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INCOME INEQUALITY AND DEPRESSION: A SYSTEMATIC REVIEW OF THE ASSOCIATION AND MECHANISMS

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ABSTRACT

Most countries have witnessed a dramatic increase in income inequality in the past three decades. This review addresses the question of whether income inequality is associated with the population prevalence of depression and, if so, the potential mechanisms and pathways which may explain this association. Our systematic review included 26 studies, most from high-income countries. Nearly two-thirds (k=16) of all studies and 5 out of 6 longitudinal studies reported a statistically significant positive relationship between higher income inequality and increased risk of depression; only one study reported a statistically significant negative relationship between income inequality and depression. Twelve studies were included in a meta-analysis with dichotomized inequality groupings. The pooled risk ratio was 1.19 (95% CI 1.07, 1.31), demonstrating greater risk of depression in populations with higher income equality relative to populations with lower income inequality. Multiple studies reported subgroup effects, including greater impacts of income inequality among women and low-income populations. We propose an ecological framework, with mechanisms operating at the national level (the neo-material hypothesis), neighbourhood level (the social capital and the social comparison hypotheses) and individual level (psychological stress and social defeat hypotheses) to explain this association. Given that the root cause of income inequality is the wide adoption of neo-liberal economic policies which are also associated with other social determinants of mental health, policy makers must reduce the population burden of depression by actively promoting actions to address the structural factors which would reduce income inequality, such as progressive taxation policies and a basic universal income. Mental health professionals must champion such policies, as well as promote the delivery of interventions which target the pathways and proximal determinants, such as building life skills in adolescents and provision of psychological therapies and packages of care with demonstrated effectiveness for settings of poverty and high-income inequality.

INTRODUCTION

The unequal distribution of income and wealth has been growing steadily over the past three decades to astonishing levels, fuelled by the wide adoption of neo-liberal economic policies and globalization. In 2016, while the bottom half of the global population collectively owned less than 1 percent of total wealth, the wealthiest top 10 percent owned 89 percent of all global assets^[1]. The growth of income and wealth inequality has been observed in countries at all levels of socio-economic development. In the United States, one of the richest countries in the world, the top 10 percent of the population now average nearly nine times as much income as the bottom 90 percent^[2]. In India, an exemplar of a low-and-middle-income country (LMIC), in 2016, the richest 1% of India owned nearly 60% of the total wealth of the country. Notably, these historic levels of inequality continue to grow, threatening the social fabric of societies globally. However, there is a three-fold variation in the range of levels of inequality between countries, with the most equal countries mostly clustered in Western Europe and the most unequal countries comprising LMIC and the USA. These variations at the country level, as well as at sub-national levels (i.e., provinces or states of countries) allow the exploration of the association between income inequality (a characteristic of populations) and a variety of social outcomes, notably health.

There is a robust body of evidence linking inequality and health outcomes, ranging from infant mortality and life expectancy to obesity. A recent review has presented a compelling case for a causal relationship between inequality and a number of negative health outcomes ^[3]. Not surprisingly, there is also evidence linking inequality with mental health outcomes. A systematic review of 107 incidence rates of schizophrenia reported a significant positive relationship between the incidence rate and country-level Gini coefficient, a widely used measure of the distribution of income or wealth in a population. The authors proposed that a possible mechanism for this association was that inequality impacted negatively on social cohesion and capital, and increased chronic stress, placing individuals at a heightened risk of schizophrenia ^[4]. A recent systematic review of 27 studies on the association of income inequality and a range of mental health related outcomes reported heterogenous findings, with about a third of studies observing a positive association between income inequality and the prevalence or incidence of mental health problems, a third observing mixed results for different sub-groups, and a third observing no association ^[5]. Depression was one of the mental health outcomes included in studies showing a positive association with income inequality. Although potential mechanisms that underlie the observed association between income inequality and health have been proposed ^[6], little is known about the precise mechanisms of this association in the case of depression. Hence, there is a need for a study which sets out to identify potential mechanisms and develops a conceptual framework that can further our understanding and set an agenda for future research in the field.

This review seeks to advance the scientific inquiry of the association between inequality and mental health in three specific ways. First, we aim to identify and descriptively synthesize the most updated literature on depression and income inequality with a

focus on study characteristics and potential differential impact by gender and level of poverty.

Second, we aim to quantitatively assess the strength of the association of income inequality and depression prevalence through a meta-analysis. Finally, we aim to conduct a scoping review of the literature to explore the potential mechanisms, and develop a theoretical framework, for this association. By focusing on one mental health outcome (depression) we hoped to provide a more in-depth analysis of potential mechanisms than has previously been possible. Our ultimate goal is to elaborate the implications of this body of evidence on policies which influence the distribution of income and wealth, and identify specific gaps in our knowledge which deserve further research investment.

METHODS

Systematic review of the association of income inequality and depression

Search strategy: Our search strategy was guided by our protocol (PROSPERO registration: CRD42017072721). A copy of the review protocol is available from the authors on request. In brief, we searched the following electronic databases: PubMed/Medline, EBSCO and PsycINFO. The search string used was: “(depress* OR mental) AND (inequal* OR Gini)”. The electronic databases were searched for titles or abstracts containing these terms in all published articles between 1st January 1990 and 31st July 2017 inclusive. The search was limited to studies published in English and involving human subjects. The reference lists of all included studies were hand-searched for additional relevant reports or key terms. If new key terms were identified (new term included: “mood”) additional searches of the above databases were conducted and relevant papers were added until no further publications were found.

All studies meeting the following inclusion criteria were selected for the review: those providing primary quantitative data with: a) a measure of depression or depressive symptoms as an outcome and b) any measure of income inequality at any geographical scale. Exclusion criteria were: (1) unpublished data of any form including conference proceedings, case reports, dissertations; (2) qualitative studies; and (3) publications reporting duplicate data from the same population - in such cases, the report with the larger sample size was preferentially included. All titles and abstracts identified in the search were screened to exclude those that were obviously irrelevant based on the above exclusion criteria. Full-text versions were obtained for all abstracts remaining after screening. Obtained full-text articles were read and those not satisfying inclusion criteria were subsequently removed. The remaining articles were included in the systematic review (see PRISMA flow diagram, Fig 1).

