Income inequality and mental illness-related morbidity and resilience: a systematic review and meta-analysis

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Lancet Psychiatry 2017; 4: 554–62

Published Online May 25, 2017 http://dx.doi.org/10.1016/S2215-0366(17)30159-1

See Comment page 512

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Summary

Background Studies of the association between income inequality and mental health have shown mixed results, probably due to methodological heterogeneity. By dealing with such heterogeneity through a systematic review and meta-analysis, we examine the association between income inequality, mental health problems, use of mental health services, and resilience (defined as the ability to cope with adversity).

Methods We searched the Global Health, PsychARTICLES, PsycINFO, Social Policy and Practice, Embase and MEDLINE databases up to July 6, 2016, for quantitative studies of the association of income inequality with prevalence or incidence of mental disorders or mental health problems, use of mental health services, and resilience. Eligible studies used standardised instruments at the individual level, and income inequality at the aggregated, contextual, and ecological level. We extracted study characteristics, sampling, exposure, outcomes, statistical modelling, and parameters from articles. Because several studies did not provide enough statistical information to be included in a meta-analysis, we did a narrative synthesis to summarise results with studies categorised as showing either a positive association, mixed results, or no association. The primary outcome in the random-effects meta-analysis was mental health-related morbidity, defined as the prevalence or incidence of any mental health problem. This study is registered with PROSPERO, number CRD42016036377.

Findings Our search identified 15 615 non-duplicate references, of which 113 were deemed potentially relevant and were assessed for eligibility, leading to the inclusion of 27 studies in the qualitative synthesis. Nine articles found a positive association between income inequality and the prevalence or incidence of mental health problems; ten articles found mixed results, with positive association in some subgroups and non-significant or negative association in other subgroups; and eight articles found no association between income inequality and mental health problems. Of the nine articles included in our meta-analysis, one reported a positive association between income inequality and mental health problems, six reported mixed results, and two reported no association. Pooled Cohen's d effect sizes for the association between income inequality and any mental disorder or mental health problems were 0·06 (95% CI 0·01–0·11) for any mental disorder, and 0·12 (0·05–0·20) for depressive disorders. Our meta-regression analysis showed that none of the factors considered (sample size, contextual level at which income inequality was assessed, quality assessment, type of instruments, and individual income as control variable) explained heterogeneity between studies (I^2 89·3%; p<0·0001). Only one study investigated the association between income inequality and resilience; it found greater income inequality was associated with higher prevalence of depression only among individuals with low income. The only study of the role of income inequality as a determinant of the use of mental health services reported no association.

Interpretation Income inequality negatively affects mental health but the effect sizes are small and there is marked heterogeneity among studies. If this association is causal and growing income inequality does lead to an increase in the prevalence of mental health problems, then its reduction could result in a significant improvement in population wellbeing.

Funding None.

Introduction

Mental disorders are highly prevalent and are associated with a substantial proportion of the global burden of disease. Pooled 1-year prevalence of mental disorders is estimated to be 17·6% among adults[1] and 13·4% among children and adolescents.[2] It has been estimated that mental disorders account for 22·9% of all years lived with disability (YLD) worldwide,[3] and for 32·4% of YLD when mental health problems that are not clinically diagnosable[4] are considered. Studies have established that, along with genetic and biological factors, social determinants affect individual and population mental health,[5–7] and that contextual factors, such as deprivation, poverty, and violence negatively affect mental health. Analysing data from a study of twins, Caspi and colleagues[8] concluded that 20% of variance in children's behaviour problems were attributed to contextual factors, and that neighbourhood deprivation accounted for 5% of the contextual effect.

It has been proposed that income inequality affects health through a material pathway and a psychosocial pathway. In the material pathway, income inequality

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Research in context

Evidence before this study

A recent meta-analysis has shown that income inequality increases the odds ratio for poor health and the relative risk of mortality. However, empirical studies of the association between income inequality and mental health problems have shown mixed results, with some studies finding that greater income inequality is associated with higher prevalence of mental health problems, whereas other studies have reported no association. Methodological heterogeneity between studies might be responsible for such mixed results. We identified research by searching six electronic databases for studies investigating the association between income inequality and mental health problems.

Added value of this study

Our meta-analysis found that income inequality is associated with mental health problems and with depressive disorder, albeit the overall effect sizes were small (0·06 and 0·12, respectively).

