ou ampliação dos equipamentos e serviços relacionados a educação, saúde, lazer e transporte público (BRASIL, 2009).

O PNHU está subdividido em três faixas de renda e estas por sua vez são compostas por suas modalidades, de acordo com as fontes de financiamento (Tabela 1). A faixa 1 do MCMV incluiu inicialmente indivíduos com renda mensal bruta de R$ 1.395, na fase I do programa, R$ 1.600 na fase II e R$ 1.800 na última fase do programa, sendo que o valor máximo atualizado para esta faixa não poderá ultrapassar 3 SM (BRASIL, 2009). Esta é a faixa de renda do MCMV inserida no contexto brasileiro de políticas públicas habitacionais de interesse social, que visam facilitar o acesso a casa própria às famílias em situação de vulnerabilidade social (LINKE et al., 2016).

A faixa 1 inclui duas modalidades principais do PMCMV (BRASIL, 2009, 2019). A primeira modalidade, a predominante nesta faixa de renda, compreende as UH construídas

com recursos provenientes do Fundo de Arredamento Residencial (FAR). Para esta modalidade, MCMV-FAR, foram construídas 400 mil UH na fase I e o dobro desse quantitativo na fase II do programa (KRAUSE; BALBIM; NETO, 2013; MACEDO; BIJOS; SANTOS, 2017; OLIVEIRA, 2014). Para a fase III, até o ano de 2017, apenas 21 mil UH do MCMV-FAR foram entregues (MINISTÉRIO DAS CIDADES, 2018).

O MCMV-FAR inclui duas tipologias de UH: as casas térreas e os apartamentos, com 36 e 39 metros quadrados, respectivamente. A partir de 2013, com a aprovação da Lei nº 12.722, de 2012, tornou-se obrigatório a construção de serviços básicos nos condomínios pertencentes ao MCMV-FAR, a exemplo de escolas, postos de saúde e espaços de lazer, além da oferta de serviços sociais a serem realizados com os futuros moradores dos empreendimentos em construção, afim de promover e fortalecer novos laços afetivos e a coesão social entre os futuros residentes (BRASIL, 2009).

A segunda modalidade da faixa 1, o MCMV-Entidades (MVMV-E), compreende os empreendimentos construídos com recursos provenientes do Fundo de Desenvolvimento Social, recebidos diretamente do Orçamento Geral do Estado (BALBIM; KRAUSE; LIMA NETO, 2015; BRASIL, 2009). Essa modalidade destina-se as associações e organizações comunitárias, sem fins lucrativos, e devidamente cadastradas no Ministério das Cidades (BRASIL, 2009). Esses grupos são responsáveis pela submissão da proposta aos municípios e/ou Estados, sorteio dos beneficiários, planejamento e a construção dos empreendimentos habitacionais (BRASIL, 2009). Esta última etapa pode ocorrer de forma direta, sendo executada pelos membros da associação, ou mediante a realização de empreitadas ou mutirão de construção (BALBIM; KRAUSE; LIMA NETO, 2015; BRASIL, 2009).

Os recursos disponibilizados o MCMV-E incluem à aquisição de terrenos, construção e requalificação de imóveis existentes. Em termos contributivos, esta modalidade é responsável pela provisão de 3% do total de UH do MCMV em todo o território nacional (BRASIL, 2009). Este também é o segmento do programa onde os Municípios e/ou os Estados têm menor controle sobre os prazos de execução da obra, podendo ocorrer atrasos variáveis, de acordo com a estrutura e o grau de organização da associação gestora do projeto (BALBIM; KRAUSE; LIMA NETO, 2015; OLIVEIRA, 2014).

Ainda na faixa 1, inclui-se os financiamentos habitacionais provenientes da Oferta Pública de Recursos (OPR), modalidade aos Municípios com até 50 mil habitantes (BRASIL, 2009). Porém, isto não invalida, a utilização de outras formas de subvenção econômica para o financiamento habitacional no âmbito do MCMV, a exemplo do MCMV-FAR ou MCMV-E.

Contudo, dada as intercorrências registradas nesta modalidade do programa, a exemplo da não entrega das habitações no período estipulado, abandono das obras e ausência de construtoras interessadas em pequenas obras nesses municípios, desde 2013 está modalidade está suspensa (BRASIL, 2013).

Para pleitear o recebimento de uma UH do MCMV pertencente a faixa 1 de renda, além dos critérios de renda, às famílias obedecem a alguns critérios de priorização (BRASIL, 2009; LINKE et al., 2016). Entre eles: i) o atendimento às famílias residentes em áreas de risco e em locais insalubres, que tenham sido desabrigadas ou que perderam a moradia em razão de enchentes, alagamentos, transbordamentos ou em decorrência de qualquer desastre natural; ii) o atendimento às famílias com mulheres responsáveis pela unidade familiar; e iii) o atendimento às famílias com pessoas que apresentam alguma deficiência (BRASIL, 2009). Além dos critérios prioritários acima descritos, os Estados, os Municípios e o Distrito Federal poderão fixar outros critérios complementares de prioridade para seleção de beneficiários da faixa 1 do programa, desde que previamente aprovados pelos conselhos locais de habitação, quando existentes, e em conformidade com as respectivas políticas habitacionais e as regras estabelecidas pela União (BRASIL, 2009). Entre os critérios adotados, destaca-se a presença de idosos no núcleo familiar, mulheres vítimas de violência e indivíduos alocados no sistema de proteção de testemunhas.

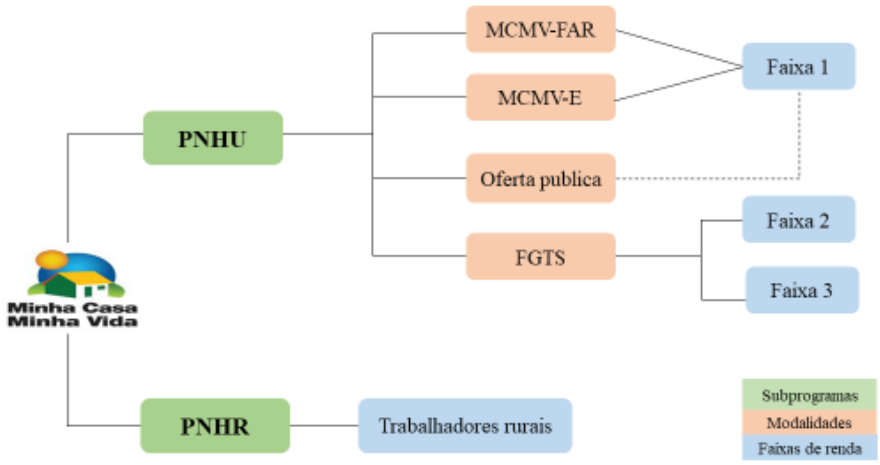
A faixa 2 do MCMV destina-se às famílias com renda mensal entre 3 a 6 SM. Esta faixa poderá utilizar recursos provenientes do FAR e da OPR (BRASIL, 2009). Já a faixa 3 incluiu indivíduos com renda mensal entre 6 e 10 SM (BRASIL, 2009). Para esta faixa é utilizado os recursos procedentes exclusivamente do FGTS (BRASIL, 2009, 2019). Em ambos as faixas, assim como na faixa 1, os valores de renda mensal foram atualizados em cada fase do Programa, porém, respeitando o teto máximo, em termos de SM, para cada faixa. O Quadro 2 sumariza à evolução dos valores de renda aplicados a cada faixa do PMCMV. A Figura 1 demonstra à organização do Programa, considerando os seus subprogramas, faixas de renda e modalidades.

Quadro 2: Evolução dos valores de renda familiar do Programa Minha Casa, Minha Vida, subprograma urbano, 2009 a 2019.

PNHU	Fase I (2009)	Fase II (2011)	Fase II (2015)	Atual (2019)
Faixa 1	Até R$ 1.395	Até R$ 1.600	Até R$ 1.800	Até R$ 1.800
Faixa 1,5	Não existia	Não existia	Até R$ 2.350	Até R$ 2.350
Faixa 2	Até R$ 2.790	Até R$ 3.275	Até R$ 3.600	Até R$ 4.000
Faixa 3	Até R$ 4.650	Até R$ 5.000	Até R$ 6.500	Até R$ 9.000

Elaborado pelo Ministério da Economia. Boletim mensal sobre os subsídios da União: Programa Minha casa, Minha Vida. Fonte: Ministério do Desenvolvimento Regional (2019).

Figura 1: Organização do Programa Minha Casa, Minha Vida



Fonte de dados: Lei nº 11.977/2009. Elaborada pela autora.

Tanto para a faixa 2 como para a faixa 3 de renda existe à possibilidade de o beneficiário escolher a localização e o tipo de empreendimento a ser adquirido, bem como é possível à aquisição de imóveis no mercado privado de construção civil. Em relação a subvenção, o financiamento da União para as faixas 2 e 3 é reduzida em relação a faixa 1 (BRASIL, 2009). A partir de 2016, com início da fase III do programa, foi criada uma nova faixa de renda, a faixa 1,5, que comporta famílias com renda mensal entre R$ 1800,00 a R$ 2600,00. Está nova faixa de renda, apresenta características especificas de financiamento dos imóveis que se assemelham à faixa 2 e visa ampliar o acesso à casa própria as famílias nesta faixa de renda, com juros inferiores àqueles praticados no mercado privado (BRASIL, 2009; MENEZES; MOURÃO, 2017).

Com exceção do MCMV-E, os demais empreendimentos do programa são construídos por empresas de construção civil do setor privado, que se habilitam, junto aos Municípios e/ou aos Estados, e se responsabilizam pela execução das obras do programa. Essas empresas, junto aos Entidades governamentais, efetuam a compra dos terrenos nas quais os empreendimentos serão construídos, determinando o padrão espacial da distribuição das UH do MCMV nos municípios (BRASIL, 2009; MARQUES; RODRIGUES, 2013).

No âmbito do PNHR, cabe aos municípios e/ou Estados, além da isenção de tributos a construção das UH no âmbito do MCMV, a condução do processo de inscrição, seleção e indicação dos indivíduos habilitados para o recebimento do imóvel, bem como a condução do trabalho social junto aos beneficiários do programa antes da sua mudança efetiva para os novos empreendimentos imobiliários (BRASIL, 2009). Assim, após o início das construções, faz-se o sorteio das famílias que se habilitarão a residir nos empreendimentos em construção, no caso do MCMV-FAR, não dando a elas o direito de escolher a localização do empreendimento e o andar da nova residência, salvos os casos específicos de moradias adaptadas, destinadas aos indivíduos com algum tipo de deficiência (OLIVEIRA, 2014; VALENÇA; BONATES, 2010).

Após esse período, cabe ao agente financeiro, na maioria dos casos, a Caixa Econômica Federal, proceder a checagem dos documentos dos indivíduos habilitados pelas entidades governamentais. Cabe ao agente financiador proceder a convocação dos beneficiários do programa habilitados e a dar sequência aos trâmites necessários, incluindo a assinatura do contrato aquando do recebimento do imóvel (BRASIL, 2009; MACEDO; BIJOS; SANTOS, 2017).

As famílias contempladas com UH do MCMV-FAR deverão pagar um valor mensal de 5 a 10% de sua renda mensal bruta, por um período de 10 anos, sendo a parcela mínima de R$ 50. Após este período, finda-se o financiamento, e o beneficiário fica livre para alugar ou vender a residência, o que não poderá acontecer durante o período de pagamento do financiamento do imóvel (BRASIL, 2009).

Dados disponibilizados pelo Ministério da Economia apontam que o MCMV contratou, até o momento, mais de 5,5 milhões de UH e já entregou cerca de 4,1 milhões de domicílios, ultrapassando a meta de contratações inicialmente proposta (Quadro 3) (BRASIL, 2009, 2019). A faixa 2 de renda detém o maior número de UH contratadas e entregues, sendo também a faixa onde o governo federal mais investiu, com gastos em torno dos 295 bilhões de

reais (BRASIL, 2019). Já a faixa 1, é a segunda com o maior número de contratações e entregas de UH, com um investimento de 92,94 bilhões de reais (BRASIL, 2019).

Quadro 3: Contratações e entregas de unidades habitacionais pelo PMCMV de acordo com as faixas de renda e o valor contratado, no período de 2009 à janeiro de 2019.

PNHU	Contratações (UH)	Entregas (UH)	Valor contratado (Bilhões de reais)
Faixa 1*	1.896.522	1.401.524	92,94
Faixa 1,5	118.930	33.840	14,70
Faixa 2	2.910.974	2.273.472	295,52
Faixa 3	656.200	387.889	62,51
Total	5.582.626	4.096.725	465,68

*As unidades contratadas no âmbito do PMCMV rural estão contabilizadas no Faixa 1 (cerca de 220 mil unidades contratadas); UH: Unidades habitacionais.

Pesquisa coordenado pelo IPEA e pelo Ministério das Cidades avaliou a satisfação dos beneficiários da fase I do MCMV, na modalidade MCMV-FAR, considerando as condições da unidade habitacional, o entorno, a inserção urbana dos empreendimentos e a satisfação com a nova moradia (BRASIL, 2014a). Partindo-se de uma amostra representativa da distribuição das UH no território nacional e aplicando-se escalas de avaliação de satisfação, os resultados demonstram que os beneficiários do MCMV-FAR mostram-se satisfeitos com a UH, apesar da insatisfação com a ausência de espaços de lazer, insegurança, aumento do custo de vida, e perda de laços afetivos e de rede de apoio social (BRASIL, 2014a)

Relatórios de auditorias do Tribunal de Contas da União (TCU) têm apontado diversas falhas na operacionalização, fiscalização e na infraestrutura dos empreendimentos do MCMV em todo o território nacional, em especial entre os municípios pequenos, com menos de 50 mil habitantes (BRASIL, 2013, 2014b, 2016). Em termos estruturais, o TCU constatou, em suas auditorias, construções inacabadas e com estruturas inadequadas, uso de materiais de baixa qualidade e atrasos na entrega das UH em todo o território nacional (BRASIL, 2014b, 2016). Em comum, os estudos referentes ao MCMV, direcionadas as famílias de baixa renda, demonstram que, a inserção das UH nas malhas dos grandes centros urbanos continua sendo negligenciada, e consequentemente, o programa continua contribuindo para a segregação sócio espacial das famílias de baixa renda, apesar das melhorias em relação as políticas habitacionais implementadas no país desde a década de 1960 (LINKE et al., 2016; MARQUES; RODRIGUES, 2013; VALENÇA; BONATES, 2010).

Os dados aqui apresentados reforçam a ideia da necessidade de uma melhor integração das políticas habitacionais de caráter social a uma matriz de desenvolvimento urbano, social e econômico, que garanta equidade de oportunidade, integração social e acesso a serviços básicos essenciais, possibilitando a efetiva realização do direito à habitação adequada, consagrada na Constituição da República Federativa do Brasil. Neste sentido, segundo Campos & Guilhoto (2017), as políticas sociais de habitação só alcançarão seus objetivos primordiais, como estratégia de combate à pobreza e iniquidades sociais, quando for possível a combinação da qualidade de moradia e a conectividade entre todos os bens públicos fornecidos pela sociedade.

Destarte os estudos aqui apresentados, os efeitos do MCMV ainda não foram avaliados em relação a outros aspetos do binômio saúde – doença, talvez pela complexidade do tema em questão, visto que a relação habitação e saúde envolve mecanismos de ação diretos e indiretos. Se tratando do PMCMV, em especial do MCMV-FAR, à avaliação desta relação se torna mais complexa ainda, dada as particularidades que envolvem o programa, desde a sua concepção até a operacionalização e entrega das UH, à exposição crônica das famílias a diversas situações de vulnerabilidade socioeconômica ao longo do curso da vida, bem como o significado psicossocial advindo do recebimento de uma habitação, independentemente dos problemas a ela associados. Aliado a este fato, a avaliação dos efeitos do MCMV na morbimortalidade por doenças crônicas não transmissíveis, a exemplo das DCV, traz um novo desafio ao campo da saúde pública no Brasil, dado os diversos fatores associados a esta morbidade, que na maioria das vezes atuam de forma sinérgica, potencializando os seus efeitos.

Efeitos diferenciais, considerando as desigualdades étnico/raciais e de gênero, devem ser observados na análise dos efeitos do programa, considerando os achados que têm sido reportados na literatura internacional (GIBSON et al., 2011; KERSHAW; PENDER, 2016; SKI; KING-SHIER; THOMPSON, 2014). Além disso, ser mulher chefe de família é um critério de priorização para aquisição da UH, tendo em vista a situação de maior vulnerabilidade social na qual este segmento social tem sido colocado. Além disso, o programa possibilita o acesso à casa própria de grupos sociais secularmente colocados às margens da sociedade e que concentram os piores indicadores de qualidade de moradia, com destaque para a população negra e indígena (IBGE, 2018).

4 PRIVACIDADE, CONFIDENCIALIDADE DAS INFORMAÇÕES E ACESSO DOS DADOS

Os dados integrados e anonimizados disponibilizados pelo CIDACS são obtidos a partir de dados administrativos governamentais. Esses dados são coletados por departamentos ou agências do governo para propósitos específicos, os quais contém informações pessoais que podem ser confidenciais e/ou sensíveis a exemplo de dados coletados para execução de programas sociais ou prestação de serviços de saúde. Sendo, portanto, a cessão desses dados para uso secundário em pesquisa restrita e analisada caso a caso levando em consideração o equilíbrio entre riscos e benefícios aos indivíduos e o predominante interesse público.

A vinculação de registros entre diferentes fontes, governamentais administrativas ou não, requer dados individualizados e identificados para a aplicação de técnicas de *record linkage*. Portanto, o acesso, processamento e análise de dados contendo informações pessoais com finalidade de pesquisa e geração de evidências para a tomada de decisões em políticas públicas na área da saúde, requer base legal, arranjos de segurança físicos e virtuais, uso exclusivo para um propósito previamente especificado, credenciais apropriadas para acesso e parecer ético favorável do estudo proposto. Pesquisadores autorizados a utilizar dados administrativos governamentais contendo informações pessoais trabalham sob condições estritas, assumindo a responsabilidade de usar os dados fornecidos apenas para fins específicos e legítimos, bem como estar cientes de que ações legais serão tomadas se os dados forem utilizados inadequadamente ou sem o devido cuidado visando proteger os dados pessoais e a privacidade dos indivíduos. Todos os procedimentos executados no CIDACS, relativos a segurança da informação, são regidos pela Lei Geral de Proteção de Dados Pessoais (Lei 13.709/2018).

5 RESULTADOS

Os resultados da presente Tese são apresentados sob a forma de três artigos científicos.

Artigo 1- Impact of social protection policies on cardiovascular health in low-and-middle-income countries: a systematic review;

Artigo 2 - Effect of social housing programme, *Minha Casa Minha Vida*, on the risk of premature cardiovascular mortality among vulnerable: a population based nested case-control study;

Artigo 3 - Evaluating the health effect of a Social Housing programme, *Minha Casa Minha Vida*, using the 100 million Brazilian Cohort: A natural experiment study protocol.

5.1 Artigo 1. Impact of social protection policies on cardiovascular health in low-and-middle-income countries: a systematic review [2.]

Abstract

Background: Social protection policies and programmes, in different low-and middle-income countries (LMICs), have been shown effective in reducing poverty and inequality, as well as poverty-related morbidity. Nevertheless, the effect on cardiovascular diseases (CVD) remains unclear.

Objective: To estimate the effects of social protection policies and programmes on cardiovascular morbidity and mortality and its underlying risk factors and behaviours.
Searched Methods: We systematically review studies published up to 31st July 2020 in MEDLINE, Scopus, Lilacs, Web of Science, and Google Scholar looking at the association between social protection programmes and CVD health behaviours, cardiometabolic risk factors, and CVD mortality. We followed the Preferred Reporting Items for Systematic Reviews and Meta-analyses.

Selection Criteria: We included all peer-reviewed studies published between 1990 and 2020, conducted in any LMIC, that quantitatively evaluate the effect of any social protection policy or programme on adult cardiovascular health and risk. We excluded studies conducted exclusively with children.

Data Collection and Analysis: We retrieved data and evaluated the quality in duplicates. We performed a narrative synthesis of the programmes, year, population and study designs, methods and study findings.

Main Results: We included 34 studies from 18 different cash and/or in-kind programmes, from 15 LMICs. Twenty-two studies reported results on health behaviours (61.8%), 12 on cardiometabolic risk factors (35.3%), and one on CVD mortality (2.9%). We found social protection to be associated with healthy diet (N=17/26, 65,3%), increased physical activities (N=2/2, 100%), lower prevalence of hypertension (N=2/3, 66,6%) and type 2 diabetes (N=1, 100%), but associated with excess body weight (N=8/11, 72,7%), especially among beneficiaries of unconditional food programmes. We found no association between social protection and the use of tobacco and alcohol (N=4/7, 57,1%) or on CVD mortality (N=1, 100%).

Authors' Conclusions: We showed that beneficiaries of social protection programmes have better diet quality and diversity and higher prevalence of excess body weight, while limited evidence on indicators of CVD health (type 2 diabetes, hypertension, physical activities and dyslipidemia) and CVD mortality was found.

Public Health Implications: The findings of our systematic review suggests that cash and in-kind transfers might play an important role in improved diet and healthy living of adults in LMICs. Nevertheless, further evidence of the direct and indirect effects of those programmes

[2] Será submetido na revista **American Journal of Public Health** (Fator de Impacto em 2019 - 6.464).

on CVD risk factors and mortality among the poorest populations of LMIC, as well the role of the conditionalities in reducing the potential adverse health effects of these programmes.

Keywords: Social policies; Social protection; Cardiovascular health; Food transfer; Cash transfer; In-kind programme.

Introduction

Social protection involves policies and programmes taken in response to levels of vulnerability, and deprivation, which are deemed socially unacceptable [1]. They have been widely implemented, at beginning in high-income countries (HICs), and later in low-and-middle-income countries (LMICs), as an essential strategy for improving income and access to basic health and education services among vulnerable groups [1–3], and to avert economics shocks and difficulties in different stages of the life-cycle, such as pregnancy, lactation, and child-rearing [1].

In LMICs, social protection policies and programmes, such as cash or in-kind transfers of goods or food, most often come as unconditional or conditional ones [4,5]. Eligibility to these programmes is usually based on specific criteria, such as poverty level and orphaned or vulnerable children within the household without any condition [4,6], while conditional programmes specifically require that beneficiaries meet certain pre-specified conditions to receive the programme benefits [4–6]. Most conditionalities include demand for basic services, such as education and health, minimizing barriers that hinder the use and access to these services [5,6], and may take the form of school attendance for children, proof of childhood immunization, or attendance at prenatal check-ups, health and nutrition care for children and pregnant [7].

