

Economic inequality and depressive symptoms: an individual versus aggregate-level analysis using Mexican survey data

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ABSTRACT

Background There is a lack of consensus on the relationship between economic inequality and mental health, which may be due to the measures of inequality used in empirical studies. We studied this relationship using individual and aggregate measures of economic inequality, and tested whether there is an interaction between the individual and the aggregate levels.

Methods We used data from a nationally representative Mexican health survey (Encuesta Nacional de Salud y Nutrición, n=44 324) where depressive symptoms were measured through a validated 7-item version of the Centre for Epidemiologic Studies Depression Scale. We estimated multilevel models employing aggregate inequality measures (Gini coefficient) and the individual-level framework of advantageous and disadvantageous inequality, where economic status comprised absolute wealth, relative deprivation and relative affluence.

Results The three facets of economic status were independently associated with depressive symptoms, while Gini coefficients showed no associations. Absolute wealth and relative affluence were associated with lower depressive symptoms while relative deprivation was associated with higher depressive symptoms. However, interaction models indicated an interplay between the Gini and relative affluence: higher status became a risk factor at high levels of aggregate economic inequality. For those at the top of the economic hierarchy, being in a context of high inequality more than doubles our measure of depressive symptoms—from 2.08 (95% CI 1.28 to 2.87) to 6.29 (95% CI 4.1 to 8.5) for state inequality and from 2.40 (95% CI 1.64 to 3.16) to 6.24 (95% CI 3.87 to 8.62) for municipal inequality.

Conclusion We provided a novel perspective on the economic gradient in mental health, and on how high aggregate economic inequality may harm also the better off. Policymakers need to consider the consequences of economic inequalities, which can harm the mental health of both those at the bottom and the top of the socioeconomic ladder.

Understanding the relationship between mental health and economic inequality is vital given that inequality is increasing in many parts of the world.^{6 7} Even in areas such as Latin America, which witnessed a sharp decrease in inequality in the early 2000s, inequality is increasing again as a result of austerity measures and regressive policies.⁸ If inequality triggers mental health problems, an increase in economic disparities would bear significant human and economic costs for society.

Of two recent systematic reviews of the literature on the relationship between aggregate indicators of economic inequality (eg, the Gini coefficient) and mental health problems, one⁹ included 27 studies and found that 9 reported a positive association, 10 mixed results and 8 no association. The other¹⁰ focused on depression and analysed 26 studies, finding that 16 studies reported a positive association, 3 mixed results, 6 no association and 1 a negative association. While these systematic reviews have limitations such as the heterogeneity of the included papers in terms of methods, outcome variables and samples, as well as the low number of studies in low and middle-income countries, they do reflect the lack of a strong consensus in the literature.

The mixed evidence on the relationship between aggregate economic inequality and mental health problems found by a number of studies has been ascribed¹¹ to the inability of aggregate-level indicators to detect aspects of economic disparities which are key determinants of mental illness. Aggregate indicators would overlook the individual-level dynamics of 'superiority and inferiority in relation to others through which inequality is likely to have its effect' (p 513).¹¹ Individuals have *lower* economic status relative to some people in society and *higher* economic status relative to others, depending on their specific positions along the economic ladder. The experience of lower and higher economic status is therefore idiosyncratic and cannot be captured by aggregate indicators. Yet, there is no study in the literature illustrating the existence of such dynamics.

We carried out an innovative analysis of the economic gradient of depression and found evidence of an interaction between the individual and the aggregate levels. We employed the individual-level framework of advantageous and disadvantageous inequality,¹² where economic status comprised an absolute standard of living component (eg, income or wealth) and two relative standards of living components: relative deprivation and relative

INTRODUCTION

Depression is a leading cause of disability and global burden of disease worldwide.¹ The health toll it takes is on the rise, in particular in low and middle-income countries.² Economic inequality has been argued to be a risk factor for depression through detrimental effects on social cohesion and trust, and through an increase in chronic stress, insecurity, violence and alienation.^{3–5}



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affluence, quantifying, respectively, the extent to which individuals or households are worse or better off than others. While health research has investigated the role of relative deprivation,¹³ the role of relative affluence has been neglected. The joint inclusion of these three variables in multivariable regressions enabled us to disentangle their specific roles, and to draw a more comprehensive picture of how one's position in the economic ladder is related to depression.