Implication of all the available evidence

Reducing income inequality could improve population mental health and wellbeing, which supports its inclusion in the public health agenda.

affects health outcomes through poverty and deprivation, which are related to increased stress[9] and reduced access to health care,[10] and are prevalent in highly unequal societies.[11] The psychosocial pathway relies on status competition and insecurity,[12] leading to social problems,[13] such as lack of social cohesion and violence, low levels of trust, and weaker community life.[12] Evidence shows that these psychosocial factors can affect health through physiological effects of chronic stress and through their effects on health-related behaviours and individuals' self-esteem.[14] Those, in turn, cause psychosocial stress[5,6] and increase the risk of developing mental health problems at an individual level.[15–19]

Understanding the association between income inequality and mental health could have major public health implications if the association is shown to be causal. For example, in a recent meta-analysis,[11] investigators estimated that for every 0·05 unit increase in the Gini coefficient of income inequality, the odds ratios for poor health and overall relative risk of mortality increased 4% and 8%, respectively. If income inequality has a similar effect on mental health, then a reduction in inequality could lead to improved population wellbeing.

So far, empirical studies of the association between income inequality and mental health problems have shown mixed results. Pickett and Wilkinson[12] reported a strong correlation (r=0·73) in high-income countries. In the USA, the result was replicated in women and children, but not in men.[12] Other findings have shown that income inequality is negatively correlated with mental health in the USA at state level, but not at more proximal levels, such as community, or in other countries.[20] Such mixed results might be attributed to methodological heterogeneity between studies, such as study design, methods used to assess mental health problems, or contextual levels at which income inequality was measured. Therefore, it is important to address these results in a systematic review and meta-analysis, which can deal with heterogeneity between studies and results through statistical methods and sensitivity analysis.

We aimed to investigate the association between income inequality and mental health-related morbidity, defined as the prevalence or incidence of any mental health problem. Specifically, we wanted to assess the association between income inequality and prevalence and incidence of mental disorders. Social capital and social cohesion, which are affected by income inequality, are thought to facilitate access to health care[21] and to increase resilience, defined as the ability to cope with adversity.[22] Therefore, we also investigated the association between income inequality and the use of mental health services and resilience. We hypothesised that the prevalence and incidence of mental disorders would be higher, and that resilience and use of mental health services would be lower, in people living in regions with greater income inequality.

Methods

Search strategy and selection criteria

This systematic review followed the Centre for Review and Dissemination's guidance for reviews in health care. The protocol is available online. We searched six electronic databases (Global Health, PsychARTICLES, PsycINFO, Social Policy and Practice, Embase, and MEDLINE) with no initial time or language restriction for articles published up to July 6, 2016. The following subject heading and keywords were used: (income inequality-related terms) AND (mental health-related terms OR resilience; the full search term list is available in appendix p 1). Studies not identified through the search were sought by consulting experts, and by checking reference lists of included articles and relevant review articles.

We included quantitative studies of the association of income inequality with prevalence or incidence of mental disorders or mental health problems, resilience, and use of mental health services. Inclusion criteria were: assessment of mental health problems at the individual

For the **Centre for Review and Dissemination's guidance** see http://www.york.ac.uk/media/crd/Systematic_Reviews.pdf

For the **protocol** see http://www.crd.york.ac.uk/PROSPERO/display_record.asp?ID=CRD42016036377

See **Online** for appendix

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level through standardised methods; and assessment of income inequality at aggregated, contextual, or ecological level. Exclusion criteria were non-data-based studies, such as reviews; research protocol; editorials and letters. We chose mental health problems as the primary outcome and, if available, resilience and use of mental health services as secondary outcomes. There were no restrictions regarding age of participants in our literature search.

Six reviewers (WSR, AB, MCRA, MY-S, PMP, and LP) participated in the screening and selection process. For reliability purposes, three sets of 300 references each were randomly selected from the non-duplicated references. Reviewers were grouped into three pairs. Each pair screened titles and abstracts of one of the 300-reference sets. Disagreements were resolved through group discussion. The remaining references were divided among reviewers, who screened titles and abstracts to identify potentially eligible studies in addition to those identified in the reliability phase. References selected in the screening phase were independently double-checked by two reviewers (WSR and SE-L). Final eligibility assessment was performed by one reviewer (WSR) and double-checked by another (SE-L).