In the short and medium-term, social protection policies have led to reduced poverty and inequality, improved living conditions, and have been effective in reducing poverty-related morbidity and mortality [1,8,9]. A major part of the evidence regarding the effect of social protection policies and programmes on health outcomes and inequalities is predominantly from studies conducted in HICs [10,11], while the few evidence from LMICs focuses on maternal and children health [4,5,12], and infectious diseases [13–15]. In addition, the long-term impact of those policies on non-communicable diseases, especially on cardiovascular diseases (CVD), the leading cause of death worldwide, is scarce [7,8,10].

This study aims to summarize the body of evidence on whether social protection programmes affect CVD health to improve targeting social programmes that can improve CVD health among vulnerable individuals in LMICs.

Methods

Literature search and search strategy

We performed this systematic review following the Preferred Reporting Items for Systematic Reviews and Meta-analyses guidelines for systematic reviews [16] and registered its protocol at the PROSPERO database (CRD42019145982).

We searched in MEDLINE, Scopus, Lilacs, Web of Science, and Google Scholar up to 31st July 2020 studies that evaluated the effect of social protection policies or programmes on cardiovascular health outcomes in adults from LMICs. We also searched references of relevant systematic reviews, we performed forward and backward citation by looking for new articles citing the selected studies and by checking the reference list for relevant articles. We have not searched for grey literature (i.e., thesis, dissertations, reports, and government documents).

We employed a search strategy in PICO (Population/Problem, Intervention/Exposure, Comparison, Outcome) format, which was developed in conjunction with specialists in the field of social policies and health sciences librarians (Table S1). The main exposure of interest was any social protection policy or programme that was intended to address disadvantaged socio-economic groups by providing cash, food, food-vouchers, food for work and social housing programmes, pension schemes, microcredit programmes, minimum wage policies, and other in-kind programmes, being conditionally and unconditionally. The control/comparison group included individuals or families who received different amounts or who did not receive the benefits from the selected social protection policies/programmes. Cardiovascular health outcomes included: i) health behaviours, such as food, tobacco, and alcohol (consumption or expenditure), and physical activity; ii) cardiometabolic risk factors, as overweight, obesity, changed BMI status and weight gain from eutrophic to overweight or obese and vice versa, type 2 diabetes, hypertension or high blood pressure, and dyslipidemia; and iii) CVD mortality and morbidity (myocardial infarction, heart failure, brain ischemia, stroke, heart disease, coronary artery disease, cerebrovascular events, vascular events, heart failure). The detailed search strategy used for MEDLINE and the adapted form for the other databases are included in Supplementary material (Table S2).

Eligibility

We included studies that were: i) peer-reviewed in well-recognized scientific journals, ii) published after 1st January 1990; iii) conducted in any LMICs as defined by the World Bank in 2020 (Table S3); and iv) have quantitatively evaluated the effect of any social protection policy or programme on cardiovascular health its risk factors and behaviours strongly related, as in the causal pathway. We excluded studies that: i) exclusively looked at children aged <12 years old; ii) evaluated weight gain in malnourished individuals or without information related to BMI category for weight gain; iii) evaluated medical or surgical interventions, behavioural or mental health interventions, or government subsidies to buy drugs; iv) modelling, reviews, and case studies; v) inter-country comparisons considering nation-states as the unit of analysis.

Four reviewers (AF, JP, EG and AG) independently screened the articles and selected based on titles and abstracts in duplicates. We only excluded manuscripts with the clear presence of excluding features. Subsequently, the reviewers independently read the full articles selected at the first step, to further perform a final selection based on the exclusion criteria. Disagreements between the reviewers were resolved by discussion and in collaboration with a third reviewer, as required, and the reasons for the exclusion of each full-text article were recorded.

Data extraction and analysis

From the selected studies we extracted data on key study descriptors, including authors, year of publication, country, study population (study size and description of intervention and control groups, if present), study design, outcomes, effect size (point estimates), main results, and bias and limitations using a standardized extraction form. For studies that presented similar data on more than one study design, we extracted data on all study designs but reported data preferably in the following order: randomized trials, longitudinal studies, case-control studies, or cross-sectional studies.

Study quality appraisal

Two independent reviewers (AG and IF) assessed the quality of studies using the Quality Assessment Tool for Quantitative Studies [17,18] and discrepancies were solved by consensus. The studies were rated in six domains: selection bias, study design, confounders,

blinding, data collection methods, withdrawals, and drop-outs, and further classified as 1 (strong - a lower chance of biases), 2 (moderate), or 3 (weak - a higher chance of biases) [17].

Summary measures and synthesis

Due to the heterogeneity of included studies design and outcome measures, a meta-analysis was not performed. Instead, we conducted a narrative synthesis of the retrieved information and summarized the findings in tables and graphs [19]. The narrative synthesis considered: i) Characteristics of the social programmes; ii) Studies characteristics (year of publication, country and study design; iii) Overview of the methods of analysis; iv) Quality assessment of studies; v) Effects of social protection programmes on cardiovascular health outcomes: diet quality and diversity, excess body weight, alcohol and tobacco consumption, physical activities, hypertension, type 2 diabetes, dyslipidemia, and CVD mortality.

Results

A total of 7900 records were retrieved. After removing duplicates and screening the titles, we assessed 108 full-text articles and included 34 manuscripts in this systematic review [20–53] (Figure 1).

Characteristics of the social programmes

We evaluated 18 different social protection programmes, of which ten were cash transfers, five provided cash/in-kind transfers and three were exclusively in-kind programmes that provide food transfers to beneficiaries. Nineteenth out of 34 studies (55.9%) evaluated conditional programmes [22–25,29–34,37–41,43–45,50] and 15 studies unconditional programmes [20,21,26–28,35,36,42,46–49,51–53] (Table 1).

Conditional programmes comprised cash transfers or cash/in-kind transfer modality. Conditional cash-transfers (CCT) included Juntos (Peru) (N=2) [34,44], Progressa (previously named *Oportunidades* or *Prospera*, in Mexico) (N=6) [24,25,30,31,37,40], Familias en Accion (Colombia) (N=2) [22,33], Bolsa Família Programme (Brazil) (N=4) [29,32,41,43], and Pantawid Pamilyang Philipino Programme (Philippines) (N=1) [45]. Conditional cash/in-kind transfer (CCIP) offered beneficiaries the possibility to receive either a food voucher, a cash or a food transfer. These programmes were the Programa de Apoyo Alimentario (Mexico) (N=3) [23,38,39], and the World Food Programme in Ecuador (N=1) [50]. The

conditionalities varied across programmes and families have to meet the following criteria: children school attendance (N=13) [22,24,25,29–34,37,40,41,43–45], immunization and nutritional surveillance (N=12) [22,23,29,32–34,38,39,41,43,44,50], health programmes, such as health checks and training, pre and postnatal care for women, and contraception for mother and adolescents (N=18) [22–25,29–34,37–41,43–45] (Table S4).

Among the unconditional programmes, there were studies on five unconditional cash transfers (UCT) - the Malawi cash payments [26], the Kenya cash transfer for orphans and vulnerable children [21], the Moderate Acute Malnutrition Out (Burkina Faso) [52], the Rural Dibao programme (China) [35], and the Harmonized Social Cash Transfer (Zimbabwe) [47]; on three unconditional food programme (UFP) that provide food baskets or meals to eligible families - the Worker's Food Programme (Brazil) (N=3) [48,49,53], Community Kitchen (Peru) (N=2) [27,42], Food Assistance Programme (Peru) (N=1) [28]; and on three unconditional cash/in-kind transfers programmes (UCIP), such as Democratic Republic of Congo cash or vouchers transfers programme (N=1) [20], the Productive Safety Net Programme (Ethiopia) (N=1) [51], and the World Food Programme (Niger and Mozambique) (N=2) [36,46], where the type of benefit (cash, food basket or voucher benefits) depends on the existence of automated teller machine (ATM) to receive it or on the availability of specific supermarkets that accepted the vouchers [20,36,46,51] (Table 1, Table S4).

Studies characteristics

The majority of the studies were published after 2011 (N=27/34) [20,21,23–28,32–37,39–47,50–53], of which 13 were published between 2016 to 2018 [20,26,27,34,35,41–47,52] (Table 1). Fifteen studies were randomized [20,21,23,25,26,30,31,36–39,45,47,50,52], of which eight were cluster control trial [21,25,26,36,37,39,50,52], eight were cross-sectional [28,29,32,35,41–43,46] or cohort [22,27,33,40,44,48,49,53] studies, and three were ecological studies [24,34,51]. In addition, two out eight cross-sectional [41,43] and one out eight cohort [22] studies were classified as a quasi-experimental design (Table 1).

All the studies included poor or very-poor individuals or households [20–53], ten were performed in rural areas or communities [20,23–26,30,31,35,38,39], and three included only women [27,28,33,39]. The study population was defined at the household (N=19) [20–22,26,29,32,34–38,41,44–47,50–52] or at the individual level (N=14) [23,25,27,28,30,31,33,39,40,42,43,48,49,53] (Table 1).

The majority of included studies (N=25) are from upper-middle-income countries [22–25,27–35,37–44,48–50,53], and nine were conducted in low-income countries - one in the Philippines [45] and eight in African countries, including Malawi [26], Mozambique [46], Niger [36], Kenya [21], the Democratic Republic of the Congo [20], Burkina Faso [52], Ethiopia [51], and Zimbabwe [47]. Nine out of 24 studies conducted in Latin America were from Mexico [23–25,30,31,37–40], and seven from Brazil [29,32,41,48,49,53] (Table 1).

Overview of the methods of analysis

From a methodological perspective, studies differ considerably and reflect the diversity of methods used to assess the association between social protection programmes and CVD health outcomes in LMICs. To estimate such associations, 19 studies used regression models (eg. ordinary least squares, linear, logistic, and poisson) [20,24,25,27–37,42,47–49,52,53], in seven difference-and-difference [21–23,26,38,39,44], in one triple difference [40] and propensity score matching [43], and 22 out of the 25 non randomized trials control the association for confounders (adjustment for a different set of covariates or propensity scores) [22,24,25,27,28,32–35,37,39–44,47–51,53] (Table 2, Table 3).

Quality assessment of studies

As determined by the Quality Assessment Tool for Quantitative Studies [18], studies were classify as strong (N=10) [24,27,28,32,35,41–43,46,51], moderate (N=11) [27,30,31,33,34,37,40,44,45,47,53], and low (N=13) [20–23,25,26,36,38,39,48–50,52] regarding quality (Table 1). The majority of studies provided an adequate report of confounders (N=30), data collection methods (N=32), selection bias (N=22) and study design (N=15), while the majority scored moderate in blinding related scores (N=33), and almost half presented low quality in withdrawals and dropouts (N=17) item. Only five out of 34 studies did not report limitations or bias associated with the study design [22,29,32,45,46]. More information related to quality assessment of included studies is described in Supplementary material (Table S5).

Effects of social protection programmes on cardiovascular health outcomes

The studies included in our review measured a wide variety of health outcomes and some reported data on more than one outcome. The most commonly reported outcomes were

health behaviours (N=22, 61.8%), followed by CVD risk factors (N=12, 35.3%), and one reported data on CVD mortality (2.9%) (Table 1, Figure 2). Different tools were used to assess excess body weight (eg. BMI, waist circumference and weight gain) [23,27,28,31,33,40,48,49,53] and diet quality and diversity (eg. food consumption or expenditure, twenty-for-hour recalls and scales related to diet diversity and quality) [20,21,26,29,32,34,36–38,41,43,45–47,50–52]. For cardiometabolic risk factors and physical activities, studies used self-reported outcomes or measured the condition when the information was not available [29,34,35,46].

Diet quality and diversity: We extracted data of 26 indicators from 17 studies evaluating the effect of social protection on diet quality and diversity [20,21,26,29,32,34,36–38,41,43,45–47,50–52] (Figure 2). Seven out of seventeen (41.2%) studies were CCT programmes [29,32,34,37,41,43,45], and two (11.8%) were CCIP [38,50]. The remaining eight studies (47%) were UCT [21,26,47,52], or UCIP [20,36,46,51] (Table 2, Table 3). From the 26 diet quality and diversity indicators extracted, 17 (65.3%) showed that social protection programmes contribute to a healthy diet, four (15.4%) to unhealthy diet [29,37,38,43] and five (19.5%) found no association [37,38,43,47,51] (Figure 3).

Excess body weight: Eleven studies evaluated excess body weight among beneficiaries and non-beneficiaries from social protection, accounting for twenty one indicators [23,27,28,30,31,33,39,40,48,49,53]. Six studies measured overweight [27,28,30,31,33,49], five obesity [27,28,30,31,33], three increased overweight/obesity [40,48,53], three abdominal adiposity [23,40,53], and three weight gained in overweight/obesity beneficiaries [39,48,49]. Eight out 11 studies (72,73%) found that beneficiaries of social programmes [27,29,33,39,48,49,53] presented a higher prevalence of excess body weight when compared to non-beneficiaries, considering, at least, one indicator of excess body weight. Considering the type of social programme, 33,3% out of 52,4% of higher prevalence of excess body weights indicators occurred among adults benefiting from UFP [27,28,48,49,53]. Three studies found a significant association between receiving benefits and lower prevalence of excess body weight [23,30,40]. In six studies, at least one indicator of overweight [27,30,33,46,53], and abdominal adiposity, in men, [23] were not associated with social protection programmes (Table 2, Table 3). No significant association between excess body weight and social programmes was found in 28.6% of selected indicators [23,27,30,33,48,53] (Figure 3).

Alcohol and tobacco consumption: Four out seven studies (57,1%) that evaluated the association between social programmes and alcohol and tobacco consumption found no association between them [22,23,32,34]. Two out seven studies (28,6%) showed that beneficiaries of social protection programmes presented a harmful consumption of alcohol and tobacco [40,48], while only one found lower use of these products among beneficiaries [25] (Figure 3). The studies that associated the harmful use of alcohol and tobacco to receiving social protection included Juntos, the CCT from Peru, and Rural Dibao, a UCT programme from China [35] (Figure 3).

Physical activities: Only two studies evaluated the association between social protection programme and physical activities, all of which related to Progressa [25,30]. Both studies showed that beneficiaries of the CCT programme reported improvement in vigorous activities and medium activities of daily living, such as work in garden, farm or sweep [25,30] (Table 3).

Hypertension, type 2 diabetes, and dyslipidemia: Two out of three studies (66.6%) evaluating the effect of social protection on high blood pressure showed that beneficiaries presented a lower prevalence of hypertension compared to non-beneficiaries [25,30], and one found beneficiaries to have a higher prevalence of the outcome [31]. The three studies analysed the programme Progressa, in Mexico. For type 2 diabetes, only one study was included and found that women who are beneficiaries of social programmes presented a lower prevalence of the type 2 diabetes, while no association was found for men [29]. Only one study accessed the effect of social protection on dyslipidemia in adults and showed that beneficiaries of the Community Kitchen Programme (Peru) presented an increase in serum levels of low-density lipoprotein and a decrease in high-density lipoprotein and hypertriglyceridemia when compared to non-beneficiaries [42]. No association was found for hypercholesterolemia [42] (Table 3).

CVD mortality: The only study evaluating the association between receiving social protection and CVD mortality showed that being a beneficiary of the Progressa CCT was not significantly associated with CVD mortality among older people (aged ≥ 65 years) in both sex group [24] (Table 2).

Discussion

This systematic review summarised the available evidence on the direct and indirect association between social protection programmes and CVD health in LMICs. While we found substantial evidence that receiving social protection is associated with improved diet quality and diversity and limited evidence on increased physical activities and reduced prevalence of hypertension and type 2 diabetes, we found that UFP are also substantially associated with excess body weight. We found no evidence that social protection programmes are related to variations in the consumption of alcohol and tobacco or CVD mortality, as well as these programmes can decrease dyslipidemia.

Results from a previous systematic review of the health impacts of cash transfers in LMICs suggested a positive impact of cash transfers on health behaviour, including healthcare utilization, immunization coverage, children anthropometric outcomes and self-reported illnesses [8]. Social protection policies that promote health behaviours have the potential, for example, to modify not only immediate impacts on health but to also reduce modifiable cardiometabolic risks factors that are associated with CVD (e.g., diet, physical activity, tobacco and alcohol use, metabolic and socioeconomic factors) [9,54,55]. However, while social protection policies such as food vouchers have been linked with improved food safety in Mexico and the US, their impact on BMI, overweight, obesity and the occurrence of metabolic syndromes in adults is still limited and controversial [56,57].

CCTs programmes were the most frequently evaluated in terms of its association with CVD health outcomes. Progressa was one of the firsts CCT programmes implemented in Latin America region and the only for which we have studies assessing the potential effects of the programme on adult health behaviours, cardiometabolic risk factors and CVD mortality. Studies have assessed the programme's short, medium and long-term term effects on health behaviours, cardiometabolic risk factors and CVD mortality [24,25,30,31,37,40]. Still, no association between receiving Progressa benefits and CVD mortality was found despite the long follow-up time (60 months).

The indirect effects of social programmes on CVD health considered the health behaviours and cardiometabolic risk factors. The beneficiaries of Bolsa Familia, Juntos, Progressa and Pantawid Pamilyang Philipino programmes presented improvement in diet quality and diversity when compared to non-beneficiaries. The possibility to afford more food and the conditionalities related to health and nutrition, common to conditional programmes,

might explain part of those results since beneficiaries could assess nutrition and health counselling, periodically, contributed to changes in health behaviours, and consequently, to reduce hypertension and type 2 diabetes [58]. Results from Progressa showed that this CCT programme could also improve physical activities [25,30], and reduce type 2 diabetes among women [25], and hypertension [25,30,31]. Nevertheless, studies from the Brazilian [29,43] and Mexican CCTs programmes [37] and the Mexican CCIP, Programa de Apoyo Alimentario [38], showed that the improvement in diet quality and diversity among beneficiaries was also accompanied by an increase in consumption of processed, fatty and sugary foods. Therefore, it is suggested a greater investment in nutritional education strategies as part of in-kind and cash transfer programmes for a better choice of foods, to achieve diet quality and diversity and to prevent future CVD risk factors [12,58,59].

Studies evaluating UCT programmes also showed an increase in diet diversity and quality among beneficiaries, despite the absence of health-related conditionalities. All of these studies are from African countries, such as Kenya, Zimbabwe, Malawi, and Burkina Faso [21,26,47,52], and provided benefits to families that struggle with higher rates of extreme poverty, food insecurity and hunger. Similar results were observed among the beneficiaries of CCIP and UCIP, also carried out in African countries [20,46,50]. These results reinforce the idea that in a context of higher vulnerability, the provision of social benefits with or without conditions, will contribute to the improvement of food consumption and diet quality and diversity among beneficiaries, reducing CVD risk factors related to unhealthy behaviours and undernutrition [12,58,59]. Also, it is important to highlight that some differences between the findings can be due to the burden of undernutrition and hunger in each country pre and during the evaluation. Since poverty and vulnerable context are at the root of malnutrition (undernutrition/obesity) and chronic diseases, interventions that improve diet quality and diversity, as social protection programmes, could help to improve health and quality of life of families [12,58,59].

Our systematic review suggested that the current body of evidence points out to a higher prevalence of excess body weight among beneficiaries of social protection programmes [27,28,31,33,39,48,49,53]. When stratifying by type of programme, this negative association was limited for CCTs [31,33], while all the UFP studies suggested a higher prevalence of excess body weight (i.e., increase in BMI, waist circumference and weight gain) among beneficiaries [27,28,48,49,53]. These results could be explained by the long exposure time (36 to 72 months) of adults to the low nutritional quality of meals, and food baskets

components offered to beneficiaries of programmes, the increase in calories from processed foods, and the absence of health-related conditionalities, such as in the Community Kitchen [27] and the Food Assistance programme [28], in Peru, and the Brazilian`s Workers Food programme [48,49,53].

Several studies have demonstrated the role of the Brazilian Worker's Food Programme in increasing excess body weight among beneficiaries, given the absence of an inspection regarding the quality of meals offered to workers, as well as the non-association of this programme with other health incentives, such as the practice of physical activity, especially in companies with long working hours and high rates of sedentary activities [21,48,49,53]. Results from a study performed in Peru, among beneficiaries of the Community Kitchen programme, reinforces the role of food quality and balanced nutrition meals delivered in this type of programme and the development of other cardiometabolic risk factors, as dyslipidemia [42].

We found no consistent association between social protection programmes and alcohol and tobacco consumption, with no association in the majority of studies [22,23,32,34]. Nevertheless, a study from Peru and China found higher alcohol and tobacco use among beneficiaries suggested that this can occur, especially when the cash benefit did not target the women that are the head of family [35,44].

Our study was subject to some limitations that might be considered when interpreting our results. First, there is great variability among the studies regarding study population, study design, statistical analysis and outcomes. The different research methods and different definitions of key variables, such as food consumption, indicators of the excess body weight and type of social protection policies, made difficult the interpretation of findings across studies and did not allow us to perform a meta-analysis. Second, as our review focuses only on studies conducted in LMICs, we did not found studies related to housing programmes, pension schemes, microcredit programmes, and minimum wage policies, that might be more commonly found in high-income countries.

Despite these limitations, to the authors' knowledge, this is the first critical appraisal of the literature on the association between social protection programmes and adult CVD health outcomes in LMICs. We employed a broad search strategy looking for studies published in different languages, and considered risk factors and outcomes related directly to CVD health outcomes. Furthermore, the outcomes examined have important implications for LMICs, considering their high burden of CVD [60]. We advocate that studies provide more

information on the number of units exposed and non-exposed to social interventions and the number of health outcomes in each group to allow future comparisons and meta-analysis between studies.

Conclusion

The results of this systematic review indicate that the effect of social protection programmes on CVD related behaviours and risk factors vary according to the type of social protection programme (cash transfer or in-kind) and its modalities (conditional and unconditional). Although there is a consistent evidence that beneficiaries of social protection programmes have better diet quality and diversity, we found that UFP beneficiaries had higher prevalence of excess body weight and there was an overall scarcity of studies looking at the effect of social protection programmes on indirect indicators of CVD health (type 2 diabetes, hypertension, physical activities and dyslipidemia) and CVD mortality in adults from LMICs. Our review shows that evaluating the impacts of cash or in-kind social protection programmes on cardiovascular health is much needed to understand the role of the conditionalities in reducing the potential adverse health effects of these programmes and to subsidize targeting of these programmes to communities and countries where there is an increasing burden of cardiovascular diseases .

Competing interest: The authors declare that they have no competing interests. The views expressed in this publication are those of the author(s) and not necessarily those of the NIHR or the UK Department of Health and Social Care.