METHODS

Data source

We used data from the 2012 Mexican National Survey on Health and Nutrition,¹⁴ a large nationally representative cross-sectional household survey compiled by the Mexican National Institute of Public Health. One randomly chosen adult per household was interviewed, based on a stratified, multistage probability sample design and employing the 2010 national census as a sampling frame (response rate=87%). We were able to use 44 324 observations out of the 46 277 surveyed adults (aged 20+), where 2.4% of observations were dropped due to missing values on the depressive symptoms module and 1.9% on sociodemographic questions.

Main variables

Information on depressive symptoms was elicited within the survey through a validated¹⁵ version of the Centre for Epidemiologic Studies Depression Scale. Respondents were asked about weekly frequency of occurrence of seven depressive symptoms, with response values on a 4-point scale ranging from 0 to 3 for, respectively, 'less than a day', '1–2 days', '3–4 days' and '5–7 days' (see online supplemental appendix A). We derived a continuous variable running from 0 (no symptoms) to 21 (highest) by adding up for each individual the numerical value of their scores.

Individual-level economic status comprises absolute standards of living, relative deprivation and relative affluence. Following a widespread approach for the measurement of absolute standards of living in low and middle-income countries,¹⁶ we employed quartiles of a wealth index computed through polychoric principal component analysis (PCA) using 38 survey items on dwelling characteristics, access to services and utilities and durable goods ownership (for details see online supplemental appendix B). We measured relative deprivation and relative affluence by computing the Yitzhaki measures¹⁷ from our wealth index, so that for each individual we obtained a continuous variable of both facets of relative standards of living. Denoting individual i 's and individual j 's wealth with y_i and y_j , respectively, for an increasingly ordered wealth vector $y = (y_1, \dots, y_N)$, the Yitzhaki measures are:

$$\text{RelDepr}(y_i, y_j) = \sum_{i=j+1}^N \frac{y_i - y_j}{N},$$

$$\text{RelAffl}(y_i, y_j) = \sum_{i=1}^{j-1} \frac{y_i - y_j}{N}$$

N is the size of the reference groups, identified as the people living in the same state or municipality for state/municipal models—for further conceptual and empirical details on all our standards of living measures see online supplemental appendix C.

At the aggregate level, we included the Gini coefficient of economic inequality and mean wealth to control for the marked geographic heterogeneity in economic development in Mexico. These were calculated from the 2010 Mexican census using polychoric PCA at both the state ($n=32$) and municipality ($n=712$) levels.

Additional variables

We included a range of potential confounders that in the literature have been found to be related to our variables of interest and adult depression. These are sex, age and age squared,¹⁸ level of education and employment status,¹⁹ household size and marital status²⁰ and health-related stressors^{21 22} (number of chronic illnesses, number of limitations in daily activities, drinking habits, possessing health insurance and having been a victim of violent events in the previous 12 months). We also included the number of general hospitals per 100 population (obtained from administrative records) to control for healthcare supply.

Statistical analysis

We first examined the unadjusted relationship between our outcome variable and our inequality indicators by plotting prediction lines from unadjusted ordinary least squares (OLS) regressions. Multivariable analysis consisted of random effects multilevel linear regression models, chosen to account for the hierarchical nature of our data. Each model included all the variables shown in table 1 to account for possible confounders and sources of variation in depressive symptoms. In order to not rely on one specific level of aggregation, we produced two sets of results by estimating state models and municipality models (upper and lower panels of table 2); these differ in the specification of the aggregate-level component of the model and in the use of state or municipal variables (models 1–5 for state and 6–10 for municipality).

We also carried out several robustness checks for our multivariable analysis based on: (1) an alternative specification of our outcome variable; (2) alternative measures of absolute standard of living; (3) alternative measures of relative deprivation and relative affluence; (4) models accounting for missing variables through Stata's multiple imputation routine; (5) full stepwise regressions to check the stability of our results; and (6) the use of sample weights.

RESULTS

As can be seen in table 1, average age was 43.47 and average household size was 3.87. 57.26% of participants were female, 50.95% were married and 45.91% had primary or no education. Fifty-three per cent were employed, and slightly over one in five received benefits from a social programme. 12.58% had chronic health problems, 50.09% drank alcohol and 2.08% had been victims of violence.

In figure 1, we plotted linear predictions of depressive symptoms from unconditional OLS regressions using relative deprivation, relative affluence and municipal and state Gini coefficients. The differences in predicted depressive symptoms between the lowest and highest values of relative deprivation and relative affluence were 3.35 (95% CI 2.99 to 3.71) and -3.72 (95% CI -4.07 to -3.36), respectively. By contrast, for aggregate inequality these differences were essentially 0 (0.20; 95% CI -0.09 to 0.49) for state Gini and -0.13 (95% CI -0.29 to 0.03) for the municipal Gini.