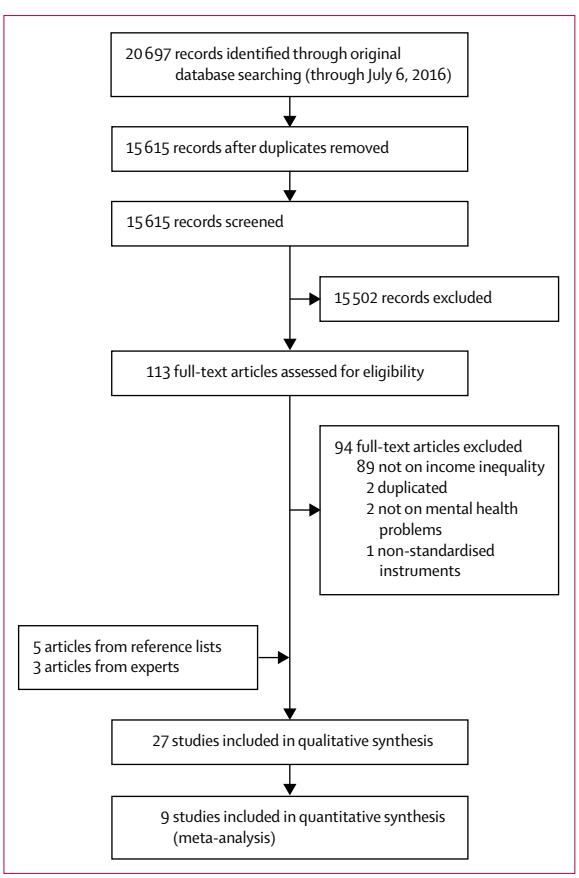

Figure 1: **PRISMA flow diagram**

Data extraction

We extracted the following information from articles: study design, methods and timing of data collection; sample frame, sample size, attrition rate, and subgroups; income inequality indices and level at which they were obtained; diagnosis and type of mental health problem and mental health assessment tools; statistical modelling; and statistical parameters.

Quality assessment

We used five questions to assess quality of the studies. First, we assessed whether the effect of missing data was taken into consideration, through sensitivity analysis or other adjustment methods (attrition bias). Second, we assessed whether confounding variables were considered (analytical bias). These two questions were derived from a framework developed by the US Agency for Health Care Research and Quality to ascertain risk of bias in observational studies.[23] Third, we checked whether studies used a longitudinal design, which is the most appropriate design to determine causal relationships. Fourth, we considered whether participants were selected through a randomised sampling strategy (selection bias). Finally, we asked whether multilevel analysis was used because this is the most appropriate strategy to distinguish effects of contextual variables on outcomes.[11,24] For every question, studies were considered to have low risk of bias (L) if they were coded "yes", high risk of bias (H) if coded "no", and unclear (U) if they did not provide enough information. L was recoded as 1, whereas H and U were recoded as 0. Therefore, studies were attributed a total score ranging from zero (highest risk of bias) to 5 (lowest risk of bias).

Narrative synthesis and statistical analysis

Because several studies did not provide enough statistical information to be included in a meta-analysis, we did a narrative synthesis to summarise results.[25] We grouped studies into three categories based on their results—positive association, mixed results, and no association—and we assessed whether groups of studies differed in relation to outcome, design, quality score, type of income inequality variable (continuous *vs* categorical), stratification, income inequality area-level, and instruments.

Our statistical analysis included studies that reported income inequality and outcomes as categorical variables. We converted association parameters and standard errors (SEs) into Cohen's d effect sizes, then we estimated pooled effect sizes for any mental disorders, depressive disorders, and common mental disorders. We then ran an alternative statistical model including only studies reporting income inequality as a linear predictor. Due to heterogeneity between studies, we used a random-effects approach and did sensitivity analyses. In the first sensitivity analysis, we excluded studies that did not control their analyses for individual income; in the second, we excluded studies that scored 2 or less in the quality assessment. We ran a random-effect meta-regression analysis to evaluate

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factors that could account for heterogeneity between studies, based on a 5% significance level ($p<0·05$). Variables included in the meta-regression were sample size, income inequality area-level, quality assessment, use of diagnostic versus screening instruments, and inclusion of individual-level income in the statistical modelling. We used Egger's test to assess bias. Analyses were done with Stata (version 13.0).