Funding: This work was supported by the National Institute for Health Research (NIHR) (GHRG /16/137/99) using UK aid from the UK Government to support global health research. CIDACS is supported by grants from CNPq/MS/Gates Foundation (401739/2015-5) and the Wellcome Trust, UK (202912/Z/16/Z). SVK is funded by an NHS Research Scotland Senior Clinical Fellowship (SCAF/15/02). AJFF has a scholarship supported by CNPq/Brazil (Number 141966/2017-3).

Availability of data and materials: All data generated or analyzed during this review are reported in the paper and its additional files in Supplementary material.

Authors' contributions: AF, JP, EG, LS, PC, SVK and EMLA conceptualized and designed the study. AF, JP, EG, and AG performed the search and extracted the data. AF and JP, conducted the analysis and interpreted the findings. AF, JP, EG, AG, and IF wrote the first version of the manuscript. All authors critically reviewed the manuscript and approved its final version.

Ethics approval and consent to participate: Not required for this work.

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Figures and tables

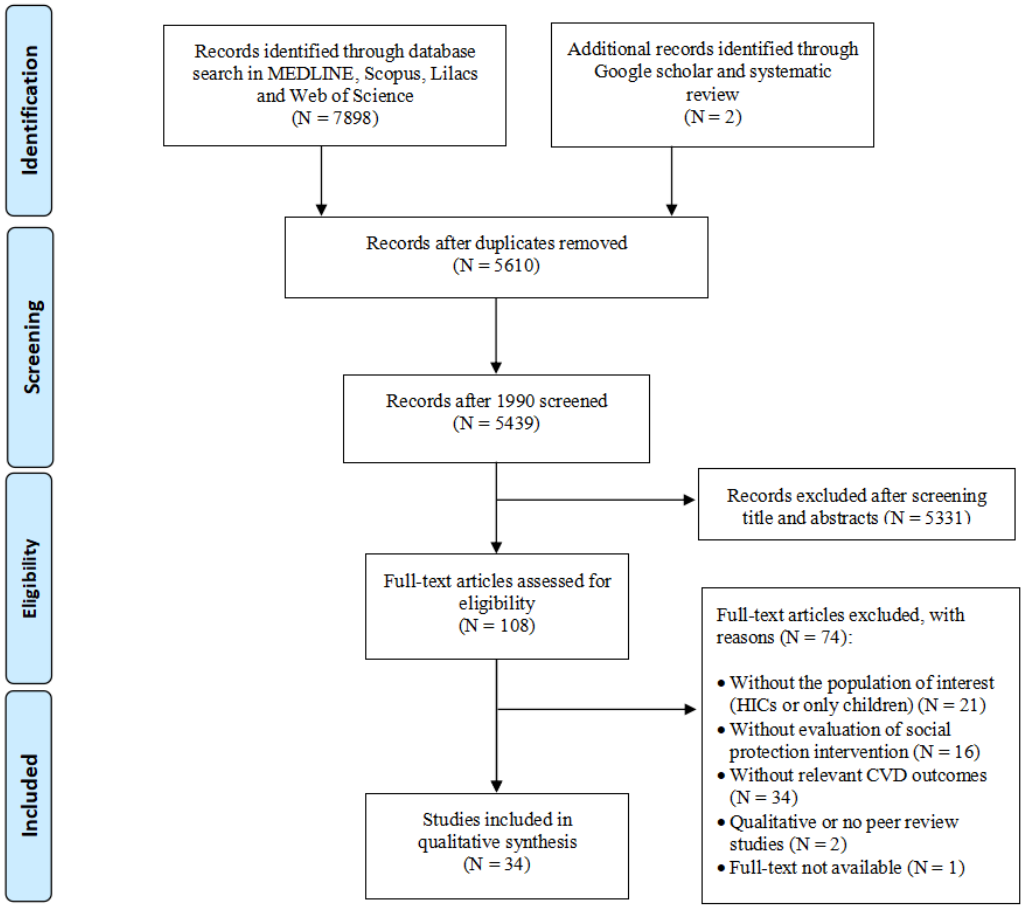


Figure 1. Flow diagram of studies selection.

Table 1. Participants and characteristic of manuscripts included in the systematic review, 1990-2020.

Author(s)/year	Country	Study			Population level	Social programmes (type)	Main outcome	Study quality
		Period (year)*	Design	Population				
Aker, 2017	Democratic Republic of Congo	2011-2012	Randomized trial[1] (Longitudinal)	Households living in an informal rural camp	Household	Democratic Republic of Congo cash or vouchers transfers (UCIP)	Diet diversity and quality	■■■
The Kenya CT-OVC Evaluation Team, 2012	Kenya	2007-2009	Cluster randomized control trial (Longitudinal)	Ultra-poor households containing at least one orphans and vulnerable children	Household	Kenya cash transfer programme for OVC (UCT)	Monthly expenditure: food, alcohol and tobacco	■■■
Attanasio and Mesnard, 2006	Colombia	2002-2003	Cohort (Longitudinal; QE)	Very poor households selected based on lowest quantile of the wealth distribution	Household	*Familias em Accion (CCT)*	Food, alcohol and tobacco consumption	■■■
Avitabile, 2012	Mexico	2003-2005	Randomized community trial (Longitudinal)	Individuals aged 20-65 years living in rural communities	Individual	*Programa de Apoyo Alimentario* (CCIP)	Central adiposity Heavy drinking and smoking	■■■
Barham and Rowberry, 2013	Mexico	1992-2002	Ecological (Panel data)	Individual household members, aged ≥ 65 years living mostly in rural municipalities	Municipality	*Progressa* (CCT)	Mortality rate from heart, stroke, and hypertension	□□■
Behrman and Parker, 2013	Mexico	1998-2003	Cluster randomized control trial (Longitudinal)	Individual household members, aged ≥ 50 years living mostly in rural municipalities	Individual	*Progressa* (CCT)	Proportion of self-reported: diabetes, hypertension, and ability to carry out vigorous activities	■■■
Bhalla et al., 2018	Zimbabwe	2013-2014	Randomized control trial (Longitudinal)	Household from poor families	Household	Harmonized Social Cash Transfer (UCT)	Diet diversity and quality Montly food expenditure	□■■

Brugh et al., 2017	Malawi	2013-2015	Cluster randomized control trial (Longitudinal)	Ultra-poor and vulnerable rural households, residents in districts of Mangochi, and Salima	Household	Malawi Cash Payments (UCT)	Diet diversity and quality Annual food group expenditures	■■■
Carrillo-Larco, Miranda, Bernabe-Ortiz, 2016	Peru	2006-2010	Cohort (Longitudinal)	Mothers of children aged 6 to 18 months, mostly living in poor areas	Individual	Community Kitchen programme (UFP)	Overweight and obesity	□■■
Chaparro, Bernabe-Ortiz, Harrison, 2014	Peru	2003-2010	Cross-sectional	Non-pregnant and non-lactating women	Individual	Food assistance programme (UFP)	Overweight and obesity	□□■
De Bem Lignani et al., 2011	Brazil	2007	Cross-sectional	Nationwide representative household sample of families included in the programme	Household	Bolsa Família programme (CCT)	Food group consumption	□□■
Fernald, Gertler, Hou, 2008	Mexico	1997-2003	Stepped wedge randomized trial[2] (Longitudinal)	Adults from both sex, aged 18-65 years living in rural low-income communities	Individual	*Oportunidades* (CCT)	Overweight and obesity Hypertension	□■■
Fernald, Hou, Gertler, 2008	Mexico	1997-2003	Stepped wedge randomized trial[2] (Longitudinal)	Rural, low-income adults, both sex, aged 30-65 years	Individual	*Oportunidades* (CCT)	Overweight, obesity hypertension, medium and heavy effort ADL	□■■
Ferrario, 2014	Brazil	2008-2009	Cross-sectional	Households and its family members from national representative sample of the Brazilian Household Budget Survey	Household	Bolsa Família programme (CCT)	Food groups, alcohol and tobacco expenditures	□□■
Forde et al., 2012	Colombia	2002-2006	Cohort (Longitudinal)	Poor non-pregnant, non-breastfeeding, non-underweight women aged ≥ 18 years	Individual	*Familias en Accion (CCT)*	Overweight and obesity	□■■
García, 2017	Peru	2009-2014	Ecological (Panel data)	Poor households with children <14 years	Household	*Juntos* (CCT)	Annual expenditure on: food, tobacco, and alcohol	□■■

Gebrehiwot and Castila, 2018	Ethiopia	2012-2014	Ecological (Panel data)	Representative sample of households from rural areas	Household	Productive Safety Net programme (CCIP)	Diet diversity and quality	□□■
Han, Gao, Xu, 2016	China	2010	Cross-sectional	Representative sample from poor families living in rural areas	Household	Rural Dibao programme (UCT)	Anual expenditure in tobacco and alcohol	□□■
Hidrobo et al., 2014	Ecuador	2011	Cluster randomized control trial (Longitudinal)	Columbian refugees and poor Ecuadorians household	Household	World Food programme in Ecuador (CCIP)	Diet diversity and quality Household food group consumption	■■■
Hoddinott, Sandstrop, Upton, 2013	Niger	2011	Cluster randomized trial[3] (Longitudinal)	Poor families of 79 villages affected by the hungry season leading up to the harvest	Household	World Food programme (UCIP)	Diet diversity and quality Food groups consumption	■■■
Houngbe et al., 2018	Burkina Faso	2013-2014	Cluster randomized control trial (Longitudinal)	Poor and very poor households, identified according to household economy analysis and with at least one child below 12 months	Household	Moderate Acute Malnutrition Out (CCT)	Diet diversity and quality	■■■
Kronebusch and Damon, 2019	Mexico	1998 - 1999	Cluster randomized control trial[2] (Longitudinal)	Households in poor urban and rural areas benefit or not from Progressa	Household	*Progressa* (CCT)	Food group consumption	□■■
Leroy et al., 2013	Mexico	2003-2005	Cluster randomized control trial[2] (Longitudinal)	Poor women, age from 18 to 49 years old from rural communities	Individual	*Programa de Apoyo Alimentario (CCIP)*	Weight gain in different categories of BMI	■■■
Leroy et al., 2010	Mexico	2003 - 2004	Randomized control trial[2] (Longitudinal)	Poor rural households beneficiaries of the programme	Household	*Programa de Apoyo Alimentario (CCIP)*	Energy food group consumption	■■■
Levasseur, 2019	Mexico	2002-2012	Cohort (Longitudinal)	Adults aged 18 to 65 years old	Individual	*Prospera* (CCT)	Overweight and obesity Risk for central adiposity	□■■

Martins and Monteiro, 2016	Brazil	2008-2009	Cross-sectional (QE)	Representative sample of poor and very poor families beneficiaries or not from the programme	Household	Bolsa Família programme (CCT)	Food group expenditure	□□■
Paredes-Aramburú and Bernabé-Ortiz, 2018	Peru	2004-2005	Cross-sectional	Individuals from both sex, with age ≥ 20 years old from metropolitan area of Lima, resto da costa, serra urbana, serra rural and Selva	Individual	Community Kitchen programme (UFP)	Dyslipidemia: low HDL, hypercholesterolemia, high LDL, and hipertriglyceridemia	□□■
Sperandio et al., 2017	Brazil	2008-2009	Cross-sectional (QE)	Representative sample of beneficiaries of the programme from Northeast and Southeast regions	Individual	Bolsa Família programme (CCT)	Food groups consumption	□□■
Torres et al., 2020	Brazil	2014-2018	Cohort (Longitudinal)	Workers of manufacturing industries adherent to and non-adherent to the WFP, from both sex, aged ≥ 18 years	Individual	Brazilian Worker Food programme (UFP)	Overweight and obesity Central adiposity	□■■
Veloso and Santana, 2002	Brazil	1996-2000	Cohort (Longitudinal)	Workers who attended by the medical team at least twice, for job admission exams, periodic exams or dismissal exams of manufacturing companies	Individual	Brazilian Worker Food programme (UFP)	Weight gain and overweight	■■■
Veloso, Santana, Oliveira, 2007	Brazil	1995- 2000	Cohort (Longitudinal)	Workers from manufacturing and construction industries in the Northeast region	Individual	Brazilian Worker Food programme (UFP)	Weight gain and overweight	■■■
White and Basu, 2016	Peru	2007-2012	Cohort (Longitudinal)	Households in urban and rural area of highlands and rainforest regions	Household	*Juntos (CCT)*	Alcohol and tobacco expenditure	□■■**
Zarsuelo et al., 2018	Philippines	2008	Randomized case-control (QE)[4]	Household beneficiaries and non-beneficiaries of of the programme from Lucena city (Quezon)	Household	*Pantawid Pamilyang Philipino* programmeme (CCT)	Diet diversity and quality	□■■

Zhou and Hendriks, 2017	Mozambique	2013	Cross-sectional	Poor families in 14 Mozambique districts beneficiaries and non-beneficiaries of the programme	Household	World Food programme (UCIP)	Diet diversity and quality	□□■

Legends: OVC: Orphans and vulnerable children; QE: Quasi-experimental; CCT: Conditional Cash Transfers; UCT: Unconditional Cash Transfers; UFP: Unconditional Food Transfers programme; UCIP: Unconditional cash or in-kind programmes; CCIP: Conditional cash or in-kind programmes; LDL: low-density lipoprotein; HDL: high-density lipoprotein; HBP: high blood pressure; ADL: Activities of Daily Living included medium effort (able to work on a farm, work in a garden, or sweep) and heavy effort (able to run or lift a heavy object; DBP: Diastolic blood pressure; SBP: Systolic blood pressure.

[1]Control arm is the allocation to the voucher compared to cash benefit;

[2]Randomization was at municipality level, not household level;

[3]Comparison cash versus food benefit;

[4]As the authors mention that treated and control groups were randomized and followed, the study could be actually considered to be a Randomized control trial.

*Considering the year (s) of data collection. **For the purpose of data extraction and evaluation of the study quality, we considered only the longitudinal design (Cohort) of the selected study.

Quality appraisal: □□■ - Low; □■■ - Moderate; and ■■■ - Strong.

Table 2. Association between conditional social programmes and Cardiovascular disease risk factors and outcomes, 1990-2020.

Author(s), year	Social programme (country)	Intervention duration (month)	Cardiovascular disease risk factors and outcomes			Statistical methods	
			Improved	Worst	No association	Effect estimation	Control for confounder
Cash transfers programmes *(N=15)*							
Attanasio and Mesnard, 2006	*Familias en Accion* (Colombia)	12	Total food consumption		Alcohol and tobacco consumption	DID tobit regression model	Adjustment.
De bem Lignani et al., 2011	Bolsa Familia programme (Brazil)	≥ 12		Self-reported consumption of high-density, and processed foods		Poisson regression model	NA
Ferrario, 2014	Bolsa Familia programme (Brazil)	NA	Food group expenditure		Alcohol and tobacco expenditure	Logit model	PSM and kernel method
Forde et al., 2012	*Familias en Accion* (Colombia)	24		Woman obesity	Overweight in woman	Logistic regression	DID
Martins and Monteiro, 2016	Bolsa Familia programme (Brazil)	12	Per capita food expenditure and diet's quality and diversity			Paired t student test	PSM
Sperandio et al., 2017	Bolsa Familia programme (Brazil)	12	Consumption of fresh or minimally processed foods in Northeast region	Consumption of processed and ultra-processed foods	Fresh and minimal food processed consumption in Southeast region.	PSM	PSM
García, 2017	*Juntos* (Peru)	≥ 48	Expenditure on food consumption		Alcoholic drinks and tobacco consumption	OLS and linear regression model	Adjustment
White and Basu, 2017	*Juntos* (Peru)	NA		Expenditures spent on alcohol and tobacco		DID	PSM

Fernald, Gertler, Hou, 2008*	*Oportunidades* (Mexico)	65		Prevalence of current hypertension for both sex Prevalence of overweight and obesity for both sex		OLS, linear and logistic regression models	Adjustment and Instrumental variable.
Fernald, Hou, Gertler, 2008	*Oportunidades* (Mexico)	60	Self-reported of ADL with medium effort in adult and older people Reduction in prevalence of obesity and hypertension in adult and older people		Overweight and heavy self-report ADL in adult and older people	OLS regression and nonparametric matching techniques	Adjustment
Behrman and Parker, 2013*	*Progressa* (Mexico)	65	Reduction in the proportion of women reporting HBP and DM Proportion of women reporting an ability to carry out vigorous activities		Proportion of health outcomes for men (HBP, DM, vigorous activities)	Linear regression model and DID	PSM
Barham and Rowberry, 2013	*Progressa* (Mexico)	60			Cardiovascular disease mortality for both sex	Linear regression model	Adjustement
Kronebusch and Damon, 2019	*Progressa* (Mexico)	18		Consumption of processed carbohydrates, saturated fat, animal protein	Fruit, and vegetables consumption	Logistic Regression model	Adjustement
Levasseur, 2019	*Prospera* (Mexico)	120	Reduction of BMI and central obesity			DDD	PSM
Zarsuelo et al, 2018	*Pantawid Pamilyang Philipino* programme (Philippines)	12	Diet diversity and quality			One-sample t-test	NA

Cash or in-kind programmes (N=4)							
Avitabile 2012	*Programa de Apoyo Alimentario* (Mexico)	24	Reduction in central adiposity in women who attended health session		Probability of heavy drink and smoking in women and men Central adiposity in men	DID	Adjustement
Hidrobo et al.,2014	World Food programme for Ecuador (Ecuador)	NA	Household food consumption Dietary diversity and quality			ANCOVA	Adjustement
Leroy et al., 2013	*Programa de Apoyo Alimentario* (Mexico)	NA		Weight gain in women that are previously overweight and obese		DID and t- test	Adjustment
Leroy et al.,2010	*Programa de Apoyo Alimentario* (Mexico)	NA	Total energy and food groups consumption	Energy from processed food in the cash transfer group	Energy from processed food in the food transfer group	DID	Adjustment

Legend: N: number; NA: not applicable; DID: difference-in-difference; DDD: triple difference or difference-in-difference-in-differences; PSM: propensity score matching; OLS: ordinary least squares; ADL: Activities of Daily Living; OVC: Orphans and Vulnerable Children; HBP: high blood pressure; ADL: Activities of Daily Living;
*For those studies that measures the outcomes in several point of time, we considered the cumulative effects/association, measured at the final of follow-up.
Adjustment was made by a set of different covariates for each included study, as well as PSM.

Table 3. Association between unconditional social programmes and Cardiovascular disease risk factors and outcomes, 1990-2020.

Author(s)/year	Social programme (country)	Intervention duration (month)	Cardiovascular risk factors and outcomes			Statistical methods	
			Improved	Worst	No association	Effect estimation	Control for confounder
Cash transfers programmes (N=5)							
The Kenya CT-OVC Evaluation Team, 2012	Kenya Cash Transfer programme for OVC (Kenya)	24	Food expenditures Low monthly spending on alcohol and tobacco			DID	Adjustment
Han, Gao, Xu, 2016	Rural Dibao programme (China)	36		Family expenditure on tobacco and alcohol		OLS and logistic regressions	PSM
Bhalla et al., 2018	Harmonized Social Cash Transfer (Zimbabwe)	NA	Diet diversity and quality		Monthly per capita food expenditure	OLS	IPTW
Houngbe et al., 2018	Moderate Acute Malnutrition Out (Burkina Faso)	NA	Diet diversity and quality among women			Poisson regression model	Adjustement
Brugh et al., 2017	Malawi Cash payments (Malawi)	12	Food expenditure and diet diversity			DID	Random allocation
Food transfers programmes (N=6)							
Chaparro, Bernabe-Ortiz, Harrison, 2014	Food Assistance programme (Peru)	72		Overweight/obesity in women		Poisson regression model	Adjustment
Carrillo-Larco, Miranda, Bernabe-Ortiz, 2016	Community Kitchen programme (Peru)	36		Risk of obesity in woman	Overweight in women	Poisson regression models	Adjustment
Paredes-Aramburú, Bernabé-Ortiz, 2018	Community Kitchen programme (Peru)	NA	Probability of presenting low hypertriglyceridemia.	Probability of presenting high LDL-c Probability of low	Probability of serum hypercholesterolemia.	Poisson regression models	Adjustment

				HDL-c			
Veloso and Santana (2002)	Worker`s Food programme (Brazil)	NA		Weight gain in eutrophic and pre-obese workers	Obesity/overweight	Poisson regression model	Adjustment
Veloso, Santana, Oliveira, 2007	Worker`s Food programme (Brazil	NA		Weight gain, and overweight among workers		Poisson regression models	Adjustment
Torres et al., 2020	Worker`s Food programme (Brazil)	48		Central adiposity	Obesity/overweight	Multiple regression	Adjustment
Cash or in-kind programmes (N=4)							
Zhou and Hendriks, 2017	World Food programme (Mozambique)	1	Dietary diversity and quality			ANOVA and Pos hoc Tunkey test	NA
Hoddinott, Sandstrop, Upton, 2013	World Food programme (Niger)	6	Diet diversity and quality Food group consumption			OLS and probit models Poisson and tobits	NA
Aker, 2017	Democratic Republic of Congo cash or vouchers transfers (Democratic Republic of Congo)	8	Households' diet diversity and quality			Regressions model	Random allocation
Gebrehiwot and Castilla, 2019	Productive Safety Net programme (Ethiopia)	NA			Diet diversity and quality Food expenditure	T-test Simpson index 2OLS	Instrument variable and PSM

Legend: N: number of included studies; NA: not applicable; DID: difference-in-difference; DDD: triple difference or difference-in-difference-in-differences; PSM: propensity score matching; OLS: ordinary least squares; IPTW: Inverse probability weights; ADL: Activities of Daily Living; OVC: Orphans and vulnerable children; HBP: high blood pressure; ADL: Activities of Daily Living; HDL-c: high density lipoprotein; LDL-c: low density lipoprotein.