Analyses: Study data were extracted onto a customised data-extraction sheet. Quality assessments were independently performed by using the Systematic Appraisal of Quality in Observational Research (SAQOR) tool that comprises six domains (each containing two to five questions): sample; control/comparison group; exposure/outcome measurements; follow-up; confounders; and reporting of data [7]. The SAQOR has been adapted for use in cross-cultural psychiatric epidemiology studies [8]. In the current study, two domains were omitted (control/comparison group; and follow-up)

as they were not applicable to any of the papers identified. A summary quality assessment was by a single rater (JBK) for each of four domains, and then an overall summary grade was determined based on adequacy in the four domains. The overall quality of the study was graded as: high; moderate; or low.

Meta-analyses were conducted using Cochrane Review Manager (RevMan) version 5.3 [9]. Data were extracted from studies to calculate risk ratios for the association of income inequality and depression. Studies that included data on depression event rates stratified by income inequality were included in the meta-analyses. Compared to risk ratios, odds ratios exaggerate effect sizes with the distortion most pronounced for outcomes with prevalence greater than 10% [10, 11]. Because depression prevalence may be greater than 10% in a population, risk is more accurately estimated with risk ratios. To calculate risk ratios, income inequality for each study was categorized as binary outcomes: higher vs. lower income inequality in a given population. When income inequality was categorized into three or more groups, we re-categorized the groups as follows: in studies with three groups, the lowest income inequality group was used as the reference and the medium and high inequality groups were collapsed; studies with four inequality groups were re-categorized grouping the two lower and two higher inequality strata; for quintiles, the two low inequality quintiles were grouped as the referent group to compare with the three high inequality quintiles, which were collapsed into one stratum; finally in studies with more than five inequality groups, the strata were regrouped into two strata of roughly equal sample size. Unadjusted prevalence rates of depression were used whenever available given the lack of consistency across studies in variables used for adjusting outcomes. When unadjusted prevalence rates were not available, demographics and other characteristics used for adjustment are reported. Random effects meta-analyses were conducted because of the heterogeneity in design, populations, and outcome measures. We conducted sensitivity analyses using the leave-one-out approach to test the impact of excluding single studies contributing a disproportionately large effect. A forest plot of the risk ratios with summary statistics (pooled effect sizes) was completed using RevMan. Heterogeneity among trials was calculated using the I^2 measure of inconsistency.

Narrative review on mechanisms

We searched the Introduction and Discussion sections of included studies in the systematic review, to identify authors' hypothesized mechanisms of the relationship between inequality and depression. We subsequently considered hypothesized mechanisms in a recent review regarding the causal links between inequality and health [3]. We then compiled a list of hypothesized mechanisms based on their plausibility, specifically the extent to which the purported mechanisms were supported by the data reported in the included studies. We sought to improve the overall coherence of these by grouping different hypothesized mechanisms into conceptual categories. Finally, we supplemented these findings with an analysis of the variability in findings from the studies included in our systematic review. This led to consideration of a number of other factors that might inform these mechanisms, namely the geographical unit of analysis, level of national development of the study country, effects of income inequality on low vs high income groups, cultural variations across countries, broader political and historical context, life course or developmental stage considerations, as well as gender and methodological considerations.

RESULTS

Systematic Review of income inequality and depression

Searches of the listed databases using the search string as well as hand-searching reference lists identified 1894 potential articles. After screening titles or abstracts, 1813 were removed as they were irrelevant or clearly did not contain primary data. Full text reports were retrieved for 81 articles, which were assessed for eligibility against inclusion and exclusion criteria. Of these, 55 were removed as they did not contain primary quantitative data on the relationship between income inequality and depression, contained duplicate data or otherwise met exclusion criteria. Thus, 26 studies were included in this review (**Table 1**). The selection process for included studies is illustrated in **Fig. 1**.

[Insert Table 1 and Figure 1 here]

Study characteristics: The majority (18) of the 26 studies testing associations between income inequality and depression came from high-income countries, with 15 studies reported from the USA. In terms of geographical scale, 4 were conducted at the country level, 14 at regional level (state, county, district, municipality), and 8 at local area or neighbourhood level. A number of studies were conducted in specific populations: 5 in older persons only [12-16]; 4 in adolescents only [7, 17-19]; 1 in students aged 17-30 years old [20]; and 1 in low-income nursing assistants [21]. The most common measure of depression, used in 10 studies, was the Centre for Epidemiologic Studies Depression Scale (CESD); while 4 used the Composite International Diagnostic Interview (CIDI) and 2 used the Alcohol Use Disorder and Associated Disabilities Interview Schedule. Each of the remaining 10 studies utilized a different instrument. Godoy et al [22] investigated 655 adults in villages within the Bolivian Amazon and found a positive relationship between village-level Gini coefficient and experiences of 'sadness' over the last 7 days. Income inequality was most commonly measured using the Gini coefficient (21 studies), with the remainder using a ratio measure (e.g. 20%:20% ratio; P10/P90 ratio). Notably all country-level studies utilized the Gini coefficient; while ratio measures were more commonly used in local area-level studies (3/8) than in regional-level studies (2/14).

Associations between income inequality and depression: Nearly two-thirds (16 [62%]) of studies found a significant positive relationship between higher income inequality and increased risk of depression; while another 3 (12%) were significant in bivariate, but not multivariate regression analysis. Six studies (23%) found no significant relationship; while only 1 (4%) reported a negative relationship between income inequality and depression (Table 1).