This study is registered with PROSPERO, number CRD42016036377.

Results

Our search identified 15 615 non-duplicate references, of which 113 were deemed potentially relevant and were assessed for eligibility (figure 1). A further five articles were found in reference lists and three were suggested by experts. After inclusion criteria were applied, 27 studies were included in the qualitative synthesis (figure 1). Of these 27 studies, 21 were derived from cross-sectional studies, four were ecological analysis[12,26–28] and two were cohort studies.[29,30] Eight articles reported results from multicountry studies;[12,27,29,31–35] ten studies were done in the USA;[28,30,36–43] three studies were done in the UK;[44–46] two articles reported results from a study done in Brazil;[47,48] one study was done in Australia,[49] one in Mexico,[50] one in Spain,[51] and one in South Africa[26] (table).

Most studies were of adult populations. One study included university students;[35] one included 11, 13, and

	Design, setting, population, sample size	Age	Outcome	Measure of income inequality	Area level variable	Statistical analysis	Adjusted variables
Ahern,[36] 2006*	Cross-sectional, USA, general, n=1355	≥18 years	Past 6 month depression	Gini coefficient	59 community districts in New York City	Multilevel analysis	Median income, individual income, age, ethnic origin
Bechtel,[49] 2012	Cohort, Australia, general, n=67 305	≥15 years	Mental health functioning	Gini, Theil, Atkinson	Neighbourhood; major statistical region; city	Multilevel analysis	Age, number of children, country of birth, education
Chiavegatto Filho,[47] 2013*	Cross-sectional, Brazil, general, n=3542	≥18 years	Depression; anxiety; any mental disorder	Gini coefficient	Area of residence	Multilevel analysis	Age, sex, education, individual income, marital status
Chiavegatto Filho,[48] 2015	Cross-sectional, Brazil, general, n=3542	≥18 years	Use of mental health services	Gini coefficient	Area of residence	Multilevel analysis	Age, sex, education, individual income, marital status
Cifuentes,[29] 2008	Cross-sectional, 65 countries, general, n=280 563	≥18 years	Major depressive episode	Gini coefficient	65 countries	Multilevel analysis	Age, sex, marital status, education, country level of development
Elgar,[31] 2015	Cross-sectional time series, 34 North American and European countries, students, n=492 788	11, 13, and 15 years	Psychological symptoms	Gini coefficient	34 countries	Multilevel analysis	Age, sex, SES, survey cycle
Fan,[37] 2011*	Cross-sectional time series, USA, general, n=293 405	≥18 years	Current depression	Gini coefficient	All US states; districts of Columbia, Guam, Puerto Rico, and US Virgin Islands	Multilevel analysis	Age, sex, ethnic origin, marital status, education, household income, number of chronic conditions, survey year
Fernandez-Niño,[50] 2014	Cross-sectional, Mexico, general, n=7867	≥60 years	Depressive symptoms	Gini coefficient	Municipality, state	Multilevel analysis	Age, sex, paid work, education, not consulted in household decision-making, number of illnesses, impairment, accident, violence, household assets, living alone, deprivation index
Fone,[6] 2013*	Cross-sectional, Wales, general, n=88 858	18–74 years	Common mental disorder	Gini coefficient	1896 lower super output areas as proxy for neighbourhood; 22 unitary authority	Multilevel analysis	Income deprivation, sex, social class, employment status, education, housing tenure
Gresenz,[38] 2001*	Cross-sectional, USA, general, n=6925	<65 years	Anxiety or depression; psychological distress	Gini coefficient	60 US census primary statistical area; state	Multilevel analysis	Age, sex, ethnic origin, family size
Henderson,[39] 2004*	Cross-sectional, USA, older adults, n=42 862	≥18 years	Depression; alcohol dependence	Gini coefficient	State	Multilevel analysis	Gender, age, ethnic origin, education, family income, family size, urbanity, beer tax
Johnson,[32] 2015	Cross-sectional, 27 countries, adults, n=27 831	Not informed	Psychotic symptoms	Gini coefficient	Country	Regression analysis	Per capita income
Kahn,[40] 2000*	Cross-sectional, USA, women with infant children, n=8285	≥15 years	Depression	Gini coefficient	State	Multilevel analysis	Age, marital status, education, ethnic origin, household size
Layte,[33] 2012	Cross-sectional, 27 countries, adults, n=27 831	≥18 years	Mental well-being	Gini coefficient	Country	Multilevel analysis	Age, sex, health status, income, education, employment status
Messias,[28] 2011	Ecological, USA, adults, n=235 067	Not informed	Depression	Gini coefficient	State	Regression analysis	Income per capita, percentage with college degree, percentage over age 65 years