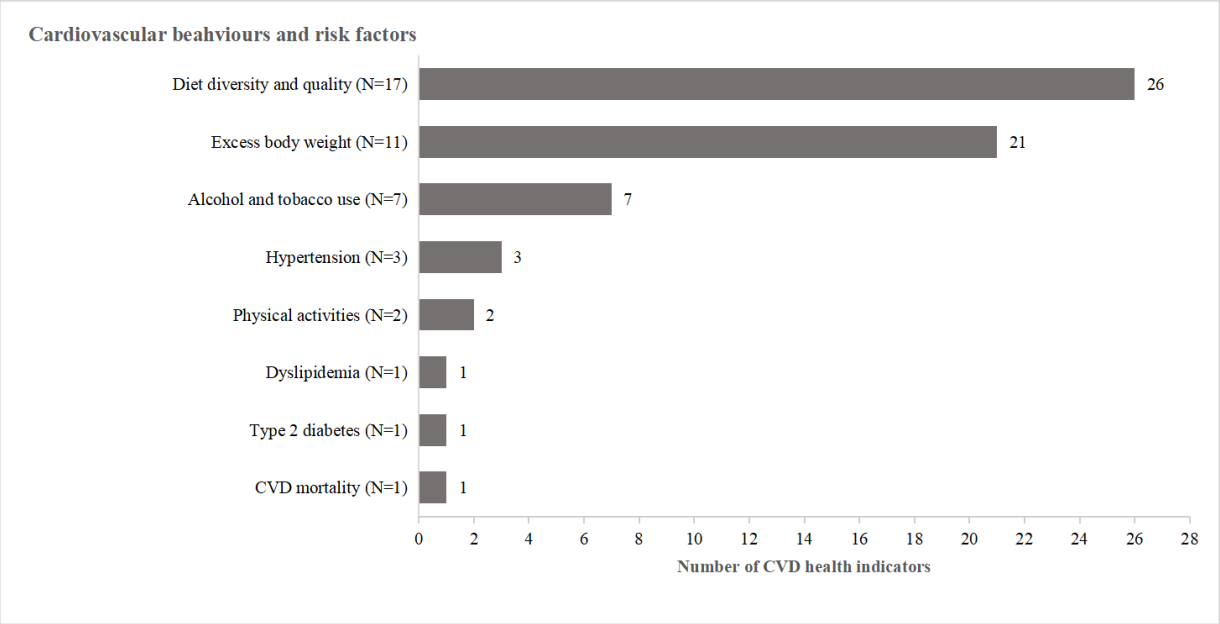
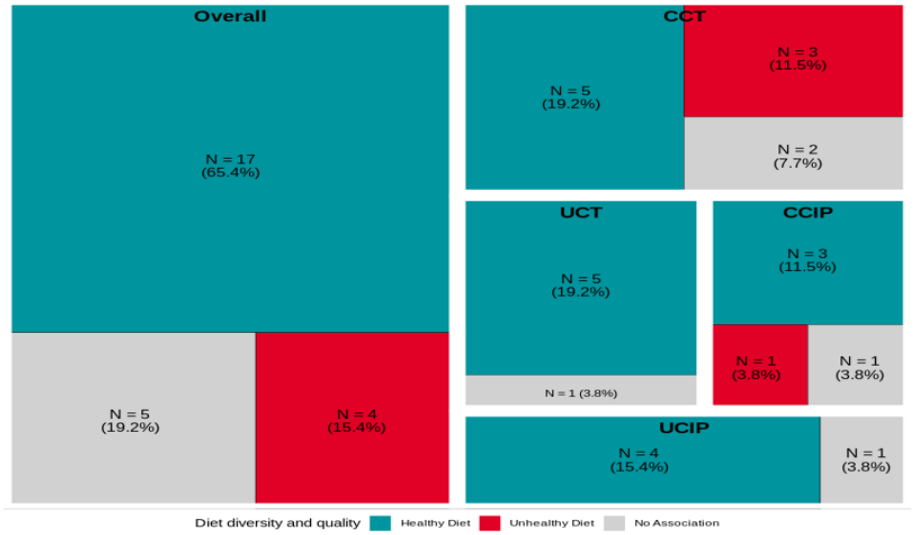


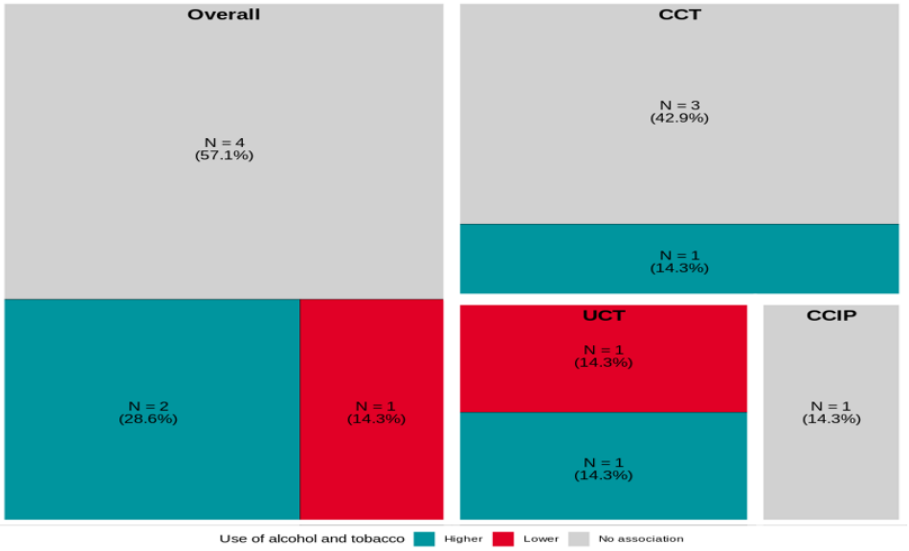
Figure 2. Number of CVD health indicators extracted of the 34 selected studies, 1990-2020.

**One study could present more than one outcome .*

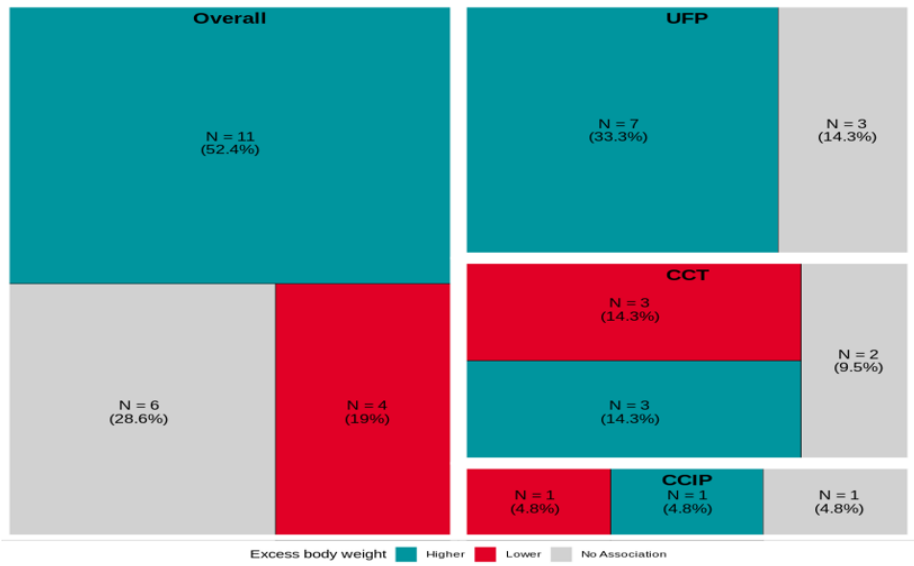
N: number of studies included for each CVD behaviours and risk factors.


Overall
N = 17
(65.4%)
N = 5
(19.2%)
N = 4
(15.4%)
CCT
N = 5
(19.2%)
N = 3
(11.5%)
N = 2
(7.7%)
UCT
N = 5
(19.2%)
N = 1 (3.8%)
CCIP
N = 3
(11.5%)
N = 1
(3.8%)
N = 1
(3.8%)
UCIP
N = 4
(15.4%)
N = 1
(3.8%)
Diet diversity and quality
Healthy Diet
Unhealthy Diet
No Association

A


Overall
N = 4
(57.1%)
N = 2
(28.6%)
N = 1
(14.3%)
CCT
N = 3
(42.9%)
N = 1
(14.3%)
UCT
N = 1
(14.3%)
N = 1
(14.3%)
CCIP
N = 1
(14.3%)
Use of alcohol and tobacco
Higher
Lower
No association

B


Overall
N = 11
(52.4%)
N = 6
(28.6%)
N = 4
(19%)
UFP
N = 7
(33.3%)
N = 3
(14.3%)
CCT
N = 3
(14.3%)
N = 3
(14.3%)
N = 2
(9.5%)
N = 1
(4.8%)
CCIP
N = 1
(4.8%)
N = 1
(4.8%)
Excess body weight
Higher
Lower
No Association

C

Figure 3. Association between social protection programmes and CVD health outcomes and risk factors by type of programme, 1990-2020; (A) Diet quality and diversity; (B) alcohol and tobacco consumption; (C) Excess body weight.

Legends: *Blue show studies from association between receiving social protection and healthy outcomes; red show studies from association between social protection and unhealthy health outcomes; and grey show studies with no association between social protection and health outcomes.*

**One study could present more than one outcome .*

*** All the studies related to diet (N=17) present 26 points estimation of diet quality, distributed by four social programmes; All the studies related to alcohol and tobacco consumption (N=7) present 7 indicators of alcohol and tobacco consumption, distributed by three social programmes; All the studies related to excess body weight (N=11) present 21 indicators of excess body weights, distributed by three social programmes.*

****On the left side we presented the overall association among social protection programmes and CVD health outcomes and risk factors, and at the right side, we detail the contribution of the specific social protection programmes on the three categories (lower, higher, no association). Each side, right and left, sum up to 100% each.*

N: Number; %: Percentage; CCT: Conditional cash transfer; CCIP: Conditional cash transfers or in-kind programmes; UFP: Unconditional food transfer programmes; CCIP: Conditional cash/in-kind programme; UCIP: Unconditional cash/in-kind programme.

Supplementary material

Table S1. Definition and component of the review.

Component of the review topic	Definitions
Population	Adults (18 years or more), from both sex, families and household from low and middle-income country*
Intervention:	Social protection policies or programmes, that aimed to reduced poverty and inequalities
Comparison	Individuals and families who received different amounts or who did not receive the benefits from the selected social protection policies/programmes
Health outcomes	Health behaviours: food, tobacco, and alcohol (consumption/ expenditure), diet quality, and physical inactivity
	CVD risk factors: overweight, obesity, type 2 diabetes, hypertension, hypercholesterolemia, dyslipidemia, excessive weight gain, and abnormal waist circumference
	CVD mortality and morbidity: heart disease, stroke, coronary heart disease, and CVD causes of death

*Low and middle-income countries are defined according to The World Bank 2020 fiscal year (Table S3)

Table S2. Search strategy used for MEDLINE and adapted to Scopus, Lilacs, Web of science and Google scholar.

	1. Countries
1	Developing Countries[MESH]
2	(Africa or Caribbean or “West Indies” or “South America” or “Latin America” or “Central America” or “Eastern Europe” or “Central Asia”)
3	(benin OR "Burkina Faso" OR "Burkina Fasso" OR "Upper Volta" OR burundi OR urundi OR "Central African Republic" OR chad OR comoros OR "Comoro Islands" OR comores OR mayotte OR congo OR "Democratic Republic of Congo" OR "Republic of Zaire" OR zaire OR eritrea OR ethiopia OR gambia OR "The Gambia" OR guinea OR "Guinea Bissau" OR liberia OR madagascar OR "Malagasy Republic" OR malawi OR nyasaland OR mali OR mozambique OR niger OR rwanda OR ruanda OR "Sierra Leone" OR "South Sudan" OR tanzania OR togo OR togolese OR "Togolese Republic" OR uganda OR "Cape Verde" OR "Cabo Verde" OR cameroon OR cameron OR "Cote d'Ivoire" OR "Ivory Coast" OR ghana OR guiana OR guyana OR "Gold coast" OR kenya OR lesotho OR basutoland OR mauritania OR nigeria OR ("Sao Tome" AND principe) OR Senegal OR swaziland OR zambia OR zimbabwe OR rhodesia OR cambodia OR "Khmer Republic" OR kampuchea OR "North Korea" OR korea OR kiribati OR Laos OR Lao OR micronesia OR "New Guinea" OR philippines OR samoa OR “Samoan Islands" OR "Solomon Islands" OR vanuatu OR "New Hebrides" OR vietnam OR "Viet nam" OR afghanistan OR somalia OR djibouti OR "French Somaliland" OR egypt OR "Arab Republic" OR morocco OR ifni OR sudan OR syria OR Syrian OR "West Bank" AND gaza OR palestine OR yemen OR bolivia OR guatemala OR guyana OR Guiana OR honduras OR nicaragua OR haiti OR "El Salvador" OR nepal OR bangladesh OR bhutan OR india OR indonesia OR myanmar OR burma OR pakistan OR "Sri Lanka" OR "Timor leste" OR "East Timor" OR armenia OR armenian OR georgia OR Georgia* OR kosovo OR "Kyrgyz Republic" OR kirghiz* OR Kyrgyzstan OR moldova OR tajikistan OR tadzhikistan OR tadjikistan OR tadzhik OR ukraine OR uzbekistan OR uzbek OR "Middle East" OR albania OR fiji OR montenegro OR algeria OR gabon OR namibia OR "American Samoa" OR nauru OR argentina OR grenada OR Paraguay OR armenia OR guatemala OR peru OR azerbaijan OR guyana OR romania OR belarus OR Iran OR "Russian Federation" OR russia OR belize OR iraq OR samoa OR Bosnia OR Jamaica OR Serbia OR botswana OR jordan OR Brazil OR kazakhstan OR "South Africa" OR bulgaria OR kosovo OR "St. Lucia" OR "Saint Lucia" OR "Santa Lucia" OR china OR lebanon OR ("St. Vincent” AND Grenadines) OR colombia OR libya OR suriname OR "Costa Rica" OR macedonia OR thailand OR cuba OR malaysia OR tonga OR dominica OR maldives OR turkey OR "Dominican Republic" OR "Marshall Islands" OR "Turkmenistan" OR "Equatorial Guinea" OR mauritius OR tuvalu OR ecuador OR mexico OR venezuela)
4	((low-income[tiab] OR lower-income[tiab] OR (middle[tiab] and income[tiab]) OR developing OR underdeveloped OR “less developed” OR “under developed” OR underserved OR “under server” OR poor*) AND (countr* OR nation* OR state* OR population* OR world OR region* OR economy*)
5	1 or 2 or 3 or 4
	2. Cardiovascular health
7	“Cardiovascular Diseases”[MESH] OR (("heart"[TIAB] OR "cardiac"[TIAB] OR "coronary"[TIAB]) AND "disease"[TIAB]) OR ("myocardial"[TIAB] AND "infarction"[TIAB]) OR ("heart"[TIAB] AND (attack*[TIAB] OR failure[TIAB])) OR Cerebrovascular[TIAB] OR cardiovascular[TIAB] OR “cardio-vascular”[TIAB] OR angina[TIAB] OR myocardial[TIAB] OR ischemi*[TIAB] OR ischaemi*[TIAB] OR Ischemia[MESH] OR infarct*[TIAB] OR

	stroke* OR stroke[MESH] OR cardiomyopath*[TIAB] OR Thrombosis[MESH] OR "Cardiovascular risk factors" [TIAB] OR (arrhythmi*[TIAB] AND cardiac[TIAB]) OR atheroscleros*[TIAB] OR dyslipidem*[TIAB] OR Hypertension[MeSH] OR Hypertens*[TIAB] OR ("Blood Pressure"[TIAB] AND High[TIAB]) OR obesity[TIAB] OR overweight[TIAB] OR bmi[TIAB] OR "body mass index"[TIAB] OR diabet*[TIAB] OR tobacco[TIAB] OR smok*[TIAB] OR alcohol*[TIAB] OR nutrition[TIAB] OR diet[TIAB] OR "sedentary lifestyle"[TIAB] OR "physical activity"[TIAB] OR "exercise"[TIAB]
3. Social protection programmes	
8	("welfare policy"[TIAB] OR "social protection"[TIAB] OR "monetary incentive" [TIAB] OR "financial incentive"[TIAB] OR "social programs"[TIAB] OR "food assistance"[TIAB] OR "food program"[TIAB] OR "cash transfer"[TIAB] OR "social policies"[TIAB] OR "social policy"[TIAB] OR "safety nets" [TIAB] OR "in kind transfers"[TIAB] OR "housing programs"[TIAB] OR "housing affordability"[TIAB] OR "poverty alleviation"[TIAB] OR "poverty reduction"[TIAB] OR "housing policy"[TIAB] OR "social housing"[TIAB] OR "Affordable Housing"[TIAB] OR "housing assistance"[TIAB] OR "subsidized housing"[TIAB] OR "supported housing"[TIAB] OR "housing policy"[TIAB])
9	(food*[TIAB] AND (subsid*[TIAB] OR incentiv*[TIAB] OR voucher[TIAB]))
10	"Public Housing"[Mesh]
11	(water[TIAB] OR sanitary[TIAB] OR sanitation[TIAB] OR hous*[TIAB]) AND (subsidy[TIAB] OR subsidies[TIAB] or incentiv*[TIAB] or voucher[TIAB])
12	8 or 9 or 10 or 11
4. Final search	
13	6 AND 7 AND 12

Table S3. Low and middle-income countries (LMICs) considered in this study are those defined by The World Bank according to the 2020 fiscal year.

Classification	Countries
Low-income	Afghanistan, Benin, Burkina Faso, Burundi, Central African Republic, Chad, Democratic Republic of Congo, Eritrea, Ethiopia, Gambia, Guinea, Guinea-Bissau, Haiti, Liberia, Madagascar, Malawi, Mali, Mozambique, Nepal, Niger, North Korea, Rep. Yemen, Rwanda, Sierra Leone, Somalia, South Sudan, Syrian Arab Republic, Tajikistan, Tanzania, Togo, Uganda.
Lower-middle income	Angola, Arab Rep. Egypt, Bangladesh, Bhutan, Bolivia, Cabo Verde, Cambodia, Cameroon, Comoros, Côte d'Ivoire, Djibouti, El Salvador, Ghana, Honduras, India, Indonesia, Kenya, Kiribati, Kyrgyz Republic, Lao PDR, Lesotho, Mauritania, Micronesia, Moldova, Mongolia, Morocco, Myanmar, Nicaragua, Nigeria, Pakistan, Papua New Guinea, Philippines, Rep. Congo, São Tomé and Principe, Senegal, Solomon Islands, Sudan, Swaziland, Timor-Leste, Tunisia, Ukraine, Uzbekistan, Vanuatu, Vietnam, West Bank and Gaza, Zambia, Zimbabwe.
Upper-middle income	Albania, Algeria, American Samoa, Argentina, Armenia, Azerbaijan, Belarus, Belize, Bosnia and Herzegovina, Botswana, Brazil, Bulgaria, China, Colombia, Costa Rica, Cuba, Dominica, Dominican Republic, Ecuador, Equatorial Guinea, Fiji, Gabon, Georgia, Grenada, Guatemala, Guyana, Iraq, Islamic ep. Iran, Jamaica, Jordan, Kazakhstan, Kosovo, Lebanon, Libya, Macedonia, Malaysia, Maldives, Marshall Islands, Mauritius, Mexico, Montenegro, Namibia, Nauru, Paraguay, Peru, Romania, Russian Federation, Samoa, Serbia, South Africa, Sri Lanka, St. Lucia, St. Vincent and the Grenadines, Suriname, Thailand, Tonga, Turkey, Turkmenistan, Tuvalu, Venezuela.

Source: The World Bank (https://datahelpdesk.worldbank.org/knowledgebase/articles/906519-world-bank-country-and-lending-groups).

Table S4. Definitions and characterization of social protection programmes included in this systematic review, 1990-2020.

Programmes (Country)	Intervention definition	Type and amount of Benefit*	Conditionalities	References
Brazilian Worker`s Food programme (Brazil)	Launched by federal government in 1976, aiming to improve worker's nutritional conditions and, secondary, to improve their quality of life, to decrease the incidence of work accidents and to increase productivity. Companies may be responsible for the whole process of producing and serving meals, distribute food baskets, or hire third party companies registered with the BWFP to provide the service.	**Food:** healthy and adequate diet to the assisted workers, based in daily reference values for adults established in the BWFP legislation. Companies can offer one or more meals a day, food basket or vouchers.	None	[1–3]
Bolsa Família programme (Brazil)	Created in 2003, aiming to combat poverty by making income transfers to low income and very poor families who achieves some criteria: families that presented a per-capita monthly incomes of up to R$ 70 (US$28.0), regardless of the household's composition, or with a monthly income lower than R$140.00 (US$56.0) with children, teenagers, pregnant women or nursing mothers.	**Cash:** monthly income ranged from R$68.00 (US$27.2) to R$200.00 (US$80.0).	Health, nutrition and immunization attendance, education and social assistance.	[4–7]
Cash payments (Malawi)	Bi-monthly UCT programme to poor household. Cash transfer schedule used varies by household size and the number of household members enrolled in primary and secondary school.	**Cash:** single-person household received Mk 1000 (US$1.4), a two-person received Mk 1500 (US$2.0), a three-member received Mk 1950 (US$2.7), and households with four or more members received Mk 2400 (US$3.3). The household receives an additional Mk 300 (US$0.4) for each member age 21 y and younger enrolled in primary school and Mk 600 (US$0.8) for members age 30y and younger enrolled in secondary school. **	None	[8]
Cash or vouchers transfers (Democratic Republic of Congo)	Households received a UCT or in-kind (vouchers). Both the cash and voucher transfers were equivalently-valued, distributed at the same frequency, with the same denomination and at the same location. For voucher households, in the first distribution, recipients could spend the voucher on a variety of food and non-food items at the fair. The second and third vouchers could be spent only on food items. The benefit was primarily provided to the female household head or spouse of the head.	**Cash:** US$130 over a seven-month period (September 2011 (US$90), November 2011 (US$20) and February 2012 (US$20). **Voucher:** value of US$130 over a seven-month period and spend it in food, school fees, clothing, agricultural inputs and small animals.	None	[9]

Community kitchens programme (Peru)	Organized by poor women's volunteer groups, usually from the same district, who prepare food menus for sale at a subsidized price. It is aimed at the population in poverty and extreme poverty, at health risk, children, adults and people with disabilities.	**Food:** low-cost meal subsidized by the government that provides basic foods such as rice, wheat, stews, and oil, while the remaining components of the dish are purchased with menu sales that occurred the day before.	None	[10,11]
Familias em Accion **(Colombia)**	Launched in 2002, CCT provides subsidies investments into education, nutrition and health in poor areas. Subsidies are paid to the mother of the children and all beneficiary families with children aged 0 through 6 years receives additional monetary supplement for mothers and children.	**Cash:** families receive 40 000 pesos (US$15) per month if they have children aged 0 to 7 years. Additional payments of 14 000 pesos (US$5.5) are made for each child regularly attending primary school and 28 000 pesos (US$11) for each child regularly attending secondary school. A flat-rate monthly monetary supplement of 46,500 pesos (US$20) is provided to mothers of all beneficiary families with children aged 0 through 6 years old.**	Children school attendance, health, nutrition, and immunization programme. Contraception programme for mothers	[12,13]
Food assistance programmee (Peru)	UCT programme (2003-2010) that include beneficiaries of: i) Glass of milk (GMP) and community kitchen (CKP) programme - poor mother, older people and children ii) Feeding and Nutrition programme for Tuberculosis Patients and Their Families (PANTBC) - contribute to the integral recovery of tuberculosis ambulatory patients and their families; iii) Wawawasi programme (now called Cuna mas) - comprehensive childcare and food for children living in poverty.	**Food:** i) 250 mL of fortified whole milk or an equivalent ready-to-drink product daily provided by GMP; ii) Low cost lunches subsidized by the government (CKP); iii) Monthly food basket comprising 13 kg of cereals, 2 kg of legumes, 1.7 kg of canned fish, and 1 liter of vegetable oil (PANTBC); and iv) Child care plus 2 meals per day (Wawawasi).	None	[14]
Juntos **(Peru)**	Launched in 2005, aimed at reducing poverty and child labor. It involves the transfer of cash to mothers from poor families. It provides a fixed, lump-sum payment to eligible households that does not vary by household size or number of children. Eligible households have a child under the age of 14 years or a pregnant woman and are selected based on a proxy means test.	**Cash:** 100 peruvian soles (US$35) per months for each selected household**.	Children school attendance, immunization, nutrition, prenatal and postnatal care for women, and parental health education	[15,16]