Absolute income effect: Nineteen studies did not stratify their analysis by absolute income. Out of the 7 studies that stratified analyses by absolute income, two studies showed a significant effect of income inequality on depression only in the low-income participants, and two studies demonstrated that the effect size was the strongest in low-income participants. Studies demonstrating greater effects in low-income participants were conducted at either the regional level (k=2) or the local level (k=2). The 3 studies reporting no absolute income effect were conducted at either the regional level (k=2) or

the country level (k=1). In summary, at the micro-level, the one study of local geographic units of analysis showed impact of income inequality-by-low income, whereas at the macro-level, the one study using country geographic units did not show a low-income subgroup effect. In between these two levels, the four studies using intermediate regional geographic units were split 2-to-2 on positive for null findings for low-income subgroup effects.

Gender effect: Five studies stratified their analyses by gender. Of these, 3 found an association between income inequality and depression in females only [19, 23, 24], 1 detected no gender effect [4], and 1 found an association in men only and only in the bivariate analysis .

Age effect: Although none of the studies stratified their analyses by age group, several were conducted in exclusively adolescent or older adult populations and some interesting observations can be made here. Of the 4 studies in adolescents only, 3 found a significant association between income inequality and depression – 2 in the regression [19]; [18] and 1 in bivariate analysis only [17]. Of the 5 studies in older adults only, 3 found an association between income inequality and depression – 2 in regression [13], [12] and 1 in bivariate analysis only [16] – 1 found no association [15] and 1 found a negative association [14]. The longitudinal study by Muntaner et al [21] was conducted in 241 low-income nursing home assistants in the USA and found a positive relationship between county-level Gini coefficient and increasing depression risk.

Ethnicity: Participant ethnicity was only reported in 8 studies, with only 3 conducted in specific ethnic populations: in nearly 9000 Hispanic adults aged 60 and older in Mexico [15]; in nearly 6500 Black and Hispanic adolescents in the USA [7]; and in Tsimane villagers in the Bolivian Amazon [22]. Notably, 2 out of 3 of these studies did not find a relationship between income inequality and depression. Of the 5 studies that stratified their analysis by ethnicity, only 1 found an ethnicity effect on the income inequality-depression relationship, with the relationship most pronounced in middle-class Blacks in a population-representative panel study in South Africa [4].

Study design: Of the 26 studies, only 6 were longitudinal, allowing for temporal analyses. Of these, 5 reported a significant positive relationship between income inequality and depression [4, 21, 24, 25]; and 1 reported no association [26]. All except two studies had large sample sizes of over 1000 participants (ranging from 1355 [27] to 293,405 [28]).

Meta-analysis: Twelve studies were included in the meta-analysis based on availability of event rates of depression to calculate risk ratios. Quality ratings of the included studies using SAQOR ranged from high to moderate (see **Table 2**). The pool of studies included 6 United States studies, 3 multi-country studies, 1 United Kingdom study, 1 Brazil study, and 1 South Africa study. Two of the U.S. studies were limited to older adults (>50 years of age). One study only included women [23]. One multi-country study limited the sample to university students [20]. Four studies employed three strata of inequality [14, 23, 29, 30]; one study employed four strata [27] and two studies employed quintiles [28, 31]. All were re-categorized as dichotomous as described earlier. Ladin et al [13] divided the sample of 10 European countries into 5 high inequality countries versus 5 low inequality countries. We followed a similar procedure for Steptoe et al.'s [20] study of 23 countries by creating a group of 11 low inequality countries and 12 high inequality countries. For the South Africa data, we extracted information from the two

studies that employed the South Africa National Income Dynamics Study [4, 26]. Data were available from Burns et al.[4] for the depression prevalence by municipality. Adjaye-Gbewonyo et al [26]calculated Gini coefficients for each municipality based on the 2011 census. We integrated depression prevalence data and Gini coefficient data by municipality and split the dataset into approximate halves around a Gini coefficient of 0.75. Unadjusted data were used for all studies when available. Unadjusted data were not presented for Cifuentes et al [30] and rates were adjusted for age, gender, and marital status. Fan et al [28] only presented adjusted prevalence figures: rates were adjusted for sex, age, race/ethnicity, marital status, education, household income, and chronic medical conditions.

Based on the 12 studies with dichotomized inequality groupings, the pooled risk ratio was 1.19 (95% CI 1.07, 1.31), demonstrating greater risk of depression in populations with higher income inequality relative to populations with lower income inequality (see **Figure 2**). The heterogeneity was very high, $I^2=98\%$, which is likely due in part to the diversity of sample designs, populations, measures used, and adjustments and weighting in analyses. In sensitivity analyses using a leave-one-out strategy, the meta-analysis was re-run leaving one study out in each analysis. In all sensitivity analyses, the pooled risk ratio was significant for higher income inequality associated with increased risk of depression ($p<.05$). Multiple studies conducted moderator analyses by stratifying the samples by gender, absolute income, country economic status, and ethnicity/race. Because of the limited number of studies with these secondary analyses with outcomes that could be dichotomized by depression and income inequality, we did not create sub-pools of studies or employ meta-regression to assess these potential moderators.

Narrative review on mechanisms

Based on the results of the systematic review, a number of potential mechanisms of the inequality-depression relationship may be hypothesized, operating at different ecological levels, from the individual, to the neighbourhood to the regional or national levels. These are set out in our conceptual framework (Figure 3).

[Insert Figure 3 about here]

At the individual level, the effects of income inequality on general health are primarily mediated through *psychological stress* [3]. This may be regarded as the final, common pathway or proximal mechanism mediating the effects of income inequality on depression in a range of other mechanisms.