(Table continues on next page)

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	Design, setting, population, sample size	Age	Outcome	Measure of income inequality	Area level variable	Statistical analysis	Adjusted variables
(Continued from previous page)							
Muramatsu,[41] 2003	Cross-sectional, USA, older adults, n=6640	≥70 years	Depression	Gini coefficient	County	Multilevel analysis	Gender, age, ethnic origin, marital status, education, individual income, physical illnesses
Pabayo,[30] 2015*	Cohort, USA, general, n=34 653	≥18 years	Major depressive disorder	Gini coefficient	50 US states and district of Columbia	Multilevel analysis	Age, sex, education, marital status, ethnic origin, household income, education, urbanity, perception of health, family history of depression, life events
Pickett,[12] 2010	Ecological, eight developed countries, general, not reported	Not informed	Mental illness	Gini coefficient	Nine developed countries and US states	Pearson's correlation	None
Rai,[34] 2013	Cross-sectional, 53 countries, general, n=187 496	≥18 years	Depressive episode	Gini coefficient	53 countries	Multilevel analysis	Age, sex, area type, marital status, education, material assets, spending, occupational class
Rocha,[51] 2015	Cross-sectional, Spain, adults, n=29 476	>16 years	Poor mental health	Gini coefficient	Autonomous communities	Multilevel analysis	Age, sex, social class, health coverage, country of origin, employment status
Steptoe,[35] 2007	Cross-sectional, 23 countries, university students, n=17 348	15–30 years	Depressive symptoms	Gini coefficient	23 countries	Multilevel analysis	Age, sex, family wealth, parental education, sense of control, GDP, tertiary education access, individualism or collectivism
Sturm,[42] 2002	Cross-sectional, USA, general, n=3460	Adults	Depressive disorder; depressive or anxiety disorder	Gini coefficient	60 communities	Multilevel analysis	Age, sex, ethnic origin, family size
Weich,[46] 2001*	Cross-sectional; England, Wales and Scotland; general; n=8191	16–75 years	Common mental disorder	Gini coefficient	18 regions	Multilevel analysis	Age, sex, social class, housing tenure, social class by head of household
Zimmerman,[43] 2006	Cross-sectional, USA, general, n=4817	40–45 years	Depression	County level percentage of households with income higher than $150 000	County	Multilevel analysis	Gender, ethnic origin, urbanity, region, income, education, poverty status, insurance status, marital status
Burns,[26] 2008	Ecological, South-Africa, general, n=508 275	15–49 years	First episode of psychosis	Ratio of income top 10%/ bottom 10%	Municipality	Partial Pearson's correlation	Urbanisation
Burns,[27] 2014	Ecological, 26 countries, general, not reported	Not informed	Schizophrenia	Gini coefficient	Country	Multilevel analysis	Migration, population density, unemployment, GDP per capita
Kirkbride,[45] 2014	Cross-sectional, UK, general, not reported	18–64 years	Psychotic syndromes	Gini coefficient	Lower super output areas as proxy for neighbourhood	Multilevel analysis	Age, sex, ethnic origin, individual-level SES, and contextual-level deprivation, population density, social fragmentation, voter[1,2] turnout

GDP=Gross Domestic Product. SES=socioeconomic status. *Studies which were included in the meta-analysis.