Table 2 presents summary results from multilevel linear regression models—for full results see online supplemental appendix D. Being in the first wealth quartile was associated with an increase in depressive symptoms of between 0.592 (95% CI 0.39 to 0.79) and 0.412 (95% CI 0.20 to 0.63) for our state models and between 0.748 (95% CI 0.49 to 1.00) and 0.389 (95% CI 0.07 to 0.71) for our municipal models. Relative deprivation was also a risk factor. Postestimation depression predictions calculated from models 5 and 10 in table 2 indicated that depressive

Table 1 Descriptive statistics

	n=44 324
Dependent variable	
Depressive symptoms (CES-D)	3.68 (4.72)
Explanatory variables—individual level	
Economic variables	
Wealth quartile 1 (poorest)	10 934 (24.67%)
Wealth quartile 2	11 084 (25.01%)
Wealth quartile 3	11 143 (25.14%)
Wealth quartile 4 (richest)	11 163 (25.19%)
Relative deprivation	0.88 (0.94)
Relative affluence	0.93 (0.87)
Sociodemographic variables	
Household size	3.87 (1.85)
Female	25 379 (57.26%)
Age	43.47 (15.85)
Married	22 582 (50.95%)
No education/primary	20 348 (45.91%)
Secondary	12 489 (28.18%)
Postsecondary	11 487 (25.92%)
Employed	23 305 (52.58%)
Not employed	1847 (4.17%)
Retired	1589 (3.58%)
Student	827 (1.87%)
Housework	15 638 (35.28%)
Other activity	1118 (2.52%)
Social programme	9655 (21.78%)
Health variables	
Chronic health problem	5575 (12.58%)
Victim of violence	923 (2.08%)
Limitations in activities	0.17 (0.50%)
Does not drink	21 947 (49.51%)
Drinks yearly	10 764 (24.28%)
Drinks monthly	7213 (16.27%)
Drinks weekly/daily	4400 (9.93%)
Health insurance	35 401 (79.87%)
Explanatory variables—aggregate level	
State wealth	6.32 (1.09)
State Gini	0.18 (0.05)
State hospitals/population	0.024 (0.010)
Municipal wealth	6.70 (1.33)
Municipal Gini	0.14 (0.05)
Municipal hospitals/population	0.026 (0.024)

Source: Own calculations with data from ENSANUT 2012.

Data are n (%) or mean (SD).

CES-D, Centre for Epidemiological Studies Depression Scale.

symptoms for an individual with the highest value of relative deprivation were, respectively, 0.93 (95% CI 0.38 to 1.48) and 0.74 (95% CI 0.72 to 1.40) higher than for an individual with the lowest value (for complete postestimation results, see online supplemental appendix E).

The Gini coefficient was not associated with depressive symptoms, as was the case for its interaction with relative deprivation. The interaction between the Gini coefficient and relative affluence was instead consistently associated with depressive symptoms: the role of relative affluence varied at different levels

of the Gini coefficient, as higher levels of aggregate inequality tended to erode the negative coefficient of relative affluence. We quantified this effect by computing postestimation predicted depressive symptoms over the relative affluence domain from models 5 and 10, at high and low Gini, and we plotted them in figure 2. Two contrasting patterns emerged: predicted depressive symptoms were lower at higher levels of relative affluence, as one would expect from the negative regression coefficient of relative affluence, only in the case of low inequality. In the case of high inequality, the pattern completely reversed and we observed a positive slope: being richer than others was a protective factor against depression at low inequality, but it became a risk factor if inequality was high. For a person at the top of the economic hierarchy, living in a context of high rather than low inequality more than doubled the depressive symptoms burden—from 2.08 (95% CI 1.28 to 2.87) to 6.29 (95% CI 4.1 to 8.5) for our state models and from 2.40 (95% CI 1.64 to 3.16) to 6.24 (95% CI 3.87 to 8.62) for our municipal models. All the above results were qualitatively unchanged throughout our robustness checks (available in online supplemental appendix F).