At the neighbourhood levels, two mechanisms are hypothesized. The first is the *social comparison* or *status anxiety* hypotheses [32] which argue that comparing oneself to those who are better off in a highly unequal context creates feelings of social defeat or status anxiety [4, 33]. In a similar vein, Walker et al [34] hypothesize feelings of withdrawal and shame experienced by those in lower social positions. The second neighbourhood mechanism is the *social capital* hypothesis, which argues that income inequality erodes social capital, including two key components: *cognitive social capital* (especially social trust) [18] and *structural social capital* (the organisational and structural arrangements which facilitate social interactions and build social trust and cooperation, for example through group membership) [35]. Social capital is critical because it facilitates *social*

integration (a dynamic process by which members of a social group participate in dialogue or collaborate to achieve a shared social goal). Income inequality therefore undermines social capital and social integration, promoting social isolation, alienation and loneliness. It also undermines perceptions of fairness (a component of trust) [33]. Ichida et al (2009)[36] confirmed the social capital hypothesis in Japan, showing that social capital (measured as social trust) mediated the effect of inequality on self-rated health. This is supported by Durkheim's theory of social integration and social regulation [37], the failure of which he linked to suicide. Perceptions of fairness and trust are also consistent with Merton's *anomie disjunction* between society's goals and normative structures governing the means to attain that goal [38]. This is more exaggerated in societies with higher levels of inequality, where the means of attaining upward social mobility are severely constrained, and therefore there is a disjunction between society's goals or aspirations (for example of acquiring wealth) and the means to attain that goal, which are not accessible to those who are lower on the socioeconomic hierarchy. Both these mechanisms may be more pronounced at certain developmental stages, in particular in adolescence, when social trust and group membership are being established, and when most mental health problems emerge. For example, social status was associated with depression among adolescents whose parents have lowest levels of education [7]. In addition, social comparison may be amplified by other group identities, for example ethnic identities or gender.

At the national or regional levels, the *neo-material* hypothesis proposes that greater income inequality coexists with a wide range of material deprivations which are relevant to health [39]. These include lack of investment in housing, education and public transport as well as pollution control, healthy food availability and accessibility of healthcare. Thus, greater inequality leads to worse physical health (for example due to less public spending on healthcare in more unequal societies), leading in turn to worse depression. This hypothesis was supported by Muramatsu et al [12], who found that the association between inequality and depression was stronger among those with more illnesses. However, it is worth noting Zimmerman et al's contrary finding that more unequal states did not in fact spend less on healthcare [40]. Also, Fone et al[32] argue that it is unlikely that the neo-material hypothesis would apply at small area level (such as neighbourhoods), as resource allocation decisions for major services are not typically made within these areas.

In all of these potential mechanisms, it is important to consider a range of *other factors* that may moderate the relationship between income inequality and depression, reflected in these studies. The first is the *geographical unit of analysis*. Of the 6 studies that found no association, 5 conducted analysis at the district level, and national level effects appear to be more marked in the studies included in this review. According to Ahern et al [27], this is likely to be at least partially influenced by the nature of the area demarcation. For example, if a neighbourhood includes strong contrasts of high versus low income groups, the effect of income inequality is likely to be more pronounced at that neighbourhood level. But frequently neighbourhoods involve homogenous demarcations, and the effect may then be less pronounced. In a similar vein, Fone et al [32] found that income deprivation was more important than income inequality for common mental disorders at the local neighbourhood level, but that the effect of income inequality became more evident at larger regional levels in Wales. Chen et al [41] is particularly interesting in this regard; their study showed that the income

inequality/health relationship is more evident at the state level than the county level, when comparing US counties and US states (although this was true for health insurance as an outcome but not for self-reported health). Thus, it may be possible to argue that different mechanisms operate at different geographical levels or units of analysis.

A second important consideration is the *level of national development*, for example as measured using the Human Development Index (HDI). One study shows a possible interaction with country HDI level, namely that the inequality/depression association is more evident in higher HDI countries [30]. Income inequality may matter in high-income countries with low levels of poverty, but not in low or middle-income countries with high levels of poverty, where the effects of material poverty and absolute income may be more significant.

A third consideration is the *effects of income inequality on low vs high income groups*. Within countries, the effect of inequality on depression appears to be more pronounced among low-income groups [27]. This is consistent with the above hypothesis regarding upward social mobility, the constraints of which are more likely to be experienced by low income groups. The hypothesis that inequality is bad for high-income groups too is also proposed by other authors [3]. Kawachi et al [42] argue that the wealthy in highly unequal societies cannot escape the “pathologies of poverty” including crime, violence and exposure to some infectious diseases.

A fourth consideration is *cultural variations across countries*. Although this may be difficult to test empirically, Steptoe et al [20] consider the results in a multi-country study alongside research on cultural variation along the axis of individualism and collectivism and the consequent association with depression. The likelihood of high levels of depressive symptoms was lower in more individualistic cultures, with 26% reduction in the odds of elevated symptoms with every unit change in individualism-collectivism score.

A fifth consideration is the *broader political and historical context* within which depression and inequality are measured. For example, in post-apartheid South Africa there have been expectations of rapid social improvements, and there is clear evidence of improvements for some, but for those who remain in poverty there is a sense of frustration, alienation, disappointment and anger, manifest in frequent service delivery protests [4]. This may well exaggerate the effects of income inequality on depression.

A sixth consideration is *life course or developmental stage*. According to one study, childhood social class is more predictive of self-rated health than adult social class [25]. Prevalence of depression varies substantially across the life course [43], and early exposure to inequality may well affect later mental health. Most of the studies included in this review lack a life course or developmental framework, even when the effect of inequality on specific age groups is examined, for example in the case of adolescent depression.

A seventh consideration is *gender*. In at least one study the effect of inequality on depression was found for adolescent girls but not for boys. This was confirmed by Hiilamo et al [44] in a study in Finland, which explored changes in municipality-level

relative poverty and antidepressant prescriptions from 1995-2010, and found a positive association for young adult females.

A final consideration is the *methods* employed by the studies themselves. For example, contrary to the finding that the association between inequality and depression was less evident in more local, homogenous populations, Fiscella et al [25] did find a positive association at local level. This finding may be attributable to the study design, which employed longitudinal, multi-level methods and baseline data were collected on county income inequality, individual income, age, sex, self-rated health, level of depressive symptoms, and severity of biomedical morbidity.

Figure 4 presents a framework on the pathways between inequality that can lead to depression, integrating the various mechanisms and moderators hypothesized above. This ecological conceptual framework may explain heterogeneity of findings, and also highlight areas for future research.