Table 1: **Characteristics of studies included in the systematic review and meta-analysis**

15-year-old students;[31] and one sampled women with infant children.[40] 22 articles assessed psychiatric diagnoses,[12,26–30,32,34–37,39–47] whereas three assessed psychological distress or symptoms, or mental wellbeing or functioning.[31,33,49] One study assessed both psychiatric diagnosis and psychological symptoms,[38] and one reported use of mental health services.[48] 23 articles assessed income inequality using the Gini index;[12,27–38,42,45,49] one of them[49] also included Theil and Atkinson indexes. Gini, Theil, and Atkinson indexes, with different formulas, estimate how unequally distributed income is in a population as compared with a theoretical parameter of perfectly equal income distribution, ranging from 0 (perfect equality) to 1 (extreme inequality).[49] One article reported area percentage of households with income higher than $150 000 as a measure of income inequality,[43] and one article reported the ratio of mean income of the top 10% to the bottom 10% earners.[26] Income inequality was assessed at different contextual levels—community or neighbourhood; region or area of residence; and city, state, and country. In the quality assessment (appendix p 2), ten studies[12,26–28,32,35,39,40,42,45] scored two or less; the remaining 17 scored 3 or 4. The main problems regarding quality of studies identified were use of cross-sectional and ecological study design and absence of missing data assessment.

Of the 27 articles included in the review, nine articles[26–28,31,32,35,40,45,49] reported that the prevalence or incidence of mental health problems was higher in areas with greater income inequality. These studies assessed depression,[28,37,41,51] psychological distress or symptoms,[31] and psychosis.[26,27,32,45] Ten articles reported mixed results: four of them found that greater income inequality was associated with higher prevalence or incidence of mental health problems in some population subgroups,[29,30,36,40]

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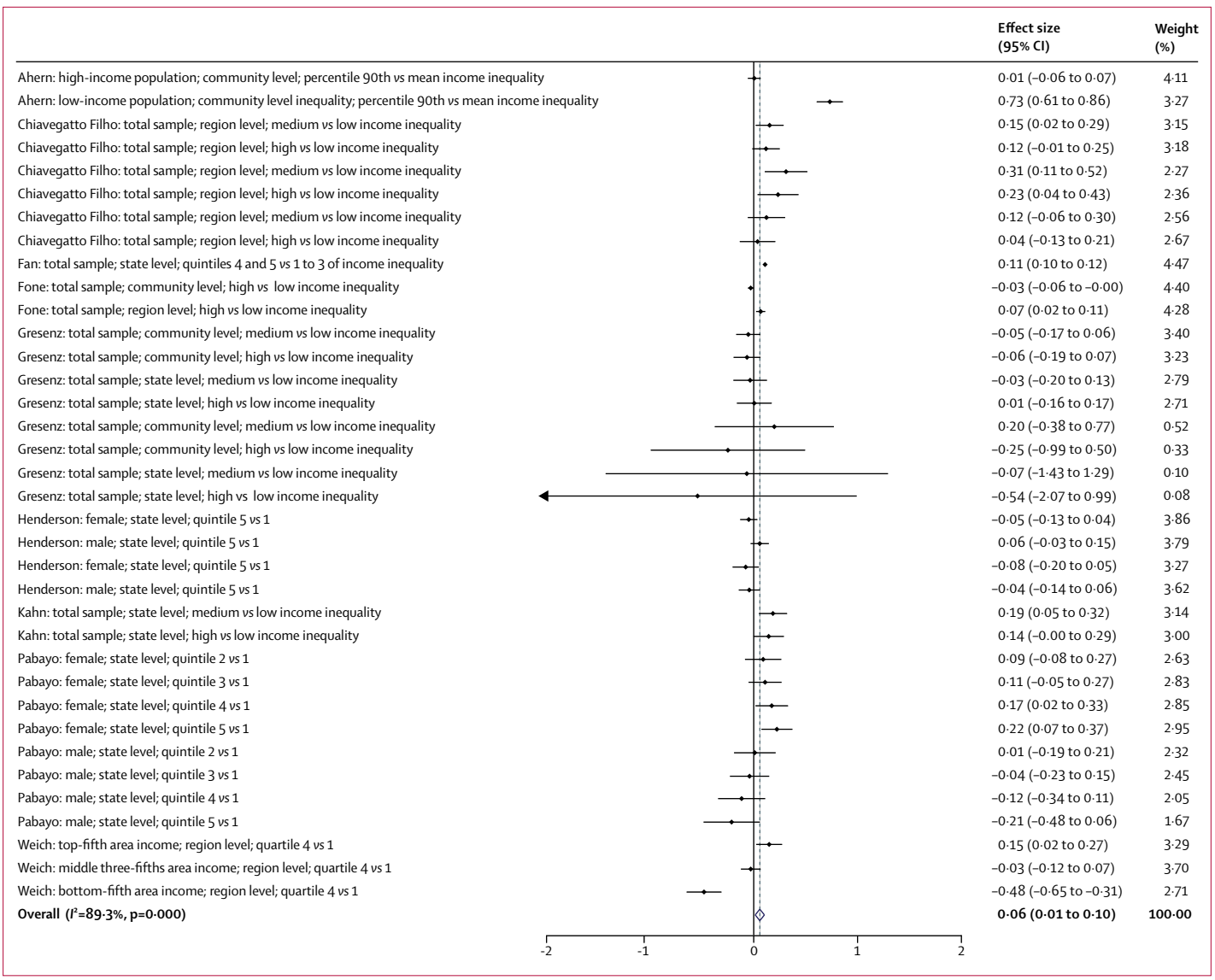

