

## Income Inequality and Depressive Symptoms in South Africa: A Longitudinal Analysis

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### Extended Abstract

**Background:** Greater income inequality has been associated with higher prevalence of mental illness in high-income countries, and it has been hypothesized that this relationship may be mediated the effects of income inequality on social relationships. South Africa is known to have very high levels of income inequality; yet little research has examined the link between income inequality and mental health in this setting. We used longitudinal data from the National Income Dynamics Study (NIDS) to examine the association between income inequality and depressive symptoms in South Africa.

**Methods:** Data from 9,664 adults aged 15 years or over from the NIDS Wave 1 (2008) and Wave 3 (2012) were merged with data from South Africa's Community Survey 2007 and Census 2011. Income inequality at the district-council level was calculated from the Community Survey and Census using Gini coefficients and linked to Waves 1 and 3 of the NIDS, respectively. Depressive symptoms were assessed for NIDS sample members using the Center for Epidemiological Studies of Depression Short Form (CES-D-10), with higher scores indicating worse symptomatology. A cutoff score of 10 or more was used to identify high depressive symptoms. Pooled cross-sectional models and longitudinal fixed-effects models were run across both waves for the continuous outcome CES-D-10 score and the dichotomous outcome high depressive symptoms. Adjusted models included individual, household, and district characteristics.

**Results:** Mean CES-D-10 scores were 8.1 (standard deviation: 4.8) in Wave 1 and 7.1 (standard deviation: 4.5) in Wave 3, and the proportion of the sample with high depressive symptoms was 34.3% in Wave 1 and 27.1% in Wave 3. The mean district-level Gini coefficient increased from 0.73 (range: 0.65-0.80) in 2007 to 0.75 (range: 0.69-0.78) in 2011. Associations between depressive symptoms and district income inequality were not statistically significant in cross-sectional or longitudinal fixed-effects models adjusted for covariates. Age, African race, female sex, low education, being single, and having lower income, among other covariates, were independently associated with higher depressive symptoms.

**Conclusions:** The results from this South African sample do not provide sufficient evidence to support the income inequality hypothesis with respect to depressive symptoms. These findings may reflect the lack of a causal relationship between income inequality and depressive symptoms in the South African setting. Alternatively, the lack of a significant association may be due to inappropriately specified lag periods or insufficient variation in Gini coefficients (ceiling effects).

**Table 1. Sample characteristics for Waves 1 and 3**

	Wave 1		Wave 3	
	Sample Size	Proportion/Mean (Standard Deviation)	Sample Size	Proportion/Mean (Standard Deviation)
Total	9,664		9,664	
Female	9,664	64.5%	9,664	64.5%
Race	9,664		9,664	
<i>African</i>		80.3%		80.3%
<i>Coloured</i>		14.8%		14.8%
<i>Asian/Indian</i>		1.1%		1.1%
<i>White</i>		3.7%		3.7%
Age 50+	9,664	27.9%	9,664	35.2%
Mean age (yrs)	9,664	38.9 (17.3)	9,664	43.1 (17.3)
Highest Education level	9,657		9,656	
<i>No Education</i>		14.0%		13.5%
<i>Some General Ed &amp; Training</i>		35.5%		31.6%
<i>General Ed &amp; Training</i>		9.1%		7.2%
<i>Some Further Ed &amp; Training</i>		21.0%		23.0%
<i>Further Ed &amp; Training</i>		14.2%		14.2%
<i>Higher Education</i>		6.29%		10.6%
Mean deflated monthly household income (Rands)	5,388	5,061.6 (8,682.7)	5,986	5,874.2 (9,697.8)
Mean household size	5,388	4.3 (2.6)	5,986	4.4 (2.9)
Rural household	5,388	51.0%	5,986	50.9%
Percent of households receiving government grants	5,369	60.6%	5,983	62.8%
Mean CES-D-10 score	9,664	8.1 (4.8)	9,664	7.1 (4.5)
High depressive symptoms	9,664	34.3%	9,664	27.1%
Employment status	9,576		9,642	
<i>Employed</i>		39.1%		38.0%
<i>Unemployed</i>		18.6%		17.1%
<i>Not economically active</i>		42.3%		44.9%
Marital Status	9,631		9,657	
<i>Currently Married/Cohabiting</i>		39.2%		38.6%
<i>Currently single</i>		60.8%		61.4%