[Insert Figure 4 about here]

DISCUSSION

In this article we present, to our knowledge, the most comprehensive review of the literature on income inequality and depression. Despite the relatively small evidence base (especially from LMIC), and methodological limitations of the available evidence, we report a compelling quantitative association between income inequality and depression, extending the findings of the most recent review on this subject [5]. Even though absolute effect size was relatively small (risk ratio of 1.19), the translation of this risk to population mental health is likely to be very large. Further, we note that the primary outcome of the studies we included was a categorical outcome of ‘case-level’ depression; this is a crude indicator of population mental health and it is very likely that the associations between income inequality and mood are likely to be greater when the latter is treated as a continuous dimension, which could capture dose-effects of the degree of inequality on the distribution of affective symptoms. If our findings are indicative of a causal relationship, then we should expect worse mental health globally in the years ahead as income inequality is continuing to increase in most countries, making the UN Sustainable Development Goal targets for mental health even harder to achieve [45]. This is especially likely to be the case for disadvantaged or vulnerable groups in the population that already bear a disproportionate burden of mental health problems, such as women, adolescents, older adults and low-income groups.

The heterogeneity of the findings of studies across populations and over time is not surprising given the complexity of likely mechanisms and pathways, and their moderation by a range of contextual factors which we have attempted to delineate. These mechanisms operate at different ecological levels, but the final pathways are, as with any mental health problem, uniquely individual, moderated by a range of distal and proximal determinants. Although we do strongly endorse the need to ‘unpack’ these mechanisms through carefully designed studies, such research is likely to be complex, time-consuming and costly (as outlined below). Thus, we propose that the evidence which already exists is sufficient to take pre-emptive action to halt the potentially damaging effects of income inequality on the mental health of populations.

Implications for reducing the global burden of depression

Our ecological framework offers indications for the kinds of interventions which hold promise. Obviously, at the national or regional level, economic policies which promote the fair distribution of income, for example through a universal basic income and progressive taxation, are potentially the most tractable [46]. Additionally, promoting social policies that reduce gender inequities which systematically disadvantage women, and income inequities such as universal health coverage and expanding opportunities for educational attainment can reduce the impact of the neo-materialist effect on low-income populations.

In addition to structural interventions, the mechanisms we propose suggest attractive opportunities for proximal interventions to mitigate the adverse personal consequences of living in unequal societies. The Disease Control Priorities project has recommended a series of interventions for the prevention, treatment and care of mental health problems, most of which can be delivered through community and routine health care platforms, using task-sharing by non-specialist providers [47]. Particularly relevant examples of such interventions would include interventions in early life through adolescence to build resilience (for example, parenting interventions and life skills interventions), as well as promoting early detection and self-help for mood and anxiety disorders (for example, through improving access to empirically supported digital apps, especially with guidance) [48]. A recent systematic review has demonstrated the effectiveness of psychological therapies delivered by non-specialist in low-resource settings [49]. Such therapies may be modified when delivered in the context of high inequality through a focus on mechanisms related to cognitive comparisons leading to social defeat and worthlessness. For example, interventions that focus on demoralization [50, 51] may be especially important in highly inequitable societies and communities. Third-wave psychological therapies that address include components of self-validation may also counter social defeat and worthlessness associated with depression and suicidality [52]. Third-wave therapies are currently being adapted for delivery in settings of extreme poverty [53].

Interventions that harness the power of social networking sites to build social capital also show promise at mobilizing specific sub-groups and reducing the risk of social isolation. Pilot programs in Mexico and South Africa have shown encouraging results at reducing levels of anxiety, depression and feelings of social isolation in adolescents and pregnant women with HIV/AIDS [54-57]. Marshall et al [14] report that social interactions and networks among sub-groups in mixed-income-neighbourhoods cushion the impact of income inequality on depression; thus, interaction between high-income groups and low-income groups may mitigate risks disproportionately experienced low-income neighbourhoods. Other research points to the role of social interactions, cultural biases and belief systems in maintaining and perpetuating conditions for income inequality [58, 59]. Thus, it is important that we develop interventions that target social and cultural aspects of inequalities (for example, designing institutional platforms such as schools and health institutions) to enhance social capital, and all interventions must be guided by a strong emphasis on equitable coverage. This is consistent with a shift from cultural competency to “structural competency”, which emphasizes the need for mental health providers to be knowledgeable of context and resources of their patients and actively

draw upon resources to mitigate social and structural determinants of mental illness [60].

Strengths and limitations

There are limitations to our review which should be noted. First, publication bias, namely a propensity for journals to publish positive findings, may overestimate the strength or consistency of the association between inequality and depression. Second, there was a heterogeneity of outcome measures for depression, with some studies not utilizing validated diagnostic assessments and a diversity in sample size and sampling strategies, all of which impact depression prevalence estimates [61]. Third, the majority of studies failed to stratify their samples by important socio-demographic factors such as gender, age and absolute income, limiting our ability to explore in greater depth the controversial question of whether the negative effects of income inequality are evenly distributed across the population or whether certain vulnerable groups are particularly affected by income inequality [62]. Regarding the meta-analysis, we were unable to use unadjusted data across all studies, and it is likely that the studies that adjusted inequality by outcomes reflect aspects of the association differently than unadjusted studies. In addition, the inequality cut-off for each study was different based on the relative levels of inequality within the sample. For example, inequality levels within the South Africa dataset are high on average compared to European nations. Therefore, our findings are reflective of regional and national relative income inequality rather than the effect of absolute inequality (e.g., dividing all samples at one specific Gini coefficient cut-off which would have been arbitrary given that inequality is, by definition, a relative measure). The meta-analysis also demonstrated high heterogeneity. As the pool of studies examining income inequality and mental health grow, it will be possible to do more subgroup analyses with studies that employ comparable designs and samples in order to reduce heterogeneity.