Figure 2: **Meta-analysis of the association between income inequality and any mental health problems**

such as women[30] or low-income groups[36] or countries with a high human development index.[29] One article[47] reported that income inequality was associated with depression, but not with anxiety or any mental disorders. Another[44] reported that greater income inequality was associated with lower prevalence of common mental disorders at community level, and higher prevalence at regional level. One study[12] reported an association at country level, and only among women and children at state level, and in another[46] greater income inequality was associated with higher prevalence of common mental disorders in high-income areas, and with lower prevalence in low-income areas. Eight articles[34,38,39,42,43,49–51] found non-significant associations between income inequality and mental health problems.

One study[36] investigated the association between income inequality and resilience by assessing the association between income inequality and depression in the aftermath of a disaster. The researchers operationalised resilience as absence of depression after exposure to a potentially traumatic experience, and tested the hypothesis that residents of New York City living in areas with greater inequality would be more vulnerable to developing depressive disorder in the aftermath of the 2001 terrorist attacks. Greater income inequality was associated with higher prevalence of depression only among individuals with low income.

One article[48] reported the role of income inequality as a determinant of use of mental health services. No

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association was reported with use of mental health services, whereas presence of a regular physician was less common in areas with greater inequality.

When articles were grouped into three categories based on the type of association (ie, positive, mixed, or none) between income inequality and outcomes (appendix p 3), the only difference between the three groups was that, in contrast to the mixed and no association groups, there was no population stratification in the positive association group. When other key study characteristics were considered, the three groups were similarly heterogeneous.

Nine articles[30,36–40,44,46,47] were included in our meta-analysis. One[37] reported a positive association between income inequality and mental health problems, six[30,36,40,44,46,47] reported mixed results, and two[38,39] reported no association. Pooled Cohen's d effect sizes for the association between income inequality and any mental disorder or mental health problems were 0·06 (95% CI 0·01–0·10; p=0·009; upper and lower limit –0·48 and 0·73, respectively; figure 2). Nearly 90% of the variation across estimates was due to heterogeneity between studies (I^2 89·3%; p<0·0001).

Pooled Cohen's d effect size for the association between income inequality and depression was estimated to be 0·12 (95% CI 0·05–0·20; p=0·0001; upper and lower limit –0·21 and 0·73, respectively). Nearly 90% of the variation was attributable to heterogeneity across studies (I^2 88·7%; p<0·0001; appendix p 4). Pooled Cohen's d effect size for the association between income inequality and common mental disorders was –0·04 (95% CI –0·11 to 0·03; p=0·307), upper and lower limit –0·48 to 0·15, with more than 80% of variation being attributed to heterogeneity (I^2 84·4%; p<0·0001; appendix p 5). In the alternative model, which included studies reporting inequality as a linear predictor, there were nine effect sizes from seven studies. The pooled effect size was not significant (effect size 0·07; 95% CI –0·01 to 0·15; p=0·092).

Our meta-regression analysis showed that none of the factors considered (sample size, contextual level at which income inequality was assessed, quality assessment, type of instruments, and individual income as control variable) explained heterogeneity between studies. In our sensitivity analyses, exclusion of studies did not change the results of the primary meta-analyses (data not shown). Egger's test for studies included in the meta-analysis showed a bias of –1·18 (95% CI –1·97 to –0·39; p=0·004).