**Table 2. Regression model coefficients for the outcome CES-D-10 score.**

Covariates/Parameters	Pooled Cross-Sectional Models			Longitudinal Fixed-Effects Models		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
Wave 1	Ref	Ref	Ref	Ref	Ref	Ref
Wave 3 (Standard Error)	<b>-1.25***</b> (0.21)	<b>-1.17***</b> (0.19)	-0.96 (0.61)	<b>-1.08***</b> (0.17)	<b>-1.05***</b> (0.17)	-0.95 (0.82)
<i>District-level variables</i>						
<b>10*District Gini Coefficient, equivalized household income</b> (Standard Error)	<b>1.10*</b> (0.54)	0.65 (0.38)	0.50 (0.56)	0.29 (0.60)	0.30 (0.59)	-0.08 (0.97)
Percent Female (Standard Error)			-0.11 (0.11)			<b>-0.43*</b> (0.17)
Percent African (Standard Error)			-0.04 (0.04)			0.19 (0.14)
Percent Coloured (Standard Error)			-0.06 (0.04)			0.22 (0.19)
Mean age (Standard Error)			0.01 (0.13)			-0.32 (0.41)
Log mean equivalized household income (Standard Error)			0.62 (1.23)			1.77 (2.65)
Percent with no education (Standard Error)			-0.06 (0.04)			<b>0.44**</b> (0.15)
Percent with complete further education (Standard Error)			-0.06 (0.07)			0.08 (0.10)
Percent with higher education (Standard Error)			-0.10 (0.08)			-0.12 (0.15)
Percent Unemployed (Standard Error)			0.05 (0.05)			0.07 (0.07)
Percent Not Economically Active (Standard Error)			0.02 (0.06)			-0.04 (0.09)
Percent Rural (Standard Error)			0.01 (0.01)			0.01 (0.05)
<i>Household-level variables</i>						
Log household income (Standard Error)		<b>-0.53***</b> (0.07)	<b>-0.53***</b> (0.07)		-0.14 (0.09)	-0.16 (0.09)
Household size (Standard Error)		0.05 (0.03)	<b>0.05*</b> (0.02)		0.04 (0.04)	0.03 (0.04)
Urban		Ref	Ref		Ref	Ref
Rural (Standard Error)		-0.27 (0.20)	-0.34 (0.20)			
Does not receive government grants		Ref	Ref		Ref	Ref
Receives government grants (Standard Error)		-0.21 (0.14)	-0.24 (0.14)		-0.31 (0.18)	-0.35 (0.18)

**Table 2 Continued. Regression model coefficients for the outcome CES-D-10 Score.**

Covariates/Parameters	Pooled Cross-Sectional Models			Longitudinal Fixed-Effects Models		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
<i>Individual-level variables</i>						
Age (yrs) (Standard Error)		<b>0.04***</b> (0.00)	<b>0.04***</b> (0.00)			
African		Ref	Ref			
Coloured (Standard Error)		<b>-1.58***</b> (0.29)	<b>-1.08**</b> (0.29)			
Asian/Indian (Standard Error)		<b>-2.01***</b> (0.40)	<b>-2.09***</b> (0.41)			
White (Standard Error)		<b>-2.25***</b> (0.29)	<b>-1.93***</b> (0.37)			
Male		Ref	Ref			
Female (Standard Error)		<b>0.52***</b> (0.07)	<b>0.54***</b> (0.08)			
No education		Ref	Ref			
Some general education & training (Standard Error)		-0.14 (0.14)	-0.22 (0.13)			
Completed general education & training (Standard Error)		<b>-0.51**</b> (0.18)	<b>-0.60**</b> (0.19)			
Some further education & training (Standard Error)		<b>-0.50**</b> (0.16)	<b>-0.58**</b> (0.16)			
Completed further education & training (Standard Error)		<b>-0.78***</b> (0.18)	<b>-0.86***</b> (0.17)			
Higher education (Standard Error)		<b>-0.78***</b> (0.18)	<b>-0.84***</b> (0.18)			
Currently single		Ref	Ref		Ref	Ref
Currently married/living with partner (Standard Error)		<b>-0.48***</b> (0.07)	<b>-0.46***</b> (0.07)		<b>-0.55*</b> (0.22)	<b>-0.59*</b> (0.22)
Not economically active		Ref	Ref		Ref	Ref
Employed (Standard Error)		-0.19 (0.10)	-0.16 (0.10)		-0.31 (0.17)	-0.23 (0.16)
Unemployed (Standard Error)		0.01 (0.13)	0.02 (0.13)		-0.17 (0.18)	-0.08 (0.16)

*Italics indicates p<0.10. Bold indicates p<0.05. \* indicates p<0.05. \*\* indicates p<0.01. \*\*\* indicates p<0.001. Models are linear, and fixed-effects models use individual fixed effects. Standard errors are clustered by district.*