Kenya Cash Transfer programme for OVC (Kenya)	Aiming to provide regular cash transfers to families living with an OVC to encourage fostering and retention of children and to promote their human capital development. Households who are ultra-poor and contain an OVC are eligible to receive the benefit. An OVC is defined as a household resident between 0 and 17 years old with at least one deceased parent, or who is chronically ill, or whose main caregiver is chronically ill.	**Cash:** fixed monthly transfer of US$21 for household	None	[17]
Moderate Acute Malnutrition Out (Burkina Faso)	Implemented from June 2013 to October 2015 in Tapoa province, the programme is targeted to economically vulnerable households with children less than 1 y old at the time of inclusion. Cash is distributed to mothers via a personal mobile phone account provided by the project.	**Cash:** monthly allowance of 10 000 western CFA franc (US$17) was transferred to caregivers of eligible children, from July to November over two years (2013 and 2014). **	None	[18]
Pantawid Pamilyang Pilipino programme **(Philippines)**	Aim to support poor families with children aged 0-18 month in the household. Family-beneficiaries will receive the grant for at most five years, provided that they comply with conditions. Eligibility criteria include: i) residence in the poorest municipalities, based on 2003 Small Area Estimates; ii) households whose economic condition is equal to or below the provincial poverty threshold; iii) households that have children 0-18 y old and/or have a pregnant woman at the time of assessment; and iv) households that agree to meet conditions specified in the programme.	**Cash:** i) a monthly health grant of Php 500 (US$10.1) per household for 12 months and an education grant of Php 300 (US$6.1) per 6-14 years old child attending school (maximum of 3 children) for 10 months of the school year; ii) If a beneficiary household satisfy all conditions, a maximum health grant of Php 6,000 (US$ 121.6) and education grant of Php 3,000 (US$ 60.8) per child will be received for each year. **	Children school attendance, health, immunization, nutrition and education assistance, pre and post-natal care for pregnant woman, and de-worming pills twice a year for children 6-16 years.	[19]
Productive Safety Net programme (Ethiopia)	Launched in 2005, the goal is to offer multi-annual transfers, such as cash (the primary form of transfers when possible), in-kind (food voucher or transfers), or a combination of both to chronically food insecure households and poor families. Households were eligible if: i) located in one of the chronically food insecure place; ii) has faced continuous food shortages (at least three months of food gap or more per year in the last three years); iii) suddenly became food insecure as a result of a severe loss of assets; iv) does not have adequate family support and other means of social protection, particularly in the case of female-headed or elderly-headed households, and those with orphans and members with disabilities. Transfers could be related to the households size.	**Cash:** daily wage rate of the cash transfers is calculated on the basis of the cost of buying 3kg of cereal and 0.8 kg of pulses per day (15 kg of cereal and 4 kg of pulses per person per month) in the market. **Food:** 15 kg of cereal and 4 kg monthly. **Vouchers:** pieces of paper provided households with equivalent of daily wage of 3kg of cereal and 0.8 kg of pulses or monthly transfers of 15 kg of cereal and 4 kg of pulses.	None	[20]

***Programa de Apoyo Alimentario* (Mexico)**	Launched in 2003 to attend Mexican rural poor communities, aiming to reduce poverty and improve households' dietary and health practices. Operates in small (population less than 2,500) localities, which are very poor, do not receive other transfer programmes, are accessible (not more than 2.5 km from a road) and close enough (not more than 2.5 km) to a public agency in charge of administering the programme (named DICONSA). It provides in-kind transfers (food baskets, which is not conditional on household size), or cash transfer to communities.	**Food:** food basket contains powdered fortified milk, beans, rice, corn flour, soup pasta, vegetable oil, cookies, corn starch, powdered chocolate drink, ready-to-eat cereal, and sardines (two baskets delivered every two months), that aimed to provide a balanced nutritional intake of 1,750 calories per day, per household. **Cash:** 150 Mexican pesos (US$ 14) per month.	Attendance of nutrition and health education sessions, as well as participating in programme-related logistic activities for mothers.	[21–23]
Prospera/ Oportunidades/ Progressa (Mexico)	Launched in 1997, programme aims to offers low-income families monthly cash benefits based on the number of children in the home. The programme includes a fixed benefit and additional benefits targeting children <22 years of age and attending school and in-kind health benefits and nutritional supplements. Once enrolled, households received benefits according to their baseline household composition for a minimum of 3 years, conditional on meeting the programme requirements, after which they were re-assessed for eligibility. Households with more children in school and enrolled in higher grades, or more female children in higher grades, had higher transfer amounts and therefore accumulated transfers faster than similar households with fewer children in school or with more male children in higher grades.	**Cash:** i) an average income of approximately US$25 per month. ii) The second cash transfer was given to households with school-aged children if the children were enrolled in and attended school. This amount varied depending on the number of children attending school and was greater for girls than for boys.	Children attending school, all family members obtaining regular preventative health care and health education training sessions.	[24–29]
Rural Dibao programme (China)	Programme began in 1997 and provides direct cash transfers to households whose net per capita income is below a minimum living standard threshold set up by the local government, and it was adopted in rural areas since 2007.	**Cash:** the programme transfers 324 yuan (US$ 46.4) for each family (median benefit amount).**	None	[30]

World Food programme in Ecuador (Ecuador)	Programme consisted of six monthly transfers of cash, food vouchers, or food, with the same value of transfer modality, to Colombian refugees and poor Ecuadorian households. The objectives of the programme were: 1) to improve food consumption by facilitating access to more nutritious foods, 2) to increase the role of women in household decision-making related to food consumption, and 3) to reduce tensions between Colombian refugees and host Ecuadorian populations. The vouchers were non-transferable. Food transfer was valued according to regional market prices.	**Cash:** monthly transfer of US$40 per household. Cash transfer had to be taken out in bundles of US$10. **Food transfer:** include rice (24 kg), vegetable oil (4 l), lentils (8 kg), and canned sardines (8 cans of 0.425 kg) - valued in US$40. **Food voucher:** Given in denominations of US$ 20, redeemable for a list of nutritionally approved foods (cereals, tubers, fruits, vegetables, legumes, meats, fish, milk products, and eggs) at central supermarkets in each urban center	Nutrition education by monthly training session, especially for women.	[31]
World Food programme (Niger and Mozambique)	The food for work or cash activities were of a disaster-mitigating nature such as digging small water reservoirs, building drainage systems, growing tree seedling nurseries or planting trees for wind breaks. Districts and localities were assigned to cash or food transfers based on WFP`s available resources for cash or food distributions. A prerequisite for cash transfers was the availability of banking services in the district or locality. Cash transfers were withdrawn monthly by the households at the nearest bank branch, using automatic teller machine cards. Food transfers provide food directly to individuals or households, so as to fill food consumption gaps directly. Payment levels for cash and food were designed to be of equivalent value.	**Cash:** each beneficiary received around US$2 per day worked to a maximum of US$50 per month. **Food:** Food basket are composed with traditonal food eaten in the region. A day's payment provided a full ration of food for the average household size of seven people, including 3.5 kg of grain, 0.72 kg of pulses, 0.14 kg of vegetable oil, and 0.035 kg of salt.	None	[32,33]
Harmonized Social Cash Transfer (Zimbabwe)	Launched in 2011, beneficiary households receive a bimonthly cash transfer that varies with household size, that corresponding, on average, 20 percent of total household consumption expenditure. Eligibility criteria to become a beneficiary are twofold: food-poor and labor constrained status of the household.	**Cash**: Every two months households receive i) US$10, for a one-person household; ii) US$15, for a two-person household, iii) US$20, for a three-person household, and iv) US$25, for households with four or more persons.	None	[34]

Legend: OVC: Orphans and vulnerable children; UN: United Nations; CCT: Conditional cash transfer; UCT: Unconditional cash transfers programmes; BWFP: Brazilian Worker`s Food programme; Mk: Kwacha Malawi; Php: peso Philipine; R$: Brazilian reais; US$: American dollar; kg: kilograms. *All this information is at the time of the study. **Values converted to US$ in 31st August 2020.

Table S5. Quality assessment of studies included in the systematic review, considering the Quality Assessment Tool for Quantitative Studies.

No	Author(s)/year	Selection Bias	Study design	Confounders	Blinding	Data Collection Methods	Withdrawals and Drop-outs	Global rating for this paper*
1	Aker, 2017 [9]	1	1	1	2	1	1	1
2	Attanasio and Mesnard, 2006 [12]	2	2	1	2	1	1	1
3	Avitabile, 2012 [21]	1	1	1	2	1	1	1
4	Barham and Rowberry, 2013 [24]	3	3	3	2	1	3	3
5	Behrman and Parker, 2013 [25]	1	1	1	2	1	1	1
6	Bhalla et al., 2018 [34]	2	3	1	2	1	2	2
7	Brugh et al., 2017 [8]	1	1	1	2	1	1	1
8	Carrillo-Larco, Miranda, Bernabe-Ortiz, 2016 [10]	3	2	1	2	1	1	2
9	Chaparro, Bernabe-Ortiz, Harrison, 2014 [14]	1	3	1	2	1	3	3
10	De Bem Lignani et al., 2011 [5]	3	3	3	2	1	3	3
11	Fernald, Gertler, Hou, 2008 [27]	1	1	1	2	1	3	2
12	Fernald, Hou, Gertler, 2008 [26]	1	1	1	2	1	3	2
13	Ferrario, 2014 [4]	3	3	1	2	1	3	3
14	Forde et al., 2012 [13]	2	2	1	2	1	3	2
15	García, 2017 [15]	2	2	1	2	1	3	2
16	Gebrehiwot and Castila, 2018 [20]	1	3	1	2	1	3	3
17	Han, Gao, Xu, 2016 [30]	1	3	1	1	2	3	3
18	Hidrobo et al., 2014 [31]	1	1	1	2	1	1	1
19	Hoddinott, Sandstrop, Upton, 2013 [33]	1	1	1	2	1	1	1
20	Houngbe et al, 2018 [18]	1	1	1	2	1	1	1
21	Kronebusch and Damon, 2019 [28]	1	3	1	2	1	1	2
22	Leroy et al., 2013 [23]	1	1	1	2	1	1	1
23	Leroy et al., 2010 [22]	1	1	1	2	1	1	1

24	Levasseur, 2019 [29]	1	1	1	2	1	3	2
25	Martins and Monteiro, 2016 [6]	1	3	1	1	2	3	3
26	Paredes-Aramburú and Bernabé-Ortiz, 2018 [11]	3	3	1	2	1	1	3
27	Sperandio et al., 2017 [7]	1	3	1	2	1	3	3
28	The Kenya CT-OVC Evaluation Team, 2012 [17]	2	1	1	2	1	2	1
29	Torres et al., 2020 [3]	2	2	1	2	1	3	2
30	Veloso and Santana, 2002 [1]	1	2	2	2	1	1	1
31	Veloso, Santana, Oliveira, 2007 [2]	1	2	1	2	1	1	1
33	White and Basu, 2016 [16]	1	1	2	2	1	3	2
34	Zarsuelo et al., 2018 [19]	2	1	1	2	1	3	2
35	Zhou and Hendriks, 2017 [32]	2	3	1	2	1	3	3

No: Number

* Global quality rating of papers: 1 (Strong), 2 (Moderate), and 3 (Weak)

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5.2 Artigo 2. Evaluating the health effect of a Social Housing programme, Minha Casa Minha Vida, using the 100 million Brazilian Cohort: A natural experiment study protocol[3].

Andrêa JF Ferreira[1,2*], Julia M Pescarini[1], Mauro N Sanchez[1,3,] Renzo Flores-Ortiz[1], Camila SS Teixeira[1,2], Rosimeire L Fiaccone[1,4,] Maria YT Ichihara[1], Rodrigo Oliveira[1,5], Estela ML Aquino[1,2], Liam Smeeth[6,7], Peter Craig[8], Sanni Ali[6], Alastair H Leyland[8], Mauricio L Barreto[1,2], Rita de Cássia Ribeiro Silva[1,2**], Srinivasa Vittal Katikireddi[8**].

[1] Center for Integration of Data and Health Knowledge (Cidacs), Gonçalo Muniz Institute (Fiocruz/Bahia).

[2] Institute of Public Health, Federal University of Bahia, Salvador, Brazil.

[3] Brazilian University (UnB), Brasilia, Brazil.

[4] Institute of Mathematics and Statistics, Universidade Federal da Bahia, Salvador, Brazil.

[5] Department of Economics, Federal University of Bahia, Salvador, Bahia.

[6] Department of Non-Communicable Disease Epidemiology, London School of Hygiene and Tropical Medicine (LSHTM), London, United Kingdom.

[7] Health Data Research (HDR), London, United Kingdom.

[8] MRC/CSO Social and Public Health Sciences Unit, University of Glasgow, Glasgow, United Kingdom.

***Corresponding Author:** Andrêa JF Ferreira

Email: andreaferreiracv@gmail.com

Postal address: Centro de Integração de Dados e Conhecimentos para Saúde (Cidacs), Fundação Oswaldo Cruz. Edf. Tecnocentro – R. Mundo, 121 – Trobogy, Salvador – Bahia/Brazil. Postal code: 41745-715.

****Co-senior authors**

[3] Publicado na revista **BMJ Open** (Fator de Impacto em 2019 – 2.496). Doi: 10.1136/bmjopen-2020-041722

Abstract

Introduction

Social housing programmes have been shown to influence health, but their effects on cardiovascular mortality and incidence of infectious diseases, such as leprosy and tuberculosis, are unknown. We will use individual administrative data to evaluate the effect of the Brazilian housing programme *Minha Casa Minha Vida* (MCMV) on cardiovascular disease mortality and incidence of leprosy and tuberculosis.

Methods and analysis

We will link the baseline of the 100 Million Brazilian Cohort (2001-2015), which includes information on socioeconomic and demographic variables, to the MCMV (2009-2015), CVD mortality (2007-2015), leprosy (2007-2015), and tuberculosis (2007-2015) registries. We will define our exposed population as individuals who signed the contract to receive a house from MCMV, and our non-exposed group will be comparable individuals within the cohort who have not signed a contract for a house at that time. We will estimate the effect of MCMV on health outcomes using different propensity score (PS) approaches to control for observed confounders. Follow-up time of individuals will begin at the date of exposure ascertainment and will end at the time a specific outcome occurs, date of death or end of follow-up (31st December 2015). In addition, we will conduct stratified analyses by follow-up time, age group, race/ethnicity, gender and socioeconomic position.

Ethics and dissemination

The study was approved by the ethic committees from *Instituto Gonçalo Muniz* – Oswaldo Cruz Foundation and University of Glasgow Medical, Veterinary & Life Sciences College. Data analysis will be carried out using an anonymised dataset, accessed by researchers in a secure computational environment according to the Center for Integration of Data and Health Knowledge (CIDACS) procedures. Study findings will be published in high quality peer-reviewed research journals and will also be disseminated to policy makers through stakeholder events and policy briefs.

Articles Summary

Strengths and limitations of this study

1. This *will be the first study to evaluate the effect of a major social housing programme on health outcomes in a middle-income country and is likely to be the largest of its type across the world*. This would allows to assess impacts on population subgroups, including adoption of an intersectionality perspective.

2. A comprehensive assessment of health impacts is being conducted, including both infectious and Non-Communicable Diseases (NCDs).

3. Our analytical approach includes the use of Propensity Score Matching, which has the limitation of accounting for only observed variables.

4. Health and behavioural information (such as smoking status, diet and comorbidities) prior to the intervention are not available, and there is therefore a risk of residual confounding arising from inadequate comparability between exposure groups.

5. Finally, this study does not allow estimating long-term effects of MCMV on health, *especially for NCDs, such as CVD mortality, and neglected diseases, such as leprosy*, given the limited length of follow-up available (up to eight years).

Introduction

Housing is a basic human right and an important social determinant of health and well-being, which not only includes the guarantee of shelter, but also its quality [1,2]. Several studies have investigated the relationship between population health and housing conditions, most of them in high-income countries [1,3–6]. Residential instability, crowding, temperature, and substandard housing conditions (such as water leaks, poor ventilation, dirty carpets, and pest infestation) are associated with chronic and infectious diseases [1,2,7,8]. The neighbourhood in which a house is located has also been shown to be associated with health in studies in high-income countries [9]. Physical neighbourhood characteristics that have been associated with health outcomes include: green parks, schools, health services, sidewalks, public transport, sanitation, aesthetic characteristic and connectivity of the street, bike lanes, availability and relative cost of healthy foods and tobacco [5,9–11]. Less visible but also important are social neighbourhood characteristics, which include measures of social network and support, violence, and social capital, especially in vulnerable communities in high-income countries [3,4,12].

Taking into account these relationships, there is a policy expectation that housing interventions could contribute to improve health and reduce social inequalities, especially among the most vulnerable [1,5,13]. Despite this, we are aware of little or no robust evidence on the positive and negative effects of housing conditions on cardiovascular disease (CVD) and infectious diseases, such as leprosy and tuberculosis. Understanding housing impacts on health in low and middle-income countries also remains particularly poorly understood.

In Brazil, there is a double burden of infectious and chronic diseases among the poorest people and, therefore, we will evaluate the effect of Minha Casa Minha Vida (MCMV), a social housing programme, both on mortality from CVD, the leading cause of death in the country, and on infectious diseases associated with poverty, like tuberculosis and leprosy [14,15]. In Brazil, 27% of all-cause of death is attributed to CVD, with most assigned to ischaemic heart disease and stroke [16,17]. Leprosy and tuberculosis are two of the most important infectious diseases in Brazil and affect predominantly vulnerable and marginalised populations [18–20]. Brazil has the second highest leprosy incidence worldwide, with almost 30,000 cases annually [14]. Tuberculosis is also common; the country reported 72,788 new cases in 2018 and 4,534 deaths in 2017 [14].

Given the social patterning of housing access and quality in Brazilian context, housing interventions may also have important impacts on the health of disadvantaged population groups, with potential benefits for racial/ethnic minorities, women, and individuals and families of lower socioeconomic position. We therefore aim to evaluate the health effects of the Brazilian social housing program MCMV, the largest social housing program in Latin American.

Our detailed objectives are:

1. To estimate the effect of MCMV on premature cardiovascular disease, ischaemic heart disease and, cerebrovascular disease mortality;
2. To estimate the effect of MCMV on all-cause mortality;
3. To estimate the effect of MCMV on leprosy and tuberculosis incidence;
4. To investigate whether any observed effects of MCMV on cardiovascular and all-cause mortality, leprosy and tuberculosis incidence differ by population subgroups (gender, race/ethnicity, age, socioeconomic position and length of follow-up).

Methods and analysis

Study design and population

This is a dynamic, retrospective, and open cohort study that will be drawn from individuals registered in the baseline of The 100 Million Brazilian Cohort [21,22], a cohort of individuals applying for government social programmes in Brazil.

Patient and public involvement

This research was done without public involvement. Public were not invited to comment on the study design and were not consulted to develop public relevant outcomes or interpret the results, since we use an administrative and deidentified dataset and do not have permission to contact individuals. Study findings will be discussed with managers and specialists from the National Housing Secretariat from the Ministry of Regional Development and the published results will be disseminated to the public through the mass media. This study is a joint effort with the National Housing Secretariat from the Ministry of Regional Development, in order to guarantee that the findings would answer relevant policy questions. CIDACS staff are, in synergy with these key stakeholders and decision-makers, providing the

methodological rigor needed to assure sound results. Findings will be incorporated into the National Housing Plan which is currently under development in Brazil. The National Housing Secretariat from the Ministry of Regional Development will not interfere in the analysis and results from studies planned in this protocol.

Intervention

We report intervention characteristics as suggested by the TIDieR-PHP template [23]. MCMV was implemented in July 2009 by the Brazilian Federal Government [24]. Its main goals are to reduce the housing shortage in Brazil (which exceeded six million houses in 2016), with 89% of unmet need concentrated among low-income families (defined as earning less than three times the minimum wage), and improve the construction sector through job generation and wider Brazilian economic growth [24]. By 2018, the government had contracted 5,164,075 and delivered 3,787,200 million house units, resulting in over six million people receiving housing across Brazil [25].

MCMV was structured to reach families from different income classes using three distinct eligibility criteria and subsidies. In this study, we focus on Class 1 subsidies, which targets low-income families, defined as households with less than three times the minimum wage (622,0 BRL in 2010, equivalent to USD 116,25) per month. Class 1 subsidies are divided in two subprogrammes targeting either urban or rural areas. In municipalities with more than 50 thousand inhabitants, the MCMV programme uses the Residential Lease Fund (FAR-MCMV) to build or acquire new housing units. Individuals eligible for Class 1 MCMV living in municipalities with less than 50,000 inhabitants or living in rural areas receive other forms of MCMV adapted to their context. For this study, we focus on FAR-MCMV, which is the largest subprogramme of MCMV. From 2009 to 2015, we estimate that FAR-MCMV delivered over 1.2 million house units across the country [25].

Eligibility criteria for FAR-MCMV include: i) the applicant must have a household income less than or equal to three times the minimum wage (without considering other social benefits, such as income from a conditional cash transfer program); ii) not be an owner, assignee or promising buyer of a residential property; and iii) not have received any previous housing benefits or grants for the purchase of construction materials [24]. Priority criteria for FAR-MCMV include: i) living in a hazardous or unhealthy area or being homeless; ii) belonging to a family headed by a lone mother (i.e. no male partner); iii) having a disabled

person(s) in the household, with legal proof; and iv) having elderly people, aged 60 years old or over within the household [24].