DISCUSSION

To our knowledge, our study is the first to examine the relationship between health and the three individual-level distributional facets of economic status. Using Mexican data, we showed that these are independently related to depression—low standards of living and relative deprivation are risk factors while relative affluence is generally a protective factor against depressive symptoms. These results support the existence of material and psychosocial pathways to ill health,^{23–25} and reveal that within the psychosocial pathway both ‘looking upward’ (at richer individuals) and ‘looking downward’ (at poorer individuals) dynamics may be in play. In addition, we showed evidence of an interplay between the individual and the aggregate levels: in contexts of high inequality, the protective role of relative affluence vanished and being richer than others became a risk factor. The reversal of the role played by relative affluence adds a new perspective to the way the psychosocial pathway is commonly believed to operate—with lower and higher status in relation to others being a possible pathway to ill health.

By disentangling the roles of different facets of economic status, this paper enriches our understanding of the complex relationship between social standing and mental health. A body of research has provided consistent evidence of the detrimental role of *lower* position in the economic ladder—using indicators of subjective social status,²⁶ perceived relative standard of living²⁷ or objective relative deprivation and rank.^{28 29} However, relative affluence has been ignored by the health literature, despite the theory of downward comparisons that has long argued that a *higher* position in the social ladder can trigger a sense of accomplishment, or, at least, a sense of relief in knowing that there is a ‘buffer’ between you and the bottom of society.³⁰

The interaction between relative affluence and overall inequality draws attention to the interplay between the individual and the aggregate levels. Rather than being fixed, the role of an individual-level variable as a risk or a protective factor may depend on the aggregate context. Important insights may be missed by assuming that the two levels exert effects independently of one another. The finding that higher social standing turns into a risk factor in contexts of high inequality can be easily reconciled with intuition and with the literature. It is not surprising that being richer than others may turn into a stressor in contexts of high inequality, if we think that these are characterised by

Table 2 Multilevel linear regression models on depressive symptoms

	State inequality							
	(1)	(2)		(3)	(4)		(5)	
	Beta	95% CI	Beta	95% CI	Beta	95% CI	Beta	95% CI
Poorest quartile	0.543 (0.0000)	0.35 to 0.74	0.592 (0.0000)	0.39 to 0.79	0.431 (0.0001)	0.22 to 0.64	0.412 (0.0002)	0.20 to 0.63
Second quartile	0.610 (0.0000)	0.46 to 0.76	0.562 (0.0000)	0.40 to 0.73	0.506 (0.0000)	0.34 to 0.67	0.483 (0.0000)	0.31 to 0.66
Third quartile	0.349 (0.0000)	0.22 to 0.48	0.271 (0.0002)	0.13 to 0.41	0.268 (0.0002)	0.13 to 0.41	0.255 (0.0005)	0.11 to 0.40
Relative deprivation	0.173 (0.0000)	0.11 to 0.24			0.137 (0.0001)	0.07 to 0.21	0.216 (0.0115)	0.05 to 0.38
Relative affluence			−0.162 (0.0000)	−0.24 to −0.09	−0.102 (0.0123)	−0.18 to −0.02	−0.109 (0.0080)	−0.19 to −0.03
Gini	2.340 (0.5260)	−4.89 to 9.57	2.635 (0.4329)	−3.95 to 9.22	2.439 (0.3767)	−2.97 to 7.85	2.831 (0.2616)	−2.11 to 7.77
Relative deprivation Gini					−0.450 (0.3036)	−1.31 to 0.41		
Relative affluence Gini							1.342 (0.0048)	0.41 to 2.27
Observations	44 324		44 324		44 324		44 324	
Overall R ²	0.0881		0.0880		0.0882		0.0884	
Between R ²	0.3099		0.3199		0.3203		0.3355	
Within R ²	0.0867		0.0865		0.0868		0.0870	
Municipal inequality								
	(6)	(7)		(8)	(9)		(10)	
	Beta	95% CI	Beta	95% CI	Beta	95% CI	Beta	95% CI
Poorest quartile	0.681 (0.0000)	0.42 to 0.94	0.748 (0.0000)	0.49 to 1.00	0.504 (0.0013)	0.20 to 0.81	0.389 (0.0177)	0.07 to 0.71
Second quartile	0.652 (0.0000)	0.48 to 0.82	0.627 (0.0000)	0.43 to 0.83	0.516 (0.0000)	0.30 to 0.73	0.397 (0.0009)	0.16 to 0.63
Third quartile	0.360 (0.0000)	0.23 to 0.49	0.306 (0.0001)	0.15 to 0.46	0.266 (0.0011)	0.11 to 0.42	0.193 (0.0251)	0.02 to 0.36
Relative deprivation	0.135 (0.0014)	0.05 to 0.22			0.119 (0.0054)	0.04 to 0.20	0.297 (0.0004)	0.13 to 0.46
Relative affluence			−0.122 (0.0086)	−0.21 to −0.03	−0.098 (0.0366)	−0.19 to −0.01	−0.142 (0.0048)	−0.24 to −0.04
Gini	−0.707 (0.6798)	−4.07 to 2.65	−0.099 (0.9542)	−3.47 to 3.27	−0.371 (0.8294)	−3.74 to 3.00	0.984 (0.5861)	−2.56 to 4.53
Relative deprivation Gini					−1.282 (0.0140)	−2.30 to −0.26		
Relative affluence Gini							1.641 (0.0016)	0.62 to 2.66
Observations	44 324		44 324		44 324		44 324	
Overall R ²	0.0875		0.0874		0.0876		0.0878	
Between R ²	0.0942		0.0894		0.0951		0.0941	
Within R ²	0.0864		0.0864		0.0865		0.0867	