Implications for research

Future research should aim to unpack the mechanisms underlying the association between inequality and depression, in particular to explain the heterogeneity of findings across contexts. Such studies should involve prospective studies in diverse nations, in particular in a range of LMIC which are witnessing rapid socio-economic changes, such as the BRICS nations. Notably, Brazil and South Africa, which both have high levels of inequality, showed comparable high effects of income inequality on depression in our meta-analysis (risk ratios were 1.38 and 1.33 respectively). Future studies should include the effects of changes in income inequality (at different geographical levels and population sub-groups of analysis) over time, with embedded assessments of hypothesized individual and area-level mechanisms; and evaluation of the effects of interventions addressing the proposed pathways. Additionally, further exploration of the studies with equivocal findings, such as countries with high levels of income inequality which did not show an increased prevalence of depression, should also be studied to understand possible structural differences, policies or sociocultural factors that mitigate this effect. It is important to methodologically take note of the historical, political, and cultural forces that may shape the association between income inequality and depression in developing countries. Modelling contextually grounded

forces, can shed greater light on the precise mechanisms that may be operating in these contexts.

Conclusion

Mental health professionals and policy makers, regardless of their political persuasion, must carefully assess the evidence presented in this review to shape their position with regards to the ideologically contentious issue of income inequality. We think that the evidence is compelling and call for both policy makers and professionals to strenuously oppose neo-liberal economic policies, which are destroying the fabric of our societies. Indeed, these policies are now widely acknowledged to be fuelling not just inequality, but also unpredictable and catastrophic fluctuations in the economic fundamentals of countries ^[46] and climate, both of which have also been demonstrated to be associated with poor mental health outcomes ^[63-67]. Mental health professionals must ally with other stakeholders in government and civil society who are arguing for a fairer, more equitable distribution of income as this is a major social determinant of poor mental health, while also drawing attention to the need for greater investments in proven

Table 1: Papers identified in systematic review reporting associations between income inequality and depression

Study	Sample	Study design	Country	Geographical unit of analysis	Inequality measure	Inequality range (Gini)	Depression measure	Absolute income effect	Gender effect
POSITIVE ASSOCIATION									
Ahern et al 2006	1,355 adults aged 18 and over	Cross-sectional	USA	Local (neighbourhood)	Gini	0.37-0.51	Brief Symptom Inventory Depression Scale	low income only	na
Burns et al 2017	25,936 adults aged 15 and over	Longitudinal panel	South Africa	District	P90/P10 ratio	0.46-0.68	CESD-10	low income only	no interaction
Chiavegatto et al 2013	3,542 adults aged 18 and over	Cross-sectional	Brazil	Municipality	Gini	0.18-0.34 (means for 1 st & 3 rd tertiles)	CIDI	na	na
Cifuentes et al 2008	251,158 adults	Cross-sectional	65 countries	Country-level	Gini	0.25-0.74	DSM-IV and Diagnosis Item Properties Scale (DIPS)	high HDI countries only	na
Fan et al, 2011	293,405 adults aged 18 and over	Cross-sectional	USA	State	Gini	0.40-0.54	PHQ-2	na	na
Fiscella et al 1999	6,913 adults aged 25-74	Longitudinal	USA	Local	ratio*	0.18-0.37 (ratio range)	General Well-Being Schedule-depression subscale (GWB-D)	na	na

Godoy et al 2006	655 adults aged 16 and over	Longitudinal panel	Bolivia	Local (village)	Gini	0.71 (0.08) (mean (SD))	'Sadness' item®	na	na
Kahn et al 2000	8,060 women with children aged 26-48 months	Cross-sectional	USA	State	Gini	0.415-0.430 (cutoffs for 1 st & 3 rd tertiles)		CESD	Effect for all incomes but most pronounced in low income women with children
Ladin et al 2010	22,777 adults aged 55 and over	Cross-sectional	10 European countries	Country-level	Gini	0.25-0.36	Euro-D Scale	na	na
Messias et al 2011	235,067 adults	Cross-sectional	USA	State	Gini	0.410-0.495	PHQ-8	na	na
Muntaner et al 2006	241 low income nursing assistants	Longitudinal	USA	County	Gini	0.31-0.48	CESD Revised (RCES-D)	na	na
Muramatsu et al 1996	6,640 adults aged 70 and over	Cross-sectional	USA	County	Gini	Not reported	CESD	no absolute income effect	na
Pabayo et al 2014	34,653 adults aged 18 and over	Longitudinal	USA	State	Gini	0.42-0.45 (cutoffs for 1 st & 5 th quintiles)	Alcohol Use Disorder and Associated Disabilities Interview Schedule-IV	no absolute income effect	effect only in women
Pabayo et al 2016	1,614 adolescents aged 14-19	Cross-sectional	USA	Local (census tract)	Gini	0.33-0.65	Modified Depression Scale	na	effect only in girls
Steptoe et al 2007	17,348 students aged 17-30	Cross-sectional	23 countries	Country-level	Gini	0.20-0.59	Beck's Depression	na	na

							Inventor y		
Vihjalms dottir et al 2007	5,958 adolesce nts aged 15-16	Cross- sectiona l	Iceland	Local (neighbo urhood)	20%:20 % ratio	4.47- 39.90 (ratio range)	SCL-90 (12 depressi on items)	na	na
EQUIVOCAL ASSOCIATION									
Choi et al 2015	34,994 adults aged 50 and over	Cross- sectiona l	USA	County	Gini	0.33- 0.60	CESD-8	na	na
Goodma n et al 2003	13,235 adolesce nts mean age 16	Cross- sectiona l	USA	Local (school)	ratio*	19.7- 40.5 (ratio range)	CESD	na	na
Henders on et al 2004	42,862 adults aged 18 and over	Cross- sectiona l	USA	State	Gini	0.38- 0.50	Alcohol Use Disorder and Associat ed Disabilit ies Intervie w Schedul e-IV	na	men only in bivariate
NO ASSOCIATION									
Fernand ez-Nino et al 2014	8,874 adults aged 60 and over	Cross- sectiona l	Mexico	State & municip al	Gini	Not reporte d	CESD	na	na
Adjaye et al 2016	9,664 adults	Longitu dinal panel	South Africa	District	Gini	0.46- 0.68	CESD-10	na	na
McLaug hlin et al 2012	6,483 adolesce nts aged 13-17	Cross- sectiona l	USA	Local (census tract)	Gini	0.59- 0.65 (cutoffs for 1 st & 4 th quartiles)	CIDI (modifie d)	na	na
Sturm et al	9,585 adults	Cross- sectiona l	USA	Municip ality	Gini	0.38- 0.54	CIDI	na	na
Rai et al	187,496 adults aged 18 and over	Cross- sectiona l	53 countrie s	Country- level	Gini	0.25- 0.74	CIDI	no absolute income effect	na