Logic models

We created a logic model for each of the health outcomes studied in this protocol, informed by the existing literature, to describe the hypothesised mechanisms through which the MCMV may affect (a) CVD mortality (Figure 1), (b) leprosy new case detection (here and after, named as "incidence") (Figure 2), and (c) tuberculosis incidence (Figure 3). We identified, for each of the outcomes, pathways that are likely to operate through direct (physical house conditions) and indirect forms (housing neighbourhood effects and subjective aspects associated with house ownership).

a) Logic model for CVD mortality

The Programme may affect cardiovascular health through different pathways. Possible direct effects include changes in the physical standards of housing, leading to improvements in thermal and acoustic comfort, basic sanitation and household density reduction [2,26–28]. Indirect effects are related to the inclusion of families in new social and physical neighbourhood environments – due to the relocation process – with potentially better socio-economic, structural and physical contexts, as well as better access to basic health services [10,29,30]. On the other hand, relocation may negatively influence the social environment of the neighbourhood, since beneficiaries lose social networks and support, reducing social cohesion [3,12,31] (Figure 1).

In the short term, improvements in living conditions could enable changes in health behaviours, like physical activity, diet, alcohol and tobacco consumption [4,11]. In addition, reducing the cost of housing also provides greater access to resources which can be spent on healthier food and health care, leading to better control of cardiometabolic risk factors [32,33]. In contrast, it is possible that greater availability of income could lead to greater consumption of unhealthy products (such as ultra-processed food, tobacco and alcohol) which could in turn increase cardiovascular risk [34,35] (Figure 1).

In the long-term, the Programme could contribute to reducing chronic and cumulative exposure to psychosocial risk factors arising from inadequate housing contexts and this could potentially reduce the incidence of cardiovascular events [36,37]. The effects of the Programme on cardiovascular outcomes might be differential by age, race/ethnicity,

socioeconomic position and gender, and might contribute to the reduction of disparities in cardiovascular mortality in Brazil (Figure 1).

b) Logic model for leprosy

There is a strong relationship between housing and differential leprosy exposure [38–41]. Housing with better infrastructure and access to drinking water and adequate sanitation may improve hygiene conditions [18,42]. Reduction in household crowding leads to lower contacts among members of the family and, consequently, reduction of leprosy transmission [43,44] (Figure 2).

Access to neighbourhood amenities might improve access to health services, as well as improve community cohesion, which are important influences on leprosy risk [38,45]. Places to purchase healthy food can facilitate food security, which might result in improvements in the nutritional status of individuals and accelerate the immune response in leprosy infection [38,46] (Figure 2).

Housing ownership may give feelings of security and/or prestige. Also, it can provide greater availability of income for expenditure on potentially health-enhancing products such as food and health care [13,47–49]. It is known that access to health care is important to support strategies for self-care, case detection, timely diagnosis and treatment, and prevention of more severe forms of the disease [50,51] (Figure 2).

c) Logic model for tuberculosis

The Programme may affect tuberculosis incidence through different pathways. Better housing leads to better ventilation and overall housing conditions, such as exposure to sunlight and reduced crowding, which reduce the possibility of transmission through aerial dispersion of the bacillus [52,53]. Alternatively, we may observe beneficiaries experiencing better quality of life or socioeconomic status due to a better environment [53]. Better housing location, if accompanied by more access to public services, including health care, can alter individual susceptibility to disease and improve treatment outcomes for those already infected. On the other hand, longer distances to school and workplace may lead to physical stress, worsened immunity and predispose people to infection given exposure to Mycobacterium tuberculosis (MTB) [20,54]. Social support may also change due to the

relocation, and may affect exposure to the agent as well as disease progression [55] (Figure 3).

We expect a differential effect of this housing programme by age group as the direct effects of the housing material will be more pronounced in children, especially in the case of intradomiciliary contacts of tuberculosis cases. As people grow older and become more exposed to external environment related factors, we hypothesise the effect of the programme to be the net effect of improved housing quality and surrounding area related factors (Figure 3).

Datasets

We will link deterministically the baseline of the 100 Million Brazilian Cohort (2001-2015) [56], which includes information on socioeconomic and demographic variables, to the FAR-MCMV (2009-2015), the Mortality Information System (SIM) (2007-2015), and the leprosy (2007-2015) and tuberculosis (2007-2015) registries from the Notifiable Disease Information System [22,57,58]. The final deidentified dataset will contain information from recipients and non-recipients of the FAR-MCMV.

Sociodemographic variables

The 100 Million Brazilian Cohort includes baseline socioeconomic and demographic data from over 114 million individuals (approximately 55% of the Brazilian population in 2019). The cohort comprises people who are enrolled in the Cadastro Unico, a register containing all individuals within a household that have applied for any social programme administered by the Brazilian Federal Government [22]. We extracted individual level information (age, sex, race/ethnicity, education and occupation), household characteristics (household density, region and area of residence, household construction material, water supply, sanitation, electricity and waste disposal); and monthly per capita income for all family members [22].

Minha Casa Minha Vida Programme – FAR modality

Socioeconomic and demographic information (date of birth, gender, marital status, household monthly per capita income, name of head of household) from those who sign the

contract to receive the housing unit – the main beneficiary – is obtained from the FAR-MCMV database [22]. In addition, we will extract from this database the name and Social identification number (SIN) from those who sign the contract, the date of signature of the contract (i.e., a proxy for the time that housing unit was delivered to the family), individuals who live with the main beneficiary at that time, and the address of the housing unit or the condominium delivered [22].

Mortality Information System (SIM)

Deaths within Brazil are subject to certification by medical professionals, so the causes of death (using ICD-10 codes) can be ascertained reasonably precisely. Despite the death registry being compulsory, there is evidence of under-ascertainment of deaths, particularly within areas that are more rural and in poorest regions of Brazil [59]. Coding of CVD related causes is thought to be good, but for some analyses, corrections are needed to take account of ill-defined causes [60]. In addition, since 2010 the proportion of garbage codes, causes of deaths that should not be considered as underlying causes of deaths, had declined, and in 2015, an estimation, show that 97.2% of deaths were included in the mortality system [60]. The highest ascertainment was observed in the state of São Paulo (99.8%), located in the Southeast region, and the lowest was observed in the state of Amapá (91.2%), in the North region of the country [60]. Under-ascertainment and miscoding of deaths is known to be most problematic in older adults, as well in young children [60].

Notifiable Diseases Information System (SINAN)

Leprosy and tuberculosis notification to the SINAN disease registry is compulsory in Brazil and coded using ICD-10. The records include individuals' socio-demographic and clinical information at the time of diagnosis and treatment updates when available. SINAN has improved its quality and completeness over time [61]. However, underreported cases and missing information still happen, especially in the poorest regions of the country. Therefore, leprosy and tuberculosis reporting to the SINAN notification system is based on passive surveillance and there is therefore heterogeneity in the frequency and completeness of reporting, which may result in the true incidence of diseases being underestimated [61].

Data analysis plan

Definitions of exposure and outcomes

We will define our exposed population as individuals who signed the contract to receive the housing unit from FAR-MCMV and the household members who live with them at the time of the contract signature. If there are no household members registered at the time of contract signature, we will include household members that appear in the last update of Cadastro Único carried out up to 2 years before receipt of the house unit from FAR-MCMV.

All outcomes will be defined according to the International Classification of Diseases, version 10 (ICD-10). We will evaluate the following outcomes: i) all-cause mortality; ii) CVD mortality (I00-I99); iii) ischaemic heart disease mortality (I20-I25); iv) cerebrovascular disease mortality (I60-I69); v) incidence of leprosy (A30); and vi) incidence of tuberculosis (A15-A19). All-cause and CVD mortality will be evaluated in adults aged 30 to 69 years old (defined as premature mortality within Brazil and of particular relevance to health policy) and in adults aged 18 to 69 years old (the broader adult population with the most reliable mortality data). We will not investigate outcomes among older adults, given the known issues of ascertaining mortality for this age group within the mortality information system. The incidence of leprosy and tuberculosis will be evaluated in all age groups.

To evaluate all-cause and specific cardiovascular mortality in individuals aged 18-69 years old, the follow-up time (in years) for each individual will start at entry into the analytical cohort (i.e. on signing a contract for the intervention group or the matching date for the control group) or the age at which an individual reaches 18 years of age, whichever is later. The follow-up time will end at the first of: date of death, end of follow-up (31st December 2015) or reaching 70 years of age.

To evaluate the incidence of leprosy and tuberculosis among individuals for all ages, the follow-up time (in years) for each individual will start at entry into the analytical cohort and will end at the first diagnosis of leprosy or tuberculosis, date of death or end of follow-up (31st December 2015).

Analysis

Estimating the effect of the FAR-MCMV programme on health outcomes is challenging due to selective uptake of the intervention by individuals. To address this, we will use different propensity score (PS) approaches to identify comparable individuals (based on

observable characteristics) who did and did not receive the FAR-MCMV intervention, given individual-level characteristics [62]. Matching methods will include nearest neighbour matching using narrow callipers to minimise bias and Kernel matching [63,64]. In addition to matching methods, we will also estimate the effect of MCMV on the selected outcome using survival models weighted by the Inverse Probability of Treatment (IPTW) to estimate the average treatment effects (ATEs) and average treatment effect on the treated (ATTs) [62].

In addition, we will stratify the analyses for key subgroups of interest – namely, gender, race/ethnicity, socioeconomic position and phases of implementation of MCMV programme. We will also investigate whether effects differ across combinations of these characteristics. Specifically for leprosy, we will also stratify the analyses by residence in a high leprosy burden municipality as defined by the Brazilian Ministry of Health [65]. We will also stratify our analyses for individuals that are (and are not) beneficiaries of the Bolsa Familia Programme (BFP), one of the largest conditional cash transfer of the world [66].

Robustness checks

To check the robustness of our findings we will perform different tests. First, in the propensity score matching analysis, we will restrict our data from matching individuals with more narrow PS (different callipers). We will also restrict our analysis to certain types of municipality where data from MCMV-FAR or the mortality information system have better quality.

Sensitivity analyses

The matching strategy relies on the outcome being independent of treatment, conditional on the propensity score (Conditional Independence Assumption – CIA) [67]. However, if there are unobserved variables which affect assignment into treatment and the outcome variable simultaneously, a bias might arise. Since this assumption is non-testable by its nature, questions about the plausibility of the CIA can arise, and our results or at least their statistical significance could probably be driven by an omitted variable strongly correlated with the treatment outcome.

We will carry out sensitivity analyses to assess how strong the influence of these postulated unobservables might be in our study. We will use Rosenbaum bounds approach [68] and the sensitivity strategy proposed by Ichino et al [67]. This approach aims to assess

the bias of our estimates when the CIA is assumed to fail in some meaningful way. A failure in the CIA is equivalent to saying that the assignment to treatment is not unconfounded given the set of observable variables [67].

Ethics and dissemination

The 100 Million Brazilian Cohort study was approved by the ethics committee of Instituto Gonçalo Muniz – Oswaldo Cruz Foundation (project number: 1.612.302) and the specific aims of this project was submitted for ethical approval in the same ethics committee. In addition, the University of Glasgow Medical, Veterinary & Life Sciences College Ethics Committee also approved the study (project number: 200190001). All data are linked in a safe room with access restricted to specified people only. After the data are linked and the linkage accuracy is calculated, researchers will have full access to the deidentified dataset. The dataset will be accessed by researchers upon application to a data curation committee with a detailed analysis plan. The dataset will receive a Digital Object Identifier (DOI), and full specification of how the dataset was created will be available online. All manuscripts will be published in high quality peer-reviewed open access journals and will also be disseminated to policy makers through stakeholder events and policy briefs.

Authors' contributions: SVK, AJFF, JMP wrote the first draft of the protocol. RR, RFO, CSST, MNS, RLF, MYT, RO, EMLA, SA, PC, LS, AHL and MLB contributed with additional material. All authors reviewed the final version.

Funding statement: This research was funded by the National Institute for Health Research (NIHR) (GHRG /16/137/99) using UK aid from the UK Government to support global health research. The Social and Public Health Sciences Unit is core funded by the Medical Research Council (MC_UU_12017/13) and the Scottish Government Chief Scientist Office (SPHSU13). SVK is funded by a NHS Research Scotland Senior Clinical Fellowship (SCAF/15/02). Cidacs/Fiocruz is supported by grants from CNPq/MS/Gates Foundation (401739/2015-5), the Wellcome Trust, UK (202912/Z/16/Z). The views expressed in this publication are those of the authors and not necessarily those of the NIHR, the UK Department of Health, CNPq/MS/Gates Foundation and the Wellcome Trust.

Competing interest's statement: The authors declare no competing interests.

Data availability statement: All data relevant to the study are included in the article or uploaded as supplementary information.

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Figure 1: Logic model to evaluate the effect of Minha Casa Minha Vida on reduction of cardiovascular mortality.

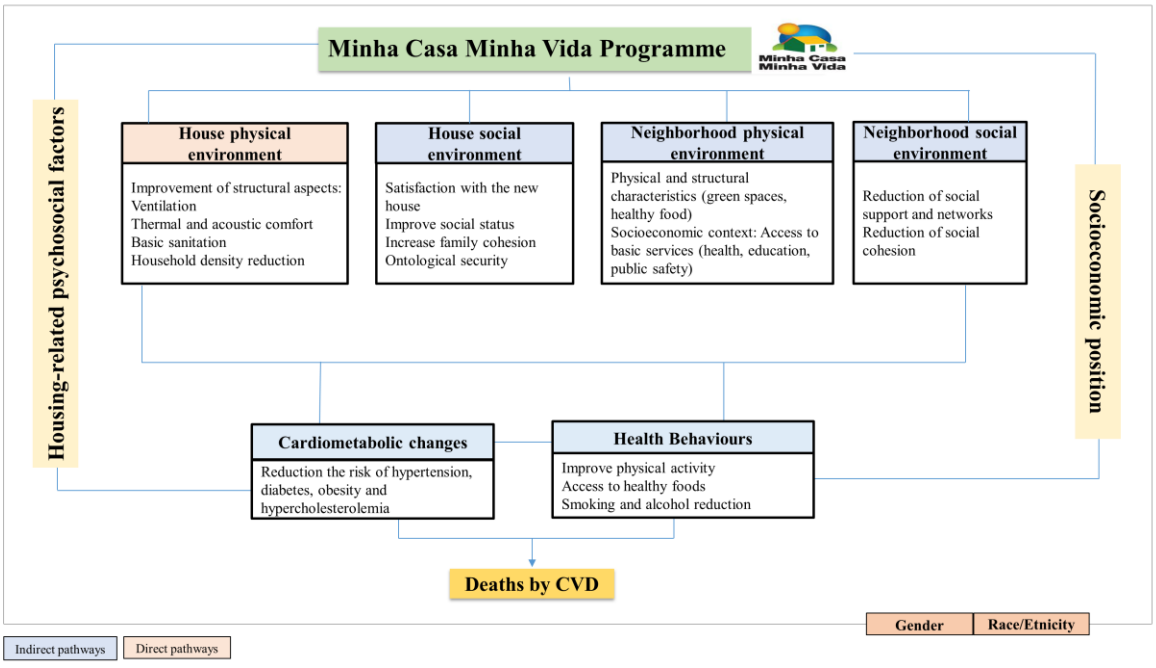


Figure 2: Logic model to evaluate the effect of Minha Casa Minha Vida on Leprosy Incidence.

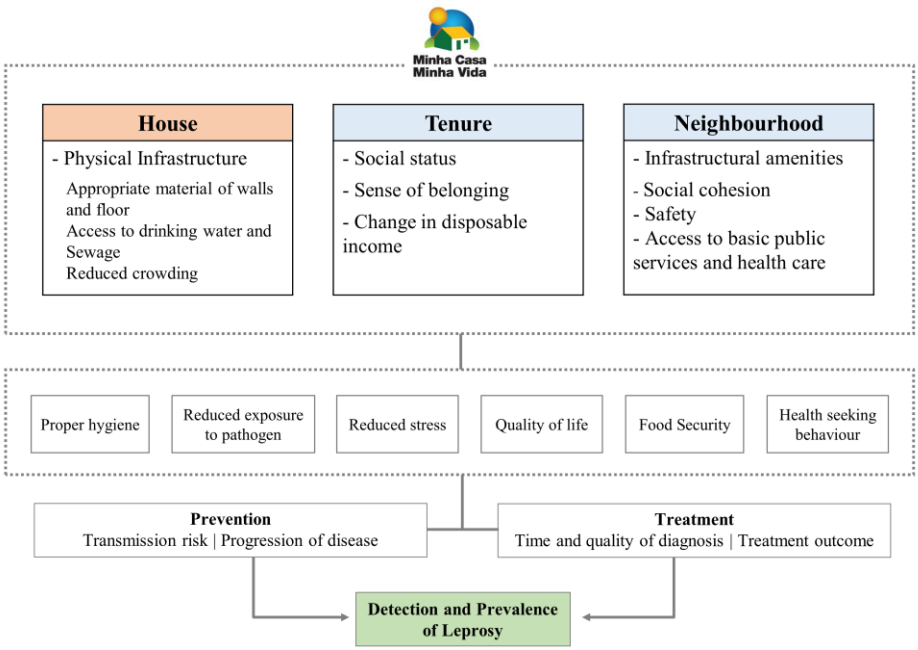
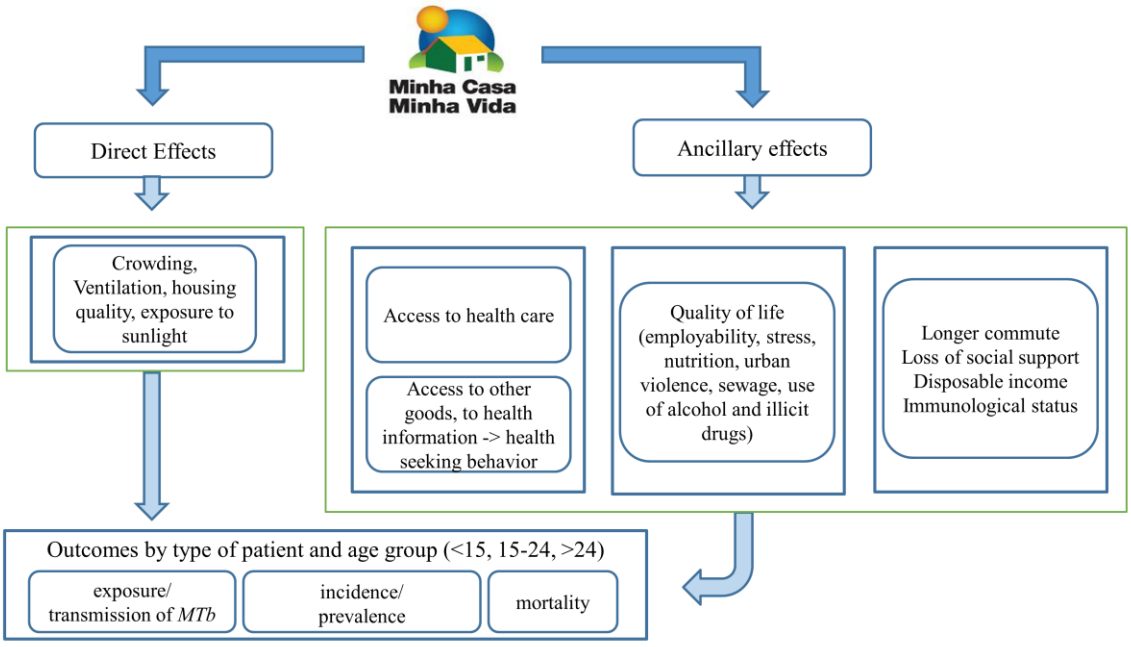


Figure 3: Logic model to evaluate the effect of Minha Casa Minha Vida on tuberculosis incidence.



5.3 Artigo 3. Effect of social housing programme, *Minha Casa Minha Vida*, on the risk of premature cardiovascular mortality among vulnerable and underprivileged: a population based nested case-control study[4].

Abstract

Background: Public interventions, as social housing programmes, can improve health outcomes, but until now few studies have assessed the effects of housing on CVD mortality, the leading cause of death in Brazil and worldwide.

Objective: To investigate the effect of a social housing programme, *Minha Casa Minha Vida* (MCMV), on the risk of premature CVD mortality.

Methods, setting, and participants: We performed a nested case-control study with individuals aged 30 to 69 years that were registered in the 100 Million Brazilian Cohort between 1st Jan 2010 and 31st Dec 2015. We defined cases as individuals who died by any CVD cause, and controls as those who were alive in the study cohort on the same time window that a death happened. Social housing programme, MCMV, defined at the date of signature of the housing contract.

Analysis: We matched premature CVD deaths to two controls that have not died within the same time after registering within our cohort (i.e., in the same month) and exact matched by age, gender, race, education, Brazilian region of residence and receipt of other social benefits. Matching was done without replacement. We performed conditional logistic regression to calculate the odds ratio (OR) of premature mortality between recipients and non-recipients of MCMV.

Main Results: A total of 8,056,442 individuals from 30 to 69 years (median age, 41 (32-53) years), contributed with 21910579 person-years of observation in the 100 Million Brazilian cohort study from 2010 to 2015, during six (median 2.7 (1.33-3.95) years of follow-up. We matched 34,294 premature CVD deaths to 68,588 controls. MCMV social housing recipients presented a higher risk (OR=1.22; 95% CI=1.11-1.35) of dying prematurely of CVD compared to non-recipients before adjustment. A slightly decrease on the risk of dying of premature CVD (OR =1.18; 95% CI = 1.07-1.30) was observed, after further adjustment for household family characteristics and municipality size, as well as in the sensitivity analysis, with only individuals from municipalities with higher HDI (OR=1.16; 95% CI = 1.03-1.30).

Author`s Conclusion: Social housing programme, MCMV, was not associated with lower risk of premature CVD mortality among individuals included in our study. This might be the result of the short time of follow-up and the previous detrimental health conditions of the recipients of MCMV. Further studies with large time of follow-up and information related to individuals' health conditions should be perform, as well as the exploration of other pathways related to health and housing, such as neighbourhood characteristics.

Keywords: Cardiovascular diseases, leprosy, tuberculosis, social housing, social protection, social policies, natural experiment.

[4] Será submetido na revista **American Journal of Public Health** (Fator de Impacto em 2019 - 6.464).

Introduction:

Housing is a basic human right and a key social determinant of health [1,2]. A house offers more than a physical space to live, it offers security, privacy, and the possibility to enhance relationships with the family and the community [1]. Thus, the housing conditions that affects health include three constructs: i. the house, as a dwelling unit with a physical structure, ii. the home, as a social and cultural space, and iii. the neighbourhood, which considers the surrounding environment of occupants and the services presents in the community [2–4]. Despite the importance of housing as one of the main social determinants of health, there has been little research on the topic, particularly in low- and middle-income countries (LMICs) [1,2].