All models include a full set of control variables: number of people in the household, chronically ill, victim of violence, limitations in daily life activities, social programme recipient, health insurance, gender, economic activity, age, married, drinking frequency, hospitals per inhabitant.

For models 1–5 the second level is the state. For models 6–10 the second level is the municipality.

Original research

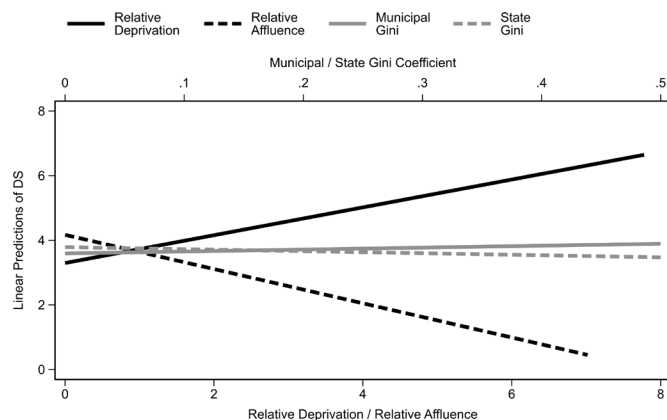


Figure 1 Unadjusted linear relationship between depressive symptoms and relative deprivation, relative affluence, municipal Gini and state Gini. DS, depressive symptom.

a greater likelihood of homicide, assault, burglary, robbery and theft,^{31–34} as well as by lower levels of trust, social cohesion and civic engagement.⁶

The evidence of an association of depressive symptoms with relative deprivation/relative affluence indicators, alongside the lack of association with Gini coefficients, sheds light on the argument around an innate shortcoming of aggregate inequality measures—specifically, their inability to detect the dynamics of superiority and inferiority triggered at the individual level by the socioeconomic divide.¹² No trace of such socioeconomic hierarchy-related individual-level dynamics would have been detected by commonly used aggregate inequality measures.

Since the range of mechanisms through which economic inequality exerts its effects are likely to differ across health outcomes, the explanatory role of aggregate inequality indicators may be outcome specific. For example, aggregate inequality emerged as a significant risk factor in a systematic review on mortality and subjective health.³⁵ This review also supported the hypothesis of a ‘threshold effect’ discussed in the literature^{36 37}—whereby the negative effects on health would become more appreciable when inequality exceeds a certain level. Our finding of a reversal of sign for relative affluence at high levels of inequality offers a possible explanation of such a threshold

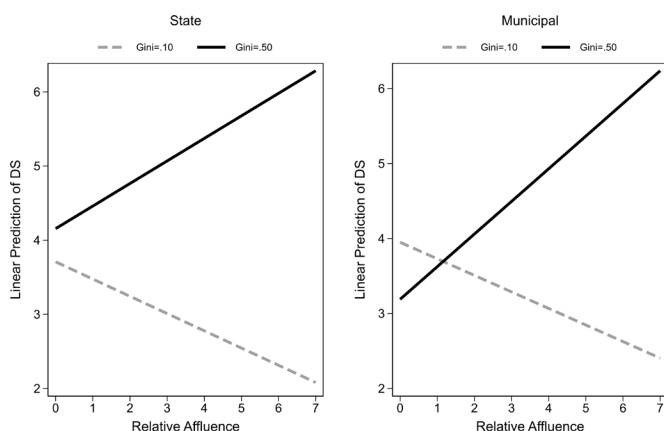


Figure 2 Average predicted depressive symptoms at different levels of relative affluence and Gini. Predicted depressive symptoms along the relative affluence domain, in the case of low and high values of the Gini coefficient (broken and solid lines, respectively), for model 5 (left graph) and model 10 (right graph). DS, depressive symptom.

effect: the negative effects on health detected by aggregate indicators beyond a certain inequality threshold may stem from a greater intensity of such effects for the worse off, and from their spread to the better off.