**Table 3. Risk ratios for the outcome high depressive symptoms (CES-D-10 score  $\geq 10$ ).**

Covariates/Parameters	Pooled Cross-Sectional Models			Longitudinal Fixed-Effects Models		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
Wave 1	Ref	Ref	Ref	Ref	Ref	Ref
Wave 3 (Standard Error)	<b>0.75***</b> <b>(0.05)</b>	<b>0.76***</b> <b>(0.05)</b>	0.78 (0.17)	<b>0.77***</b> <b>(0.05)</b>	<b>0.77***</b> <b>(0.05)</b>	0.68 (0.24)
<i>District-level variables</i>						
<b>10*District Gini Coefficient, equivalized household income</b> (Standard Error)	<b>1.28*</b> <b>(0.16)</b>	<i>1.21</i> <i>(0.13)</i>	1.25 (0.21)	1.13 (0.21)	1.15 (0.21)	1.32 (0.45)
Percent Female (Standard Error)			0.98 (0.04)			<b>0.81*</b> <b>(0.08)</b>
Percent African (Standard Error)			0.99 (0.01)			1.07 (0.07)
Percent Coloured (Standard Error)			0.98 (0.01)			1.08 (0.09)
Mean age (Standard Error)			1.02 (0.04)			0.84 (0.15)
Log mean equivalized household income (Standard Error)			0.97 (0.34)			0.81 (0.77)
Percent with no education (Standard Error)			0.99 (0.01)			<b>1.22**</b> <b>(0.08)</b>
Percent with complete further education (Standard Error)			0.99 (0.02)			1.03 (0.05)
Percent with higher education (Standard Error)			0.99 (0.03)			1.00 (0.06)
Percent Unemployed (Standard Error)			1.01 (0.01)			1.02 (0.02)
Percent Not Economically Active (Standard Error)			1.00 (0.02)			0.99 (0.03)
Percent Rural (Standard Error)			1.00 (0.00)			1.01 (0.02)
<i>Household-level variables</i>						
Log household income (Standard Error)		<b>0.87***</b> <b>(0.02)</b>	<b>0.87***</b> <b>(0.01)</b>		<b>0.92*</b> <b>(0.03)</b>	<b>0.91**</b> <b>(0.03)</b>
Household size (Standard Error)		<i>1.01</i> <i>(0.01)</i>	<i>1.01</i> <i>(0.01)</i>		1.01 (0.01)	1.01 (0.01)
Urban		Ref	Ref			
Rural (Standard Error)		0.98 (0.06)	0.94 (0.06)			
Does not receive government grants		Ref	Ref		Ref	Ref
Receives government grants (Standard Error)		0.94 (0.04)	0.94 (0.04)		0.96 (0.05)	0.96 (0.05)

**Table 3 Continued. Risk ratios for the outcome high depressive symptoms (CES-D-10 score  $\geq 10$ ).**

Covariates/Parameters	Pooled Cross-Sectional Models			Longitudinal Fixed-Effects Models		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
<i>Individual-level variables</i>						
Age (yrs) (Standard Error)		<b>1.01***</b> (0.00)	<b>1.01***</b> (0.00)			
African		Ref	Ref			
Coloured (Standard Error)		<b>0.74**</b> (0.07)	<b>0.80*</b> (0.07)			
Asian/Indian (Standard Error)		<b>0.42***</b> (0.07)	<b>0.41***</b> (0.07)			
White (Standard Error)		<b>0.48***</b> (0.08)	<b>0.50***</b> (0.09)			
Male		Ref	Ref			
Female (Standard Error)		<b>1.13***</b> (0.03)	<b>1.14***</b> (0.03)			
No education		Ref	Ref			
Some general education & training (Standard Error)		1.01 (0.04)	1.00 (0.04)			
Completed general education & training (Standard Error)		0.96 (0.05)	0.94 (0.05)			
Some further education & training (Standard Error)		0.93 (0.05)	0.92 (0.05)			
Completed further education & training (Standard Error)		<b>0.85**</b> (0.05)	<b>0.84**</b> (0.04)			
Higher education (Standard Error)		<b>0.84*</b> (0.06)	<b>0.82**</b> (0.05)			
Currently single		Ref	Ref		Ref	Ref
Currently married/living with partner (Standard Error)		<b>0.88***</b> (0.02)	<b>0.88***</b> (0.02)		<b>0.85*</b> (0.06)	<b>0.82*</b> (0.06)
Not economically active		Ref	Ref		Ref	Ref
Employed (Standard Error)		0.95 (0.03)	0.96 (0.03)		<b>0.89*</b> (0.05)	0.91 (0.05)
Unemployed (Standard Error)		1.02 (0.05)	1.02 (0.05)		0.95 (0.06)	0.97 (0.06)

*Italics indicates p<0.10. Bold indicates p<0.05. \* indicates p<0.05. \*\* indicates p<0.01. \*\*\* indicates p<0.001. Cross-sectional models use Poisson regression, and longitudinal models use conditional Poisson regression (with individual fixed effects). Standard errors are clustered by district.*