More than 1.8 billion people across the world still live in substandard housing conditions [1]. In Brazil, despite the improvements of sanitation, electricity, water supply access in the past decades [5], higher amounts of people still live in substandard housing due to unavailability or unaffordability of adequate houses [6]. Between 2010 to 2015, more than six million people were estimated not having a adequate house to live in Brazil, and housing shortage was highly concentrated in urban areas (87.7%), particularly, in the Northeast and Southeast regions [6]. To reduce the shortage of housing and to increase the access to affordable housing, the Brazilian Federal Government launched the social housing programme *Minha Casa Minha Vida* (MCMV), that aims to subsidize adequate housing to most vulnerable and underprivileged groups in the country [7]. Since the launch, in 2009, more than one million houses have been provided to those families, being the largest subsidized social housing programme in Latin America [7].

Cardiovascular disease (CVD) is the leading cause of death worldwide [8], and represents 27% of all deaths registered in Brazil [9]. While there is evidence of the effect of social housing and specific housing conditions on health, including respiratory disease, injuries, and mental illness, [2,4], most of them come from high-income countries (HICs), and few studies have assessed the effects of housing on cardiovascular disease (CVD) morbidity [3,10,11] or mortality [12–14].

To fill this gap on the literature, we estimated the association between receiving MCMV and premature CVD mortality. We hypothesized that cardiovascular health outcomes, measured by CVD mortality, of vulnerable individual's recipient or not of social housing

programme are different from each other, being better for those living in subsidized social housing, considering that housing types have different physical and social characteristics, as well as neighbourhood characteristics and spatial locations within the city.

Methods

Study design, data source and population

We draw a nested case-control study from the 100 Million Brazilian Cohort, a dynamic cohort constructed from large-scale administrative linked data [15]. The 100 Million Brazilian Cohort aims to enhancing the understanding of the effect of social protection policies, such as cash transfer and social housing programmes, on health outcomes in low-income individuals, defined as those who earning less than three times the minimum wage. The study baseline contains demographic, socioeconomic, and household data from CadUnico database, which includes individuals eligible to receive benefits from governmental social protection programmes [15]. From 2001 to 2015 more than 114 million people was registered in CadÚnico and enrolled in the cohort [15].

The baseline of cohort was linked probabilistically to health databases, such as the Mortality Information System (*Sistema de Informação da Mortalidade* - SIM, in Portuguese), using a set of common attributes presented in both systems (e.g. name, gender, mother's name, date of birth and municipality code) since there were no common unique keys between both. From national Mortality Information System we retrieved information regarding the cause and date of death, using information from a medical death certificate, signed by a doctor [15–17]. After this, we linked the data deterministically to social housing programme, MCMV, database through a common unique key - the Social Identification Number (NIS) [15]. The MCMV database presented information regarding date of signature of housing contract, the holder and cohabitants of the new house, as well as the location of the new house at municipal level. Analysis of linkage accuracy were performed, and included manual verification and assessing the Receiver Operating Characteristic curve [15,17,18]. All details of data source used in this study and linkage process were reported elsewhere [15–17].

Identification of the study cohort

We identified individuals aged 30 to 69 years, registered in the 100 Million Brazilian Cohort between 1st January 2010 and 31st December 2015 (N=8,056,442). All individuals identified on these age strata were followed the date of application until they died or until the end of the study, i.e., on 31st December 2015, whichever date comes first.

Exposure

In our study, the exposure status was classified as two mutually exclusive categories: those who are recipients and non-recipients of MCMV, a subsidized social housing programme, implemented in July 2009 by the Brazilian Federal Government, and structured to reach families from different income classes [7]. In this study, we focus on the social housing subprogramme that use Residential Lease Fund (FAR) to build or acquire new housing units as our main exposure [7]. FAR is the largest subprogramme of MCMV, that aims to subsidized new houses unit to low-income families, defined as households with less than three times the minimum wage (622,0 BRL in 2010, equivalent to USD 116,25) per month (without considering other social benefits, such as income from BFP) [7]. Other eligibility criteria for this subprogramme include: i) living in urban areas of municipalities with more than 50 thousand inhabitants; and ii) not be an owner, assignee or promising buyer of a residential property, as well as received any previous housing benefits or grants for the purchase of construction materials [7]. In addition, the subprogramme has some priority criteria, including: i) families who living in a hazardous area or being homeless; ii) belonging to a family headed by a lone mother (i.e. no male partner); iii) having a disabled person(s) in the household, with legal proof; and iv) having elderly people, aged 60 years old or over, within the household [7]. More information related to MCMV programme and data was described in a previously publication [15,16].

We based our exposure classification on the date of signature of the housing contract for cases and controls, and we established the MCMV exposure status of cases and controls before the case index date. We classified as non-recipient of MCMV, individuals whose house were not related to any recipient of social housing benefit, but still eligible to receive a social housing from the Federal Government, considering the MCMV criteria mentioned above.

Measurement of Covariates

Baseline sociodemographic indicators (age, gender, race, and education) and geographic information (region) for all individuals were extracted. Besides, we retrieved family living conditions (household construction material, water supply, sewage, and counter electricity in the household) and information from recipient or not of BFP [15]. Also, we used population size of the Brazilian municipality [19], in 2010, and we organized all the municipalities in four categories: i) below 50 thousand inhabitants; ii) from 50 to less than one hundred thousand inhabitants; iii) from one hundred thousand to five hundred thousand inhabitants; and iv) those with equal or more than five hundred thousand inhabitants. The income domains of Human Development Index (HDI) at municipal level was also used in the analysis, considering three categories: high (≥ 0.700), intermediate (0.600-0,699)and low (≤ 0,599) HDI level [19].

Definition of cases and controls

Cases were defined as deaths by any CVD cause (codes I00-I99, International Classification of Disease, 10th Revision - ICD-10) [20]. As it would be too computational expensive to define controls on a daily basis, we defined time windows of one month from the date of application of each individual in the cohort. Controls were then defined as individuals that were alive in the study cohort on a same time window that a death happened, i.e., were "at risk" of becoming a case on the same cohort month when the case occurred [21]. To control for potentially confounders in the association between the main exposure and the outcome, we also required cases and controls to have similar socioeconomic and demographic characteristics [21,22].

To perform an optimal unbiased selection of controls, a given cohort member selected as a control for a case on one date (risk set) could not become a control for another case occurring on a later index date, despite a control could subsequently become a case [21]. This method has slightly greater statistical efficiency than the alternative of randomly sampling, with replacement, from the entire risk set [21]. We excluded potential cases and controls if they were not enrolled on the index date or died for other causes [21].

Analysis

For every case, we randomly selected two controls, without replacement of non-case members of the risk set for each case, considering an eligible pool of individuals under

observation in the study period [21]. After this, we matched them considering factors based in prior literature: age, gender, race, education level, region, and recipient of BFP [23], to avoid potential overmatching caused by inappropriate selection of matching factors, which may harm the statistical efficiency of the analysis [21]. Among the matching factors, only age was continuous variable. The other five matching variable were categorical.

The covariate balance before and after matching was assessed using the standardized mean difference, and meaningful imbalances between groups were determined when the standardized difference was greater than 0.1 [24].

Conditional logistic regression was used to calculate the odds ratio (OR) and the 95% confidence intervals (95% CI) of the effect of MCMV on premature CVD mortality in the matched sample. The OR controlled for the matched covariates (model 1) was calculated along with further adjustment for family living conditions (model 2), and size of municipality (model 3). Only covariates with p-value <0.1 in model 2 was accounted in model 3. For robustness check, we perform the same model and adjustment, considering only the municipalities with higher level of HDI. All analyses were performed with Stata version 15. We defined tests with 2-sided p-value < 0.05 as significant in the final model.

Patient and public involvement

This research was done without public involvement. Public were not invited to comment on the study design and were not consulted to develop public relevant outcomes or interpret the results, since we use an administrative and deidentified dataset and do not have permission to contact individuals.

Ethical approval

The 100 Million Brazilian Cohort study was approved by the ethics committee of Instituto Gonçalo Muniz – Oswaldo Cruz Foundation (project number: 1.612.302) and the specific aims of this project was submitted for ethical approval in the same ethics committee. In addition, the University of Glasgow Medical, Veterinary & Life Sciences College Ethics Committee also approved the study (project number: 200190001). Individual requirement for informed consent was waived because only registry data was used.

Results

A total of 8,056,442 individuals from 30 to 69 years (median age, 41 (32-53) years) contributed with 21910579 person-years of observation in the 100 Million Brazilian Cohort study from 2010 to 2015, with a median of follow-up of 2.7 (1.33-3.95) years. In the cohort 2.89% (N=232,748) of study population was recipient of MCMV programme. Demographic and geographic characteristics and family living conditions of the cohort study population in this period are described in supplementary material (Table S1). The cumulative incidence of premature CVD mortality was higher among recipients compared to non-recipients of the social housing programme during the study period (Figure S1). From this cohort, we identified 34,294 cases of premature CVD deaths, median age, 58 (50-63) years, and 68,588 matched controls, median age of 55 (50-61) years (Table 1). We excluded 442 cases who did not meet the enrolment criteria (i.e., deaths occurred at the same date of the begin of the cohort) (Figure 1).

The distributions of all the matching covariates (age, sex, race, Brazilian living region, education, and recipient of BFP benefit) between cases and controls are balanced (SMD<0.1). The same occurs for the other geographic characteristics and family living conditions include in the study (Table 1). Most of cases (59,72%) and controls (57,14%) are from municipalities with huge size - more than one hundred thousand inhabitants. However, those who died of CVD (cases) had slightly less access to inadequate water supply (9.02 vs 8.77%) and no counter or electricity in household (7.21% vs 6.11%) than the control group (Table 1). The same pattern was observed for those whose household construction material was wood, vegetal or other material (11.46% vs 10.27%). The distribution of the sociodemographic and geographic characteristics and family living conditions of recipients and non-recipients of MCMV, according to case and control group was presented in Supplementary material (Table S2).

Model 1 showed the association of social housing programme and premature CVD mortality after matching for selected covariates. Recipients of social housing programme presented a higher risk of dying of premature CVD (OR = 1.22, 95% CI=1.11-1.35) compared with non-recipients. Similarly, after further adjustment for family living conditions (sewage, water supply, household material construction and counter for electricity), in model 2, and for size of municipality, model 3, we observed a small reduction in the risk of dying of premature CVD between the recipient of MCMV (OR = 1.18, 95% CI 1.07-1.30) compared with non-

recipient (Table 2). The same results were observed when we performed the same adjusted models, considering only cases and controls from municipalities with high HDI (OR = 1.16, 95% CI=1.03-1.30).

Discussion

This population-based study included a large-scale and representative sample of low-income individuals in Brazil. We found that the risk of dying from premature CVD mortality was greater among recipients of MCMV, even after adjustment for prior family living condition and size of municipality, which are not in line with our initial hypothesis.

Despite the broad literature related to the effect of housing on CVD behaviours [3,25,26], risk factors [3,11], and cardiovascular morbidity [3,11,27,28], few studies explored this effect on CVD mortality [13,29]. Until now, we did not find studies in Brazil or other LMICs that assess the association between social housing programmes and CVD mortality. From HICs, few studies explored this topic [13,14]. Results from a cohort study in Portugal, reveals that people living in substandard housing, called *Ilhas*, showed a 2.4 times higher risk of dying of CVD compared with those living in conventional housing, even after accounted for socioedemografic characteristics and traditional cardiovascular risk factors [14]. The same occurs for residents of social housing (OR=1.29; 95%CI: 0.69-2.28) [14]. The magnitude of the association of these results are similar to our findings, however with a statistically significant difference between both groups in our study.

Although the premise behind the development of social housing was to guarantee adequate housing to vulnerable and unprivileged individuals [7,30], studies have shown a significant association between residing in social housing and poor health, including higher risk of obesity [11,31], hypertension [11], and diabetes [31,32], all of them important CVD mortality risk factors [8,23]. The explanation for those findings is probably multifactorial and complex and might be related to previously health and socioeconomic conditions of the recipients of social housing programme and with psychosocial stress pathways, as pointed out by previous studies [14,33,33,34].

The shortage of housing in Brazil, particularly among vulnerable and underprivileged [6], is chronically and higher, making families living in substandard housing for extend periods of time. In this sense, we suspect that individuals who receive the new houses were those who have been living in a more vulnerable context, and therefore presented a

detrimental health condition prior the recipient of the social benefit, which might increase a variety of health risk, such as poor mental health, injuries and chronic diseases, as CVD [33]. Therefore, despite the longitudinal study design and control for current demographic and socioeconomic conditions, we cannot fully separate what is the effect of living in the social housing from the effect of early life health and living conditions, in particularly, considering the short time of follow-up, and the nature of our outcome.

Additionally, studies highlight the psychosocial stress as another pathway that might help to understand the results since it is a well-established risk factor for CVD mortality [34,35]. In the context of MCMV, the relocation of the social housing beneficiaries in a different place in which the family currently live, as well as the family insertion in a new neighbourhood and community could influence negatively the social cohesion due to the loss of social networks and support [27,35]. This forced moved and disruption of social ties can improve conflicts and violence in the new neighbourhood, increasing psychosocial stress, particularly among the oldest [35,36].

Besides, the places where housing complexes have been built - mostly in the peripheral regions of large urban centers [37,38], tend to present neighbourhoods with poor social and physical characteristics and higher-poverty levels, in particularly, in municipalities with huge population size. Those negative aspects of neighbourhood have been associated with increased risk of CVD and all-cause mortality in studies from USA [12,13,27]. Moreover, a broad literature, support the role of evidence that poor neighbourhood characteristics are associated with development and worsening of cardiometabolic risk factors [3,26,28], reducing access to health services and screening for chronic diseases [3,26], as well as increase of chronic stress [34,35]. In Brazil, previous studies shown that recipients of MCMV have been reported poor access to basic services, as health, public transportation, parks and schools, after moving to social housing [30,37,39]. Also, they reported reduced use of bicycles and walking, and increased of travel time after moving to the new housing, which could influence negatively CVD health outcomes [38–41].

The absence of information regarding the quality and physical structure of the environments inside the MCMV houses (e.g., ventilation and indoor air pollution), as well as the neighbourhood condition, should be explored in future studies, since the initial planning of the MCMV programme did not present a concern with those aspects, particularly the last one. Only in 2013, after civil society demands, Federal Government become mandatory the

requirement to build public schools, parks and health services in social housing complexes with more than 500 houses units, as well as the offer of social services to improve the relationship among new residents [7]. However, not all housing complexes of this size fulfilled this requirement, which highlight the need to further improve the physical and social environments around these social buildings, as well as the exploration of those information in future studies [7]. Besides, we suggested that other pathways beyond those mentioned above should be further investigated considering the MCMV context, namely the urban violence in the neighbourhood around social housing units [39,41], the cost of living in the new house on family income, considering the monthly budget for housing mortgage, and the cost of transportation [38,41] and employments opportunities [38,40,41], since social houses are far away of urban centers.

Also, other multiple psychosocial factors related to social housing conditions, such as housing tenure, stigma, and housing stability might be explored in studies related to MCMV, based in previous studies carry out in HICs [42–44]. Therefore, increase the socio-economic, structural, physical and social contexts, as well as better access to basic health services around the social houses complexes might play an important role in prevention of CVD, considering that housing is an important social determinant of CVD health outcomes [1,3]. Despite these, there is a need to further examine how housing quality and conditions may affect CVD behaviours and risk factors that contribute to the development of CVD, as well as improve design interventions that address multiple features of housing to better understand how it contribute to cardiovascular health or increased cardiovascular risk factors that shape iniquities among social groups [3].

Strength and limitation

The key strength of our study is the use of nationally representative population sample of the most vulnerable in Brazil, enabling the examination of risk of dying from premature CVD mortality, the leading cause of death in Brazil. The representativeness of cases and controls improved both the internal and external generalisability of the findings in this population context, particularly in LMICs. Besides, to our knowledge, this is one of the first study to assess the association among social housing programme and CVD mortality in a large scale. Also, considering the low incidence of the outcome in the cohort study (0.43%), especially among the exposure group (0.3%), perform a nested case-control is an opportunity

to study this association. Also, our cases and controls were well matched on age, sex, race, education, region and recipient of BFP, making this an effective design to assess different exposure to housing types on risk of CVD mortality in a LMIC.

Our study presented a number of potential limitations that need to be discussed since they may have influenced the results. First, the absence of information related to CVD behaviours and risk factors, such as tobacco and alcohol consumption, diet quality, hypertension, type 2 diabetes, excess body weight and physical activities, on the baseline, as well as previous CVD morbidity, did not allow us to explore the role of these outcomes in CVD mortality among cases and controls. Although we have matched and adjusted for several confounding variables, some residual confounding attributable to unaccounted socio-economic variables (e.g., tenure status, income) and unmeasured indoor and outdoor environmental factors (e.g., pollution, access to basic services) might still presented.

Second, we speculated that the short time of follow-up might interfere in our results since we have only six year of follow-up, and the observed association could not be a direct consequence of living in a social housing. Future studies with more time of follow-up should be performed to better understand the role of MCMV on CVD mortality, since it is expected that social housing intervention could help to reduce chronic and cumulative exposure to psychosocial risk factors arising from prior inadequate housing contexts and this could potentially reduce the incidence of cardiovascular events.

Third, we did not have access to the precisely date that individuals move to the new house. Possible delayed to move might occur in the whole country, particularly among small municipalities. This could influence the results, despite we adjusted the final analysis by size of municipality. Also, we do not have information regarding the permanence or not of those families in the new house, which could influence our results.

Forth, despite the relocation process and importance of neighbourhood characteristics on CVD health outcomes, these pathways could not be analysed regarding the absence of information. Thus, we are not allowing to analyse the effect of changes in neighbourhood physical and social context on premature CVD mortality. More research is needed to better understand the characteristics of the new neighbourhood that beneficiary of MCMV are exposed, as well as the effect of environmental changes, and which neighbourhood characteristics (e.g. healthy food stores retail, recreational facilities, greenness, walkability,

safety, social cohesion) are most important for improving cardiovascular health of MCMV recipients.

Finally, underestimation of CVD mortality in our study could occur since we used administrative data from SIM without correction for garbage code as suggested by Malta [45]. In future analysis, correction of mortality data should be take into account to avoid potentially bias.

Conclusion

The social housing programme, MCMV, has not impacted, as expected, on premature CVD mortality since we found a higher risk of death among recipients of the programme compared to non-recipients. However, these results need to be viewed with caution regarding the short time of follow-up of our study, the potentially previous worst health conditions of those recipients of the programme, as well as the limited information related to date of move to the new house and the lake of information regarding of the neighbourhood characteristics.

Future studies with more time of follow-up should be perform to better understand the effect of social housing in cardiovascular health outcomes, considering the scarcity of studies particularly in LMIC and with outcomes such as mortality. Also, potential pathways related to housing, such as housing structure, the aspects related to home and family, as well as the neighbourhood effect should be taken into account when social housing intervention was planned, as well as the relocation process, considering the role of those pathways in cardiovascular health. Thus, it is important to guarantee affordable housing or relocation programmes that do not disconnect people from social (family, childcare support etc.), economic (employment, businesses), education (schools) and health (hospitals and primary health care) networks.

Additionally, we suggested that social housing programmes, as MCMV, despite the guarantee of access and affordability to high-quality standard housing, should integrated the new houses complexes in a healthy neighbourhood, since the positive effect of adequate housing conditions on cardiovascular health. Besides, those pathways should be addressed in future studies related to MCMV, as well as this information should be collected to better inform future public policies. Also, more integrative approaches between social housing

intervention with other social protection programmes and health interventions could contribute to reduction of health inequities, particularly among the vulnerable and unprivileged, as well as increase the chance to target the SDG for CVD until 2025.

Availability of data and materials: The data that support the findings of this study are available from Cidacs team data curation. All data was linked in a safe room with access restricted to specified people only. After the data was linked and the linkage accuracy was calculated, researchers have full access to the deidentified dataset. The dataset has been accessed by researchers upon application to a data curation committee with a detailed analysis plan. The dataset received a Digital Object Identifier (DOI), and full specification of how the dataset was created could be available online when required. Restrictions apply to the public availability of these data, which were used under license for the current study, and so are not publicly available

Acknowledges: We thank the CIDACS team for all data linkage and curation process, the Brazilian Federal Government and the Ministry of Health and City for providing all databases. The author also thanks to CNPq/Brazil for the PhD scholarship.

Funding statement: This research was funded by the National Institute for Health Research (NIHR) (GHRG /16/137/99) using UK aid from the UK Government to support global health research. Cidacs/Fiocruz is supported by grants from CNPq/MS/Gates Foundation (401739/2015-5), the Wellcome Trust, UK (202912/Z/16/Z). The views expressed in this publication are those of the authors and not necessarily those of the NIHR, CNPq/MS/Gates Foundation and the Wellcome Trust. Andrêa Jacqueline Fortes Ferreira has a PhD scholarship from CNPq/Brazil (Number 141966/2017-3).

Contribution: AF, JMP, CSST, RLF and RCRS designed the study. AJFF analysed the data and wrote the first draft. AF, CSST, JP, and RLF provided further data analyses and interpretation. RCRS, RLF, JP and MB advised the study and revised the manuscript. All authors have approved the final version of the manuscript.

Competing interest's statement: The authors declare no competing interests.

Data availability statement: All data relevant to the study are included in the article or uploaded as supplementary information.