The main limitations of our study concern the use of cross-sectional data from one country. Similar analyses should be repeated for other countries, and extended to longitudinal data to obtain greater insights into the causal nature of the relationships observed. Wealth is a useful variable for the study of economic gradients in health, and its visible character makes it particularly suitable for the construction of indices of relative standards of living (see online supplemental appendix C). At the same time, a natural extension of this work would be to replicate it addressing inequalities in other economic domains (eg, income, wages, etc). Finally, since the data are from 2012 it would be useful to replicate our work with more recent surveys.

Future research should refine the joint analysis of the individual and aggregate levels—including the understanding of how, and to what extent, the way we measure and model one level affects the estimates obtained for the other. When individual-level variables such as relative deprivation/affluence are considered, a deeper conceptualisation of the phenomena involved and a greater awareness around the statistical properties of the indicators used are needed. This is because the ecological fallacy challenge is more complex than the case of Gravelle’s ‘statistical artefact’ thesis—which argued that the observed significance of aggregate-level inequality variables may be in part driven by the failure to appropriately account for diminishing marginal health returns of absolute income or wealth at the individual level.³⁸ That ecological fallacy is clear because the largely accepted ‘transfer’ properties of individual and aggregate-level indicators have unambiguous implications in the case of distributional changes: a regressive transfer (ie, from a poorer person to a richer one) brings about an increase in inequality, a loss for the donor and a (less-than-compensating) benefit for the recipient, regardless of their exact positions in the economic ladder—so that an increase in inequality goes in tandem with a decrease in aggregate welfare. However, in the case of relative deprivation/affluence, the picture is more complex. Distributional changes have implications which go beyond the individuals directly involved, extend to all members of the reference group and depend on the exact point of the distribution where a change takes place. The change in aggregate-level inequality measures like the Gini coefficient following a change in relative deprivation/affluence is also less clear-cut, and depends on factors including the relative deprivation/affluence measures used. Since any measure of inequality reflects value judgements which need to be made explicit,³⁹ the joint analysis of the aggregate and the individual levels will demand a stronger conceptual framework where the desirability as well as the compatibility of the principles underpinning measures at both levels is fully expounded.

Our work sends a clear message to policymakers. The toll taken by mental health problems is likely to increase if absolute poverty is not addressed and if societies become more unequal. Scarcity of resources is negatively related to mental well-being in accordance with the material pathway to ill health. In a country where 46.2% of the population lives in absolute poverty,⁴⁰ the preservation of mental well-being becomes an additional reason why the government should increase their efforts to fight poverty. The evidence that relative deprivation and relative affluence are, respectively, a risk and a protective factor for depressive symptoms emphasises the pervasive character of socioeconomic disadvantage: those at the bottom of the socioeconomic ladder are also at the bottom of the mental well-being ladder. This indicates

that disadvantages in different domains cumulate, and points to the need to reduce economic inequality to avoid that the less privileged are affected by multiple jeopardies. Finally, we show that being at the top of the socioeconomic hierarchy can turn into a risk factor in a context of high inequality. This provides an additional motivation for reducing economic disparities because the mental health gains associated with economic advantage may vanish if inequality is not contained.

What is already known on this subject

- Existing research on the relationship between aggregate economic inequality and mental health shows mixed results. It has been argued that this may be because aggregate-level indicators cannot account for individual-level dynamics through which economic inequality exerts its effects.
- There is, however, no empirical evidence able to shed light on this hypothesis and to disentangle the multiple individual-level effects that economic inequality may exert on mental health.

What this study adds

- By employing the model of advantageous and disadvantageous inequality, for the first time in health research, we show that the above impasse is due to an ecological fallacy.
- The economic gradient of depression is multidimensional and comprises three individual-level facets of economic status, which aggregate inequality measures cannot capture.
- Absolute wealth and relative deprivation are associated with a decrease and an increase in depressive symptoms, respectively. Relative affluence is generally a protective factor, except at high levels of economic inequality where higher status also becomes a risk factor.

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