Zimmerman et al 2007	4,817 adults aged 40-45	Cross-sectional	USA	County	percent rich' ratio	Not reported	CESD	na	na
NEGATIVE ASSOCIATION									
Marshall et al 2014	10,644 adults aged 50 and over	Cross-sectional	UK	Local (neighbourhood)	Gini ^s	Not reported	CESD	most salient in low income people	na
					Significant in bivariate but not in regression				
					Not significant				
					Inverse relationship; lower depression in high inequality areas				

Figure1: PRISMA FLOW DIAGRAM – INEQUALITY AND DEPRESSION

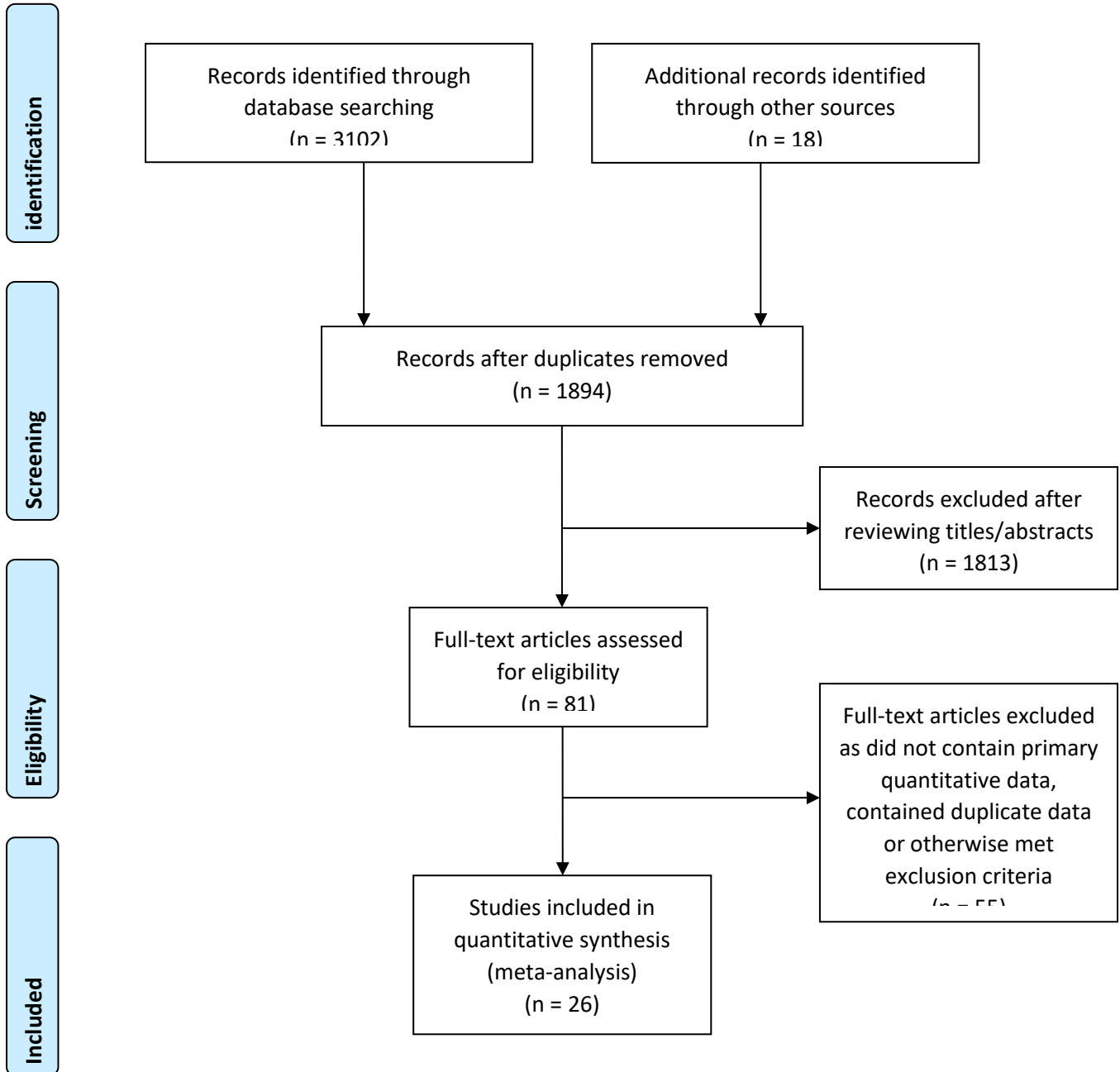


Table 2: Quality assessment of papers included in meta-analysis (SAQOR tool)

Paper	Sample	Exposure / Outcome measures	Distorting influences	Reporting of data	Overall Quality
Ahern et al 2006	Adequate	Adequate	Adequate	Adequate	High
Ladin et al, 2010	Adequate	Adequate	Unclear	Unclear	Moderate
Chiavegatto et al 2013	Adequate	Adequate	Adequate	Adequate	High
Kahn et al, 2000	Adequate	Adequate	Adequate	Unclear	Moderate
Choi et al, 2015	Adequate	Adequate	Adequate	Adequate	High
Fan et al, 2011	Adequate	Adequate	Adequate	Adequate	High
Henderson et al, 2011	Adequate	Adequate	Adequate	Adequate	High
Cifuentes et al, 2008	Adequate	Adequate	Adequate	Unclear	Moderate
Sturm et al, 2002	Adequate	Adequate	Adequate	Inadequate	Moderate
Marshall et al, 2014	Unclear	Adequate	Adequate	Adequate	Moderate

Table 3: Figure. Meta-analysis of the association between income inequality and depression.