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Tables and Figures

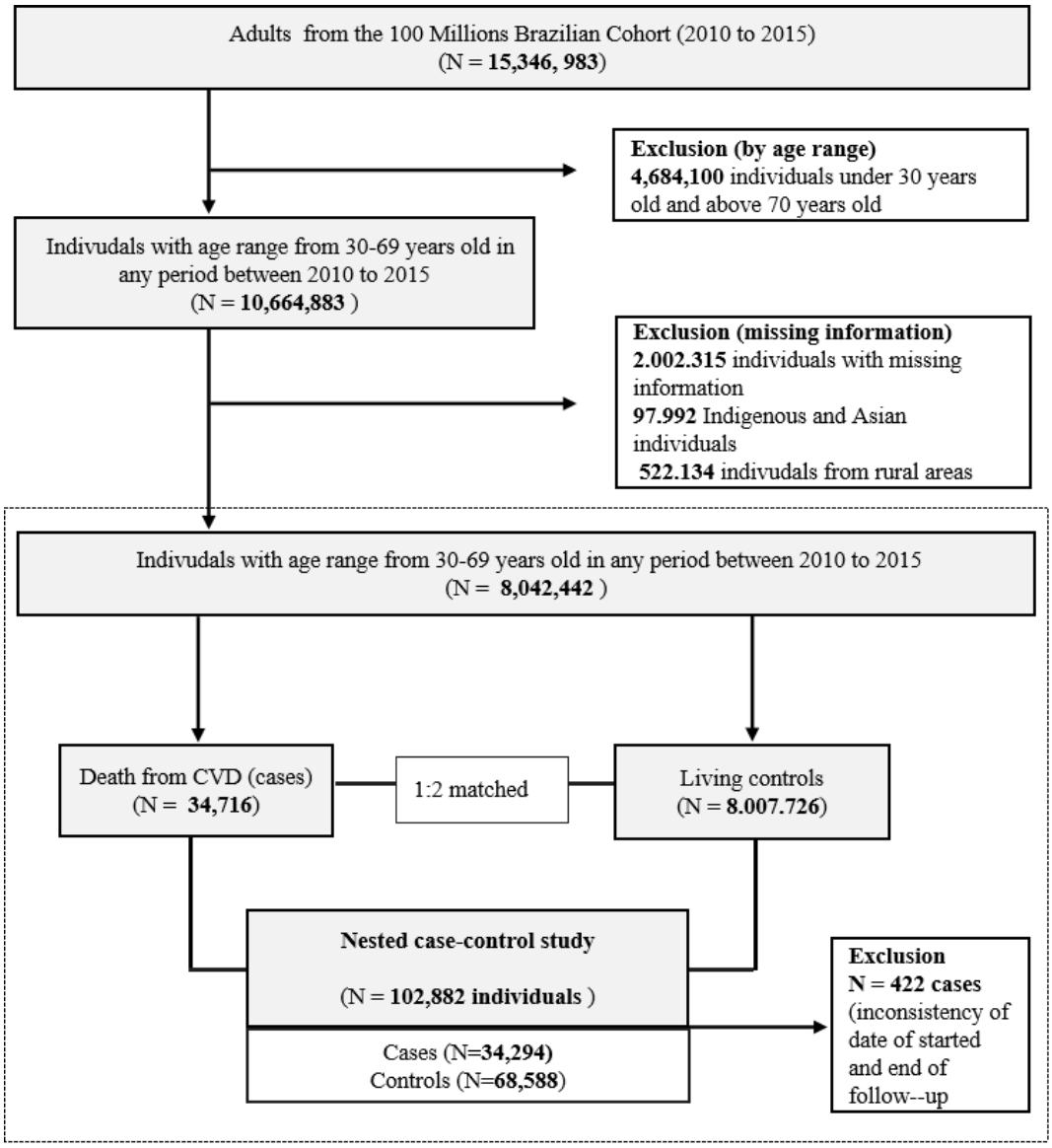

Figure 1. Selection of the study participants, 2010-2015.

Table 1. Baseline characteristics between cases and matched controls for premature CVD mortality, 2010–2015.

Characteristics	Cases (N=34,294)		Controls (N=68,588)		Total (N=102,882)		
	n	%	n	%	n	%	SMD
Sociodemographic							
Gender							
Female	14,627	42.65	29,254	42.65	43,881	42.65	<0.001
Man	19,667	57.35	39,334	57.35	59,001	57.35	
Age strata at baseline							
20-29	313	0.91	626	0.91	939	0.91	
30-49	7,874	22.96	15,748	22.96	23,622	22.96	<0.001
50-69	26,107	76.13	52,214	76.13	78,321	76.13	
Age at baseline, y	58 (50-63)		55 (50-61)		56 (50-62)		<0.001
Age at end of study, y	60 (52-65)		60 (53-65)		60 (53-65)		<0.001
Race							
Black	3,811	39.65	7,622	11.11	11,433	11.11	<0.001
Mixed/Brown	16,885	49.24	33,770	49.24	50,655	49.24	
White	13,598	39.65	27,196	39.65	40,794	39.65	
Education Level							
Never go to school	6,720	19.60	13,440	19.60	20,160	19.60	<0.001
Primary school (≤5y)	17,880	52.14	35,760	52.14	53,640	52.14	
Secondary school (≤9)	9,305	27.13	18,610	27.13	27,915	27.13	
High school (≥10y)	389	1.13	778	1.13	1,167	1.13	
Social protection programme							
Benefit of BFP							
Yes	13,303	38.79	26,606	38.79	39,909	38.79	0.009
No	20,991	61.21	41,982	61.21	62,973	61.21	
Benefit of MCMV							
Yes	685	2.00	1,122	1.64	1,807	1.76	0.027
No	33,609	98.0	67,466	98.36	101,075	98.24	
Geographic							
Size of municipalities (Inh.)							
Under 50 thousands	9,919	28.92	21,354	31.13	31,273	30.40	0.054
50 ├ 100 thousands	3,893	11.35	8,040	11.72	11,933	11.60	
100 ├500 thousands	9,672	28.20	18,602	27.12	28,274	27.48	
≥ 500 thousands	10,810	31.52	20,590	30.02	31,400	30.52	
Missing	-	-	2	0.00	2	0.00	
Region, %							
North	1,579	4.60	3,158	4.60	4,737	4.60	<0.001
Northeast	6,513	18.99	13,026	18.99	19,539	18.99	
Midwest	3,524	10.28	7,048	10.28	10,572	10.28	
Southeast	17,715	51.66	35,430	51.66	53,145	51.66	
South	4,963	14.47	9,926	14.47	14,889	14.47	
Family living condition							
Sewage							
Public network	27,397	79.89	54,755	79.83	82,152	79.85	≤0.001
Septic tank/ditch/other	6,897	20.11	13,833	20.17	20,730	20.15	
Water supply							
Public network	31,199	90.98	62,573	91.23	93,772	91.15	0.008
Well/natural source/other	3,095	9.02	6,015	8.77	3,095	8.85	
Counter for electricity							
Yes	31,821	92.79	64,396	93.89	96,217	93.52	0.038
No counter/electricity	2,473	7.21	4,191	6.11	6,664	6.48	
Missing	1	0.00	-	-	1	0.00	

Household construction material							
Bricks or cement	30,364	88.54	61,544	89.73	91,908	89.33	0.044
Wood/vegetal and other materials	3,930	11.46	7,043	10.27	10,973	10.67	
Missing	1	0.00	-	-	1	0.00	

Data are percentages or median (interquartilic range), unless otherwise specified. BFP: Bolsa Familia Programme; MCMV: Minha Casa Minha Vida Programme with Residential Fund Release;SMD: Standardised mean difference. Hab: inhabitants;

Table 2. Premature CVD mortality risk among recipients and non-recipients of MCMV (N=102,882), 2010-2015.

	Model 1 [*]	Model 2 [†]	Model 3 [‡]
	OR (95%CI)	**OR (95%CI)**	**OR (95%CI)**
MCMV			
Recipients	1.22 (1.11-1.35)	1.21 (1.10-1.33)	1.18 (1.07-1.30)
Sewage			
Septic tank/ditch/other		0.98 (0.94-1.01) [a]	-
Water supply			
Well/natural source/other		1.00 (0.95-1.05) [a]	-
Household construction material			
Wood/vegetal and other materials		1.14 (1.09-1.20)	1.16 (1.11-1.22)
Counter for electricity			
No counter/electricity		1.189 (1.12-1.25)	1.15 (1.09-1.22
Municipality size (thousands Inh)			
50 ├ 100			1.04 (1.00-1.09) [a]
100 ├500			1.13 (1.09-1.17)
≥ 500			1.14 (1.10-1.18)

[*]Odds ratio and 95% confidence adjusted inherently for age, race, gender, education, Bolsa Familia recipient, and region in the matching design;
[†]Model 2 was adjusted by household characteristics, including water supply, sewage, household construction material, and counter for electricity;
[‡]Covariates in model 3 are adjusted for covariates from model 2 with p<0.1 and for municipality size;
p-value ≤0.001;
[a] p-value ≥0.05
N: number; Inh: inhabitants;

Table 3. Premature CVD mortality risk among recipients and non-recipients of MCMV living in municipality with higher HDI (N=66,951), 2010-2015.

	Model 1 [*]	Model 2 [†]
	OR (95%CI)	**OR (95%CI)**
MCMV		
Recipients	1.17 (1.05-1.32)	1.16 (1.03-1.30)
Household construction material		
Wood/vegetal and other materials		1.21 (1.13-1.28)
Counter for electricity		
No counter/electricity		1.17 (1.10-1.25)

[*]Odds ratio and 95% confidence adjusted inherently for age, race, gender, education, Bolsa Familia recipient, and region in the matching design;
[†]Model 2 was adjusted by household characteristics, including household construction material, and counter for electricity;
[‡]Covariates in model 3 are adjusted for covariates from model 2 with p<0.1 and for municipality size;
p-value ≤0.001;
N: number; Inh: inhabitants;

Supplementary material

Table S1. Demographic, family living conditions, and geographic characteristics of the 100 Million Brazilian Cohort according to recipient of MCMV, 2010-2015.

Characteristic	MCMV						SMD
	Recipient (N=232,748)		Non- Recipient (N=7,823,694)		Total (N=8,056,442)		
Sociodemographic	**n**	**%**	**n**	**%**	**n**	**%**	
Gender							
Female	140,801	60.50	4,361,108	55.74	4,501,909	55.88	0.096
Male	91,947	39.50	3,462,586	44.26	3,554,533	44.12	
Age strata, y							
21-29	44,497	19.12	999,927	12.78	1,044,424	12.96	0.241
30-49	134,974	57.99	4,312,791	55.12	4,447,765	55.21	
50-69	53,277	22.89	2,510,976	32.09	2,564,253	31.83	
Race							
Black	23,311	10.02	626,917	8.01	650,228	8.07	0.095
Mixed/Brown	127,034	54.58	4,127,116	52.75	4,254,150	52.80	
White	82,403	35.40	3,069,661	39.24	3,152,064	39.12	
Education Level							
Never go to school	13,487	5.79	620,422	7.93	633,909	7.87	0.166
Primary school (≤5y)	66,912	28.75	2,700,404	34.52	2,767,316	34.35	
Secondary school (≤9)	143,414	61.62	4,235,138	54.13	4,378,552	54.35	
High school (≥10y)	8,935	3.84	267,730	3.42	276,665	3.43	
Benefit of BFP							
Yes	93,536	40.19	3,595,821	45.96	3,689,357	45.79	0.117
No	139,212	59.81	4,227,873	54.04	4,367,085	54.21	
Geographic							
Region							
North	23,441	10.07	585,345	7.48	608,786	7.56	0.161
Northeast	61,041	26.23	1,813,765	23.18	1,874,806	23.27	
Midwest	27,503	11.82	767,386	9.81	794,889	9.87	
Southeast	93,482	40.16	3,632,401	46.43	3,725,883	46.25	
South	27,281	11.72	1,024,797	13.10	1,052,078	13.06	
Size of municipality (Inh.)							
Under 50 thousands	14,539	6.25	2,217,839	28.35	2,232,378	27.71	0.682
50-100 thousands	43,078	18.51	883,133	11.29	926,211	11.50	
100-500 thousands	107,297	46.10	2,141,042	27,.37	2,248,339	27.91	
≥ 500 thousands	67,818	29.14	2,581,071	32.99	2,648,889	32.88	
Missing	16	0.01	609	0.01	625	0.01	
Family living condition							
Sewage							
Public network	185,207	79.57	6,159,182	78.12	6,344,389	78.75	0.021
Septic tank/ditch/other	47,541	20.43	1,664,512	21.28	1,712,053	21.25	
Water supply							
Public network	211,146	90.72	7,095,723	90.70	7,306,869	90.70	<0.001
Well/natural source/other	21,602	9.28	727,971	9.30	749,573	9.30	
Counter for electricity							
Yes	210,536	90.46	7,328,161	93.67	7,538,697	93.57	0.073
No counter/electricity	22,212	9.54	495,516	6.33	517,728	6.43	
Missing	-	-	17	0.0	17	0.0	
Household construction material							
Bricks or cement	205,307	88.21	7,078,336	90.47	7,283,643	90.41	0.119
Wood/vegetal and other materials	27,441	11.79	745,337	9.53	772,778	9.59	
Missing	-	-	21	0.0	21	0.0	

Premature Deaths[1]							
Cardiovascular disease	692	0.30	34,024	0.43	34,716	0.43	0.023
Other cause of deaths	2,039	0.88	93,151	1.19	95,190	1.18	0.039
Other							
Year of entry cohort							
2010	43,446	18.67	1,139,815	14.57	1,183,261	14.69	
2011	70,991	30.50	1,229,271	15.71	1,300,262	16.14	0.514
2012	55,746	23.95	1,92,373	25.08	2,018,119	25.05	
2013	27,163	11.67	1,004,963	12.85	1,032,126	12.81	
2014	27,212	11.69	1,466,564	18.75	1,493,776	18.54	
2015	8,190	3.52	1,020,708	13.05	1,028,898	12.77	

Data are number and percentages or median (interquartile range), unless otherwise specified. BFP: Bolsa Familia Programme; MCMV: Minha Casa Minha Vida Programme with Residential Fund Release; Inh: inhabitants.
[1]Considering all study population in the 100 Million Brazilian cohort aged 30-69 years.

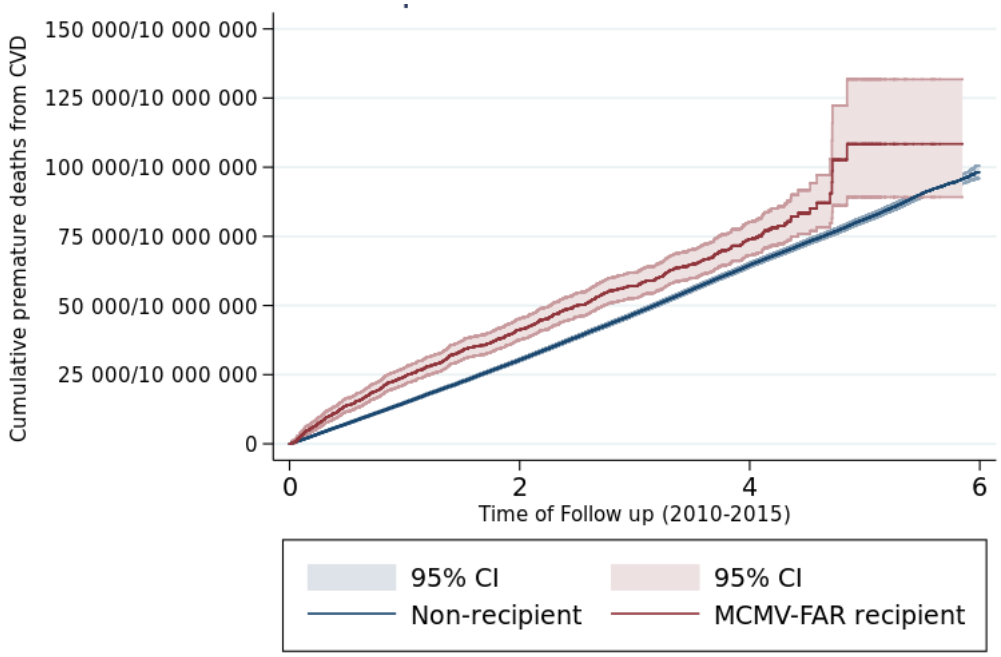

Figure S1. Kaplan Meyar Cumulative incidence curve of premature CVD mortality among recipients and non-recipients of MCMV.

Table S2. Socio-demographic, Geographic characteristics and family living conditions of cases and matched controls currently exposed to MCMV, 2010–2015.

Characteristics	MCMV							
	Non-Recipient (N=101,075)				Recipient (N=1,807)			
	Cases (N=33,609)		Controls (N=67,466)		Cases (N=685)		Controls (N=1,122)	
Sociodemographic	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**
Gender								
Female	14,293	42.53	28,736	42.59	334	48.76	518	46.17
Man	19,316	57.47	38,730	57.41	351	51.24	604	53.83
Age strata, y								
20-29	302	0.90	601	0.89	11	1.61	25	2.23
30-49	7,658	22.79	15,413	22.85	216	31.53	335	29.86
50-69	25,649	76.32	51,452	76.26	458	66.86	762	67.91
Age at baseline, y	58 (50-63)		55 (50-61)		55 (46-61)		53 (43-59)	
Age at end of study, y	60 (52-65)		60 (53-65)		58 (49-64)		58 (47-64)	
Race								
Black	3,722	11.07	7,472	11.08	89	12.99	150	13.37
Mixed/Brown	16,542	49.22	33,196	49.20	343	50.07	574	51.16
White	13,345	39.71	26,798	39.72	253	36.93	398	35.47
Education Level								
Never go to school	6,626	19.71	13,259	19.65	94	13.72	181	16.13
Primary school (≤5y)	17,558	52.24	35,244	52.24	322	47.01	516	45.99
Secondary school (≤9)	9,047	26.92	18,205	26.98	258	37.66	405	36.10
High school (≥10y)	378	1.12	758	1.12	11	1.61	20	1.78
Recipient of BFP								
Yes	13,088	38.94	26,258	38.92	215	31.39	348	31.02
No	20,521	61.06	41,208	61.08	470	68.61	774	68.98
Geographic								
Size of municipalities (inh.)								
Under 50 thousands	9,890	29.43	21,293	31.56	29	4.23	61	5.44
50 ├ 100 thousands	3,788	11.27	7,861	11.65	105	15.33	179	15.95
100 ├500 thousands	9,334	27.77	18,117	26.85	338	49.34	485	43.23
≥ 500 thousands	10,597	31.53	20,193	29.93	213	31.09	397	35.38
Missing	-	-	2	0.00	-	-	-	-
Region								
North	1,541	4.59	3,105	4.60	38	5.55	53	4.72
Northeast	6,358	18.92	12,776	18.94	155	22.63	250	22.28
Midwest	3,457	10.29	6,901	10.23	67	9.78	517	13.10
Southeast	17,394	51.75	34,913	51.75	321	46.86	517	46.08
South	4,859	14.46	9,771	14.48	104	15.18	155	13.81
Family living conditions								
Sewage								
Public network	26,825	79.81	53,840	79.80	572	83.50	915	81.55
Septic tank/ditch/other	6,784	20.19	13,626	20.20	113	16.50	207	18.45
Water supply								
Public network	30,571	90.96	61,555	91.24	628	91.68	1,018	90.73
Well/natural source/other	3,038	9.04	5,911	8.76	57	8.32	104	9.27
Counter for electricity								
Yes	31,211	92.87	63,412	93.99	610	89.05	984	87.70
No counter/electricity	2,398	7.13	4,053	6.01	75	10.95	138	12.30
Missing	-	-	0.0	1	-	-	-	-
Household material								
Bricks or cement	29,781	88.61	60,543	89.74	583	85.11	1,001	89.22
Wood/vegetal and other materials	3,828	11.39	6,922	10.26	102	14.89	121	10.78
Missing	1	0.0	-	-	-	-	-	-

Data are number and percentages or median (interquartile range), unless otherwise specified. BFP: Bolsa Familia Programme; MCMV: Minha Casa Minha Vida Programme with Residential Fund Release; y-years.

6 CONSIDERAÇÕES FINAIS

As DCV são uma importante causa de morte prematura no país, afetando de forma desproporcional os indivíduos em situação de vulnerabilidade social. A carga social e econômica associada as DCV pode ser reduzida, mediante ações focalizadas à nível populacional, e que considerem os determinantes sociais de saúde, entre eles os socioeconômicos. Neste sentido, além das ações de prevenção primária que tem sido adotada para reduzir a carga das DCV na população, sugere-se que políticas e programas de proteção social podem auxiliar na redução da morbimortalidade por DCV, mediante sua ação direta na melhoria das condições de vida dos indivíduos em situação de vulnerabilidade social, bem como, de forma indireta, na redução dos fatores comportamentais e de risco cardiovascular.

Os resultados desta Tese evidenciam que, em países de baixa e média renda, os programas de transferência de renda e alimentos foram associados a melhorias na qualidade e diversidade da dieta dos seus beneficiários, porém, o mesmo não foi observado para o excesso de peso e a dislipidemia, em especial entre os beneficiários dos programas de transferência não condicionados de alimentos. Isto ressalta a importância de aliar os programas de transferência de renda, a outros serviços básicos, nomeadamente à educação e serviços de saúde, para alcance de melhores resultados. Por outro lado, escassas evidências sobre o papel positivo dos programas sociais de transferência condicionada de renda na redução da hipertensão, diabetes do tipo 2 e aumento da atividade física são relatados na literatura. Apenas em um estudo foi avaliado o efeito de um programa de transferência condicionada de renda na mortalidade. Contudo, os resultados não foram favoráveis; o tempo curto de seguimento foi atribuído aos achados. Este cenário reforça a necessidade de mais investigações nesta área, considerando o extenso número de programas sociais implementados nos países de baixa e média renda, e a tendência crescente da ocorrência de doenças crônicas não transmissíveis nestes países, em especial das DCV. Além disso, observa-se um vazio na literatura sobre os efeitos dos programas de habitação social na saúde cardiovascular de adultos, apesar da importância deste determinante social na saúde.

Além disso, uma outra contribuição desta Tese foi a utilização de bases de dados administrativos, de diversas origens, linkados entre si para melhor entender o efeito de programas habitacionais sociais na saúde dos indivíduos de baixa renda. Os resultados apontam um maior risco de óbito prematuro por DCV entre os beneficiários do programa, quando comparado com os não beneficiários. Contudo, os achados devem ser interpretados

com cautela. A construção de empreendimento em áreas desprovidas, em particular, de serviço de promoção de saúde, área de lazer, alimentação saudável e transporte público adequado, pode ter contribuído com tais resultados desfavoráveis. Por outro lado, alguns limites do estudo precisam ser considerados, a exemplo do curto tempo de seguimento dos indivíduos registrados na nossa coorte (máximo de 6 anos), a ausência de informações relativas à saúde dos indivíduos acompanhados na coorte, e a exposição prévia a piores condições de moradia entre os casos (óbitos prematuros por DCV), quando comparado com os controles. Cabe também destacar que, apesar de se reconhecer o potencial da habitação social na melhoria das condições de vida e de saúde dos seus beneficiários, o PMCMV não foi projetado com o intuito de promover à saúde e bem-estar dos beneficiários, e pouca atenção foi dada a outros elementos relacionados a habitação, como a estrutura física e social da vizinhança, a territorialização das famílias e suas redes de apoio.

Assim, sugere-se que novos planejamentos das habitações sociais no país devem considerar a habitação e seus efeitos no binómio saúde-doença, ressaltando não somente a qualidade e adequação da estrutura física da casa, mas também os aspetos estruturais e sociais da vizinhança, o bem-estar familiar e o significado mais abrangente da habitação. Também reiteramos a necessidade de se atentar aos impactos da realocação das famílias, visto que este processo enfraquece os laços sociais, econômicos, e culturais na comunidade, podendo influenciar negativamente à saúde. Novos estudos, com metodologias cada vez mais robustas, e que possam acompanhar os beneficiários do programa por um tempo maior, bem como reunir informações prévias da saúde dos seus beneficiários e das características da vizinhança antes e pós mudança, devem ser consideradas nos próximos estudos relativos as principais causas de morbimortalidade entre os mais vulneráveis, com destaque para as doenças crônicas não transmissíveis e para as infectocontagiosas.

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