Discussion

Our systematic review and meta-analysis provides a comprehensive synthesis of the evidence on the association between income inequality and mental health problems, and found that pooled effect sizes for the association of income inequality, as a categorical variable, with any mental health problem and with depressive disorder were significant, albeit small (0·06 and 0·12, respectively). These results have important political implications as the well documented growth in income inequality worldwide[52,53] could lead to an increase in the incidence of mental health problems and disability. One study noted that higher income inequality is associated with lower resilience[36] and one study found no association between income inequality and use of mental health services.[48] These results should not be generalised because they are based on individual studies.

Our narrative synthesis provides some insights into the mechanisms and pathways linking income inequality and mental health problems. The findings of an interaction between income inequality and neighbourhood deprivation,[44] area income,[36] and country-level human development index[29] suggest that these factors might mediate the association between income inequality and mental health problems, supporting the material pathway mechanism.[9–11] One study[33] provided evidence that income inequality might affect mental health through a psychosocial pathway[12–14] by finding that status anxiety and social capital mediated the association between income inequality and mental health problems. These results are based on individual studies and are not necessarily generalisable to all countries or contexts. Research designed specifically to investigate such interactions is now needed.

Other studies have shown that income inequality is associated with an increased risk of self-rated poor health and mortality.[11] By focusing on mental health problems, our review provides evidence on which outcomes income inequality might affect the most. Our meta-analysis models found the largest pooled effect size for depression, which is now considered the leading cause of disability.[54]

Some limitations of this systematic review and meta-analysis should be considered. First, only two of 24 articles reported results based on cohort studies, which have a better design than cross-sectional analyses to explore associations between exposure and outcome. Reverse causality should not be discarded in cross-sectional studies because mental illness can undermine productivity and earning capacity,[20] leading to high levels of unemployment and very low income in areas with high prevalence of mental health problems. Considering that income inequality tends to be relatively stable over time, cross-sectional studies could minimise the likelihood of reverse causality by collecting information on the onset of mental health problems and date when participants first moved to their neighbourhood of residence, although these assessments would still be vulnerable to recall bias. Second, only nine articles provided the necessary information to be included in the meta-analysis. Therefore, one should be cautious when considering our pooled effect sizes. Third, we included a broad definition of mental health problems, rather than using the specific terminology, for feasibility purposes. Our key words might not have been precise enough to identify articles that used more specific terms, such as

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psychosis, resulting in publication bias. Finally, none of the studies were specifically designed to address the association between income inequality and mental health problems. Therefore, methodological factors limit our understanding of this relationship, particularly its direction, mechanisms that might lead to poor mental health, and the pathways to specific disorders.

Even though our narrative synthesis showed mixed results, its general trend suggests that income inequality negatively affects mental health, as did our meta-analysis. Therefore, our findings support the inclusion of income inequality in the public health agenda, because reducing income inequality could improve population mental health and wellbeing. Reducing inequalities has been recognised as a priority as one of the 17 UN Sustainable Development Goals,[55] and could lead to a virtuous cycle if it improves population mental health and wellbeing, providing individuals with more psychosocial resources to engage in education and employment, achieving better economic circumstances, and hence further reducing the income inequality gap.

Contributors

WSR and SE-L conceived the systematic review and search strategy; WSR ran the search strategy; WSR, AB, MCRA, MY-S, PMP, and LP screened references retrieved from the search strategy, and selected eligible studies based on the inclusion and exclusion criteria; WSR and SE-L conceived and ran the statistical modelling; ESFC supervised and reviewed the statistical analysis; WSR wrote the manuscript with inputs from AB, MCRA, MY-S, PMP, LP, MK, ESFC, and SE-L; AB, MCRA, MY-S, PMP, LP, MK, ESFC, and SL-E revised the final manuscript and contributed to the interpretation of the results.

Declaration of interests

SE-L has received consulting fees from Lundbeck unrelated to this work. SE-L and WSR are funded by the European Research Council under the European Union's Seventh Framework Programme (FP7/2007-2013)/ERC grant agreement number [337673]; and PMP is in receipt of research support from the Brazilian National Council for Scientific and Technologic Development (CNPq). WSR, AB, MCRA, MY-S, PMP, LP, MK, and ESFC declare no competing interests.

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