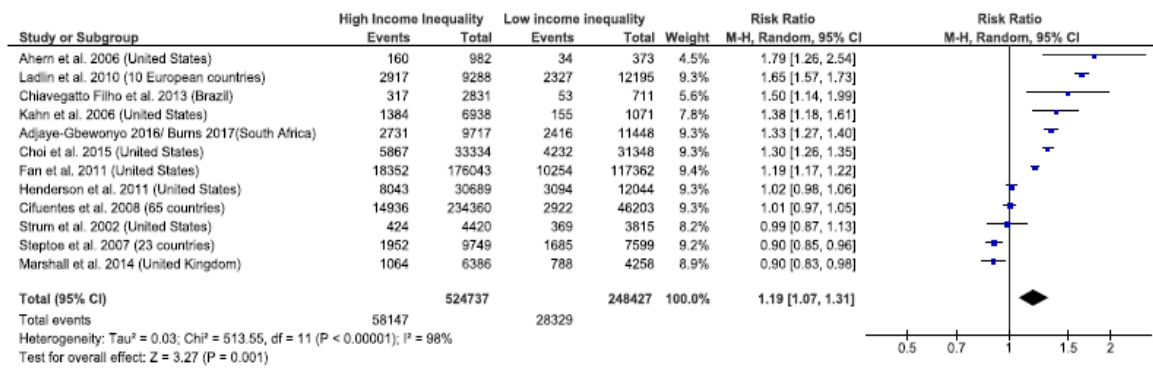


Figure 3: Conceptual framework, depicting hypothesized mechanisms of the effect of income inequality on depression

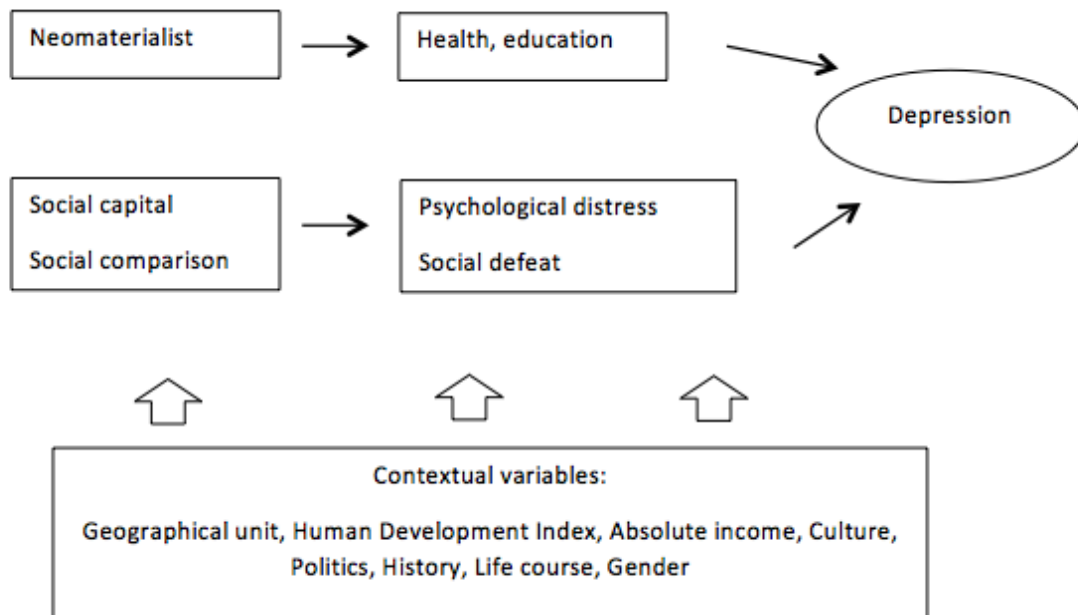
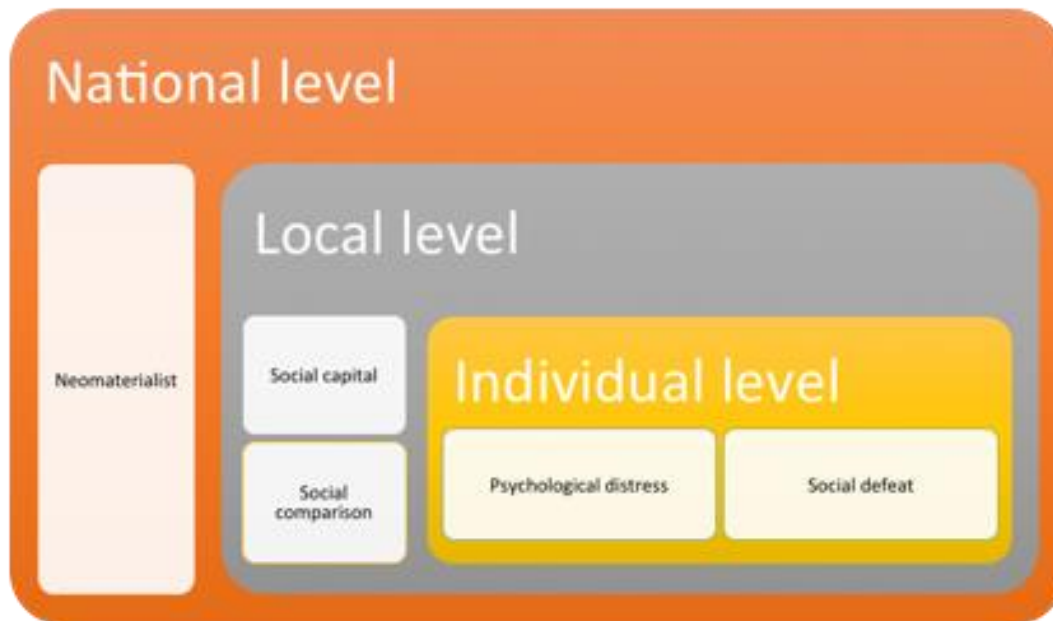


Figure 4. Differential effects of inequality/depression mechanisms at different geographical levels



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