

Original Investigation

Psychiatric Hospital Beds and Prison Populations in South America Since 1990

Does the Penrose Hypothesis Apply?

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IMPORTANCE In 1939, English mathematician, geneticist, and psychiatrist Lionel Sharples Penrose hypothesized that the numbers of psychiatric hospital beds and the sizes of prison populations were inversely related; 75 years later, the question arises as to whether the hypothesis applies to recent developments in South America.

OBJECTIVE To explore the possible association of changes in the numbers of psychiatric hospital beds with changes in the sizes of prison populations in South America since 1990.

DESIGN, SETTING, AND PARTICIPANTS We searched primary sources for the numbers of psychiatric hospital beds in South American countries since 1990 (the year that the Latin American countries signed the Caracas Declaration) and compared these changes against the sizes of prison populations. The associations between the numbers of psychiatric beds and the sizes of prison populations were tested using fixed-effects regression of panel data. Economic variables were considered as covariates. Sufficiently reliable and complete data were obtained from 6 countries: Argentina, Bolivia, Brazil, Chile, Paraguay, and Uruguay.

MAIN OUTCOMES AND MEASURES The numbers of psychiatric beds and the sizes of prison populations.

RESULTS Since 1990, the numbers of psychiatric beds decreased in all 6 countries (ranging from -2.0% to -71.9%), while the sizes of prison populations increased substantially (ranging from 16.1% to 273.0%). Panel data regression analysis across the 6 countries showed a significant inverse relationship between numbers of psychiatric beds and sizes of prison populations. On average, the removal of 1 bed was associated with 5.18 more prisoners (95% CI, 3.10-7.26; $P = .001$), which was reduced to 2.78 prisoners (95% CI, 2.59-2.97; $P < .001$) when economic growth was considered as a covariate. The association between the numbers of psychiatric beds and the sizes of prison populations remained practically unchanged when income inequality was considered as a covariate (-4.28 [95% CI, -5.21 to -3.36]; $P < .001$).

CONCLUSIONS AND RELEVANCE Since 1990, the numbers of psychiatric beds have substantially decreased in South America, while the sizes of the prison populations have increased against a background of strong economic growth. The changes appear to be associated because the numbers of beds decreased more extensively when and where the sizes of prison populations increased. These findings are consistent with and specify the assumption of an association between the numbers of psychiatric beds and the sizes of prison populations. More research is needed to understand the drivers of the capacities of psychiatric hospitals and prisons and to explore reasons for their association.

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In 1939, the English mathematician, geneticist, and psychiatrist Lionel Sharples Penrose postulated an inverse relationship between the numbers of psychiatric beds and the sizes of prison populations based on cross-sectional data from 18 European countries, a notion that has become known as the *Penrose hypothesis*.¹ The context of his study was that some countries had reduced numbers of beds in large psychiatric asylums since the beginning of the 20th century, while prison capacities had been expanded. Psychiatric hospital beds were the dominant form of mental health care at that time.

Although the reduction in the numbers of beds—often referred to as “deinstitutionalization”—has been dominating mental health policies in many countries over the last few decades,² research on how the numbers of beds actually changed and on how these changes were linked with changes in other forms of institutions has been rather limited. In particular, it remains unclear whether there is an association between capacities in psychiatric hospitals and the prison population. The Penrose hypothesis is now 75 years old and still unresolved. A worldwide analysis of countries in 2004 found no support for the Penrose hypothesis.³ The numbers of psychiatric beds were positively correlated with the sizes of prison populations in low- and middle-income countries, whereas there was no association in high-income countries. Like the original study by Penrose, however, this analysis was based on cross-sectional data only. Longitudinal data are required to identify whether or not changes in the numbers of psychiatric beds are associated with changes in the sizes of prison populations over time.

Longitudinal data from the United States assessing treatment histories of prisoners indicated that the reduction in the number of state mental hospital beds could only account for a small proportion of the increasing size of prison populations between 1968 and 1978.⁴ Longitudinal data from Europe have suggested that mental health care might have reached a phase of “reinstitutionalization,”⁵ in which the numbers of psychiatric hospital beds might further decrease, but that capacities in other institutions (such as supported housing and prisons) might increase.⁶ However, these studies have not provided any evidence for a direct association between decreasing numbers of beds and increasing prison populations.^{7,8} Further research pointed toward a potential role of the economy and suggested that both the numbers of psychiatric beds and the sizes of prison populations might be driven by macroeconomic factors.^{9,10}

Since the 1960s, the numbers of psychiatric beds decreased substantially in most Western countries. It has been suggested that, with regard to deinstitutionalization, the United States failed to reinvest the funding that would have been spent on mental hospitals in new services in the community.¹¹ This shortcoming may apply even more to settings with very little resources. The reduction in the numbers of psychiatric beds in South America (ie, deinstitutionalization) was driven by World Health Organization (WHO) policy representing a consensus of Western high-income countries¹² rather than the care needs within specific socioeconomic and cultural contexts.

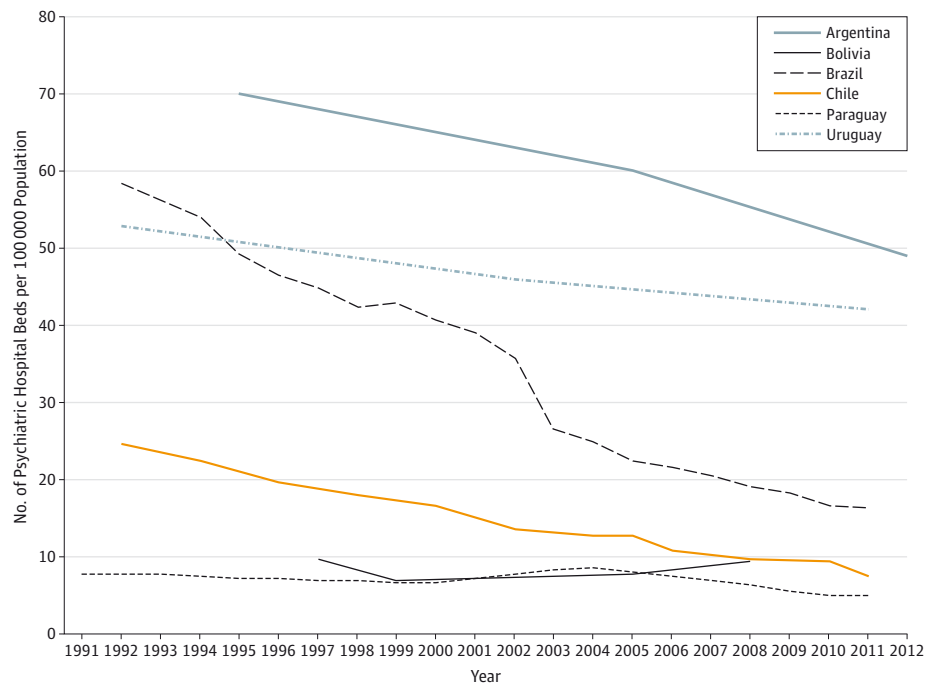
The radical reforms that resulted in reductions in the numbers of psychiatric beds in countries such as Italy also had an influence on politics worldwide, including South America.¹³ The Caracas Declaration of 1990 is seen as a landmark of psychiatric reform in South America.¹⁴ Participating countries committed themselves to reducing the numbers of beds in traditional asylums and expanding outpatient mental health services, psychiatric units in general district hospitals, and residential facilities for chronically mentally ill people.^{15,16} The aim of the present study was to assess changes in psychiatric hospital bed capacities and prison populations over the past 2 decades following the Caracas Declaration in South America. We explored the possible association of changes in the numbers of psychiatric beds with changes in the sizes of prison populations, and we considered macroeconomic variables as potentially influential factors.

Methods

A research network that spans across South American countries was developed to obtain reliable data on the sizes of prison populations and on the numbers of psychiatric beds. These countries included Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, Paraguay, Peru, Uruguay, and Venezuela. We searched for data from the 20 years that followed the Caracas Declaration (ie, from 1991 to 2011). At least 2 different researchers in each South American country were contacted by e-mail. The Caribbean countries Guyana, Suriname, and French Guiana, which are considered to be part of a different sociocultural context, were excluded from our study. The authors of the WHO Assessment Instrument for Mental Health Systems reports, the authors of internationally indexed publications in the field of mental health or mental health service provision, institutional representatives on the Internet, local offices of the Pan-American Health Organization, and personal contacts were used as references. All researchers who responded but were unable to provide the required data were asked to refer other colleagues in their country. The approach has been used previously to study indicators of institutionalized care in Western⁷ and Eastern Europe.⁸

Data on the numbers of psychiatric beds were retrieved using a stepwise approach. First, we searched for primary national data sources. If these were unavailable, secondary national data sources, including publications, were used. Third, the data were checked against the WHO publication “Mental Health Atlas 2005,”¹⁷ which provides estimations on the numbers of psychiatric beds for a single year, for each country in the region. Primary data sources were used for the sizes of prison populations. Whenever primary data sources were unavailable, data published online by the International Centre for Prison Studies (www.prisonstudies.org) were used. Data on the per capita gross national income (GNI) in US dollars were retrieved from the World Bank. The data on income distribution were retrieved from the World Bank as the “Gini index,” a widely used measure of income inequality (“[it] measures the extent to which the distribution of income or consumption expenditure among individuals or households within an

Figure 1. Numbers of Psychiatric Hospital Beds per 100 000 Population in 6 South American Countries (1991-2012)



economy deviates from a perfectly equal distribution” [www.worldbank.org]). Country-specific details can be found in the eAppendix in the Supplement.

Analysis

The numbers of beds and the numbers of prisoners were calculated as proportions (ie, number per 100 000 population) according to local census data or estimates of the World Bank. The associations of changes in the proportions of psychiatric beds and prisoners, the GNI, and the Gini index were tested using panel data regression in Stata/SE version 12.0 (StataCorp). We first computed univariate analyses with the numbers of beds, the GNI, or the Gini index as independent variables and with prison populations as the dependent variable. In further univariate analyses, we considered the GNI or the Gini index as the independent variables and the numbers of beds as the dependent variable. We then conducted 2 multivariate regression analyses. In both analyses, the numbers of beds were the independent variable, and sizes of prison populations the dependent variable. In the first multivariate analysis, we added the GNI as a covariate, and in the second multivariate analysis, we added the Gini index as a covariate.

The use of fixed-effects models controls for all time-invariant differences between the countries in the sample, and the resulting estimation is not biased by omitted time-invariant characteristics.¹⁸ The modified Wald test for groupwise heteroskedasticity¹⁹ indicated the presence of heteroskedasticity ($P < .001$). Autocorrelation was detected ($P < .001$) with the Wooldridge test for autocorrelation in panel data.¹⁸ Therefore, robust sandwich estimators

were used because they produce estimates of the standard errors that are robust to heteroskedasticity and autocorrelation.^{18,20} We conducted a sensitivity analysis, omitting 4 data points for psychiatric bed numbers from WHO surveys because these data are sometimes considered less reliable than primary data sources or secondary data sources from within countries.

Results

Psychiatric Beds, Prison Populations, GNI, and Gini Index

Data were obtained from Argentina, Bolivia, Brazil, Chile, Paraguay, and Uruguay and analyzed. We failed to identify sufficiently reliable or complete data from Colombia, Ecuador, Peru, and Venezuela. **Figure 1** shows the changes in the numbers of psychiatric beds numbers for Argentina, Bolivia, Brazil, Chile, Paraguay, and Uruguay.

The numbers of psychiatric beds were reduced in Argentina, Bolivia, Brazil, Chile, Paraguay, and Uruguay (Figure 1). There were years without a decrease in the numbers of beds and even short phases of increase in some countries, but overall numbers decreased in all participating countries. The relative decrease between the first and last data points ranged from -2.0% to -71.9% in these 6 countries (Table). The changes in the sizes of prison populations are presented in **Figure 2**.

Prison populations increased between the first and last points of observation in all participating countries. There were years without an increase, and even decreasing numbers in some countries, but overall the relative increase was substantial in all countries, ranging from 16.1% to 273.0% (Table).

Table. Percentage Changes in Prison Populations, Numbers of Psychiatric Beds, Gross National Income, and Gini Index Between First and Last Data Point

Country	Percentage Change			
	Size of Prison Population	No. of Psychiatric Beds	Gross National Income ^a	Gini Index
Argentina	137.1	-30.0	187.5	-4.5
Bolivia	16.1	-2.0	118.7	33.9
Brazil	273.0	-71.9	110.3	1.3
Chile	99.2	-69.5	240.9	-4.9
Paraguay	65.5	-36.9	80.6	-9.9
Uruguay	157.0	-20.8	169.5	13.1

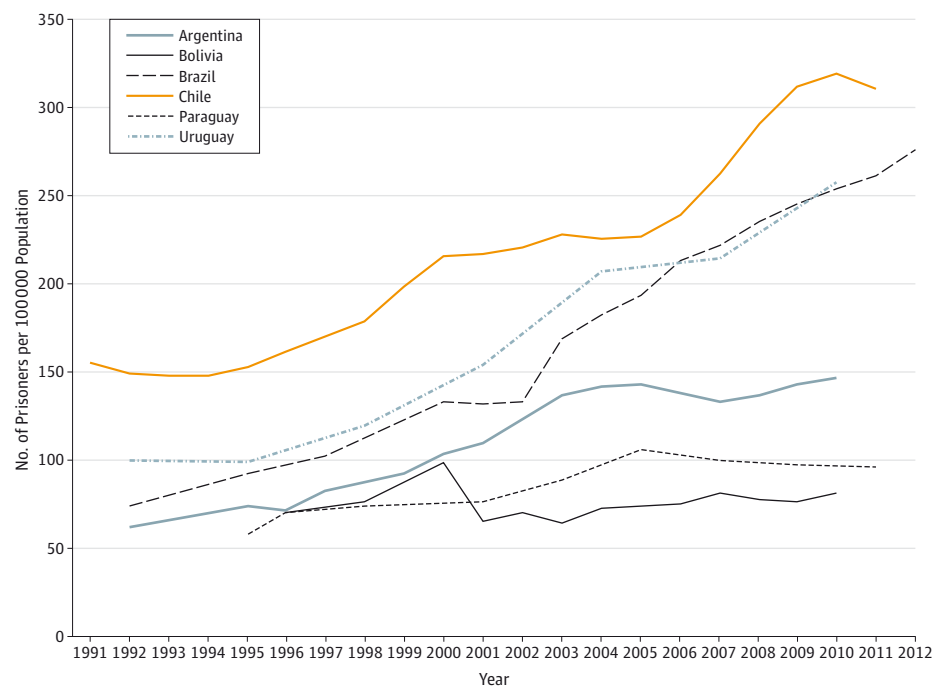
^a Between 1991 and 2011.**Figure 2. Numbers of Prisoners per 100 000 Population in 6 South American Countries (1991-2012)**

Figure 3 shows the changes of the GNI in the countries studied. In the 2 decades under observation, GNI per capita increased in all countries (Figure 3). There were notable discontinuities of GNI growth in Argentina and Uruguay between 1998 and 2002 corresponding to financial, political, and social crises. In most countries, the Gini index showed high levels of income inequality, with a moderate increase in the first decade and a decrease in the second decade of our study (eFigure in the Supplement).

The Table summarizes the percentage changes of the 4 parameters for each country over the full 20-year period. Brazil had the highest relative increase in prison populations, as well as the highest relative decrease in numbers of psychiatric beds. At the other end of the spectrum, Bolivia showed both the lowest increase in prison populations and the lowest decrease in numbers of psychiatric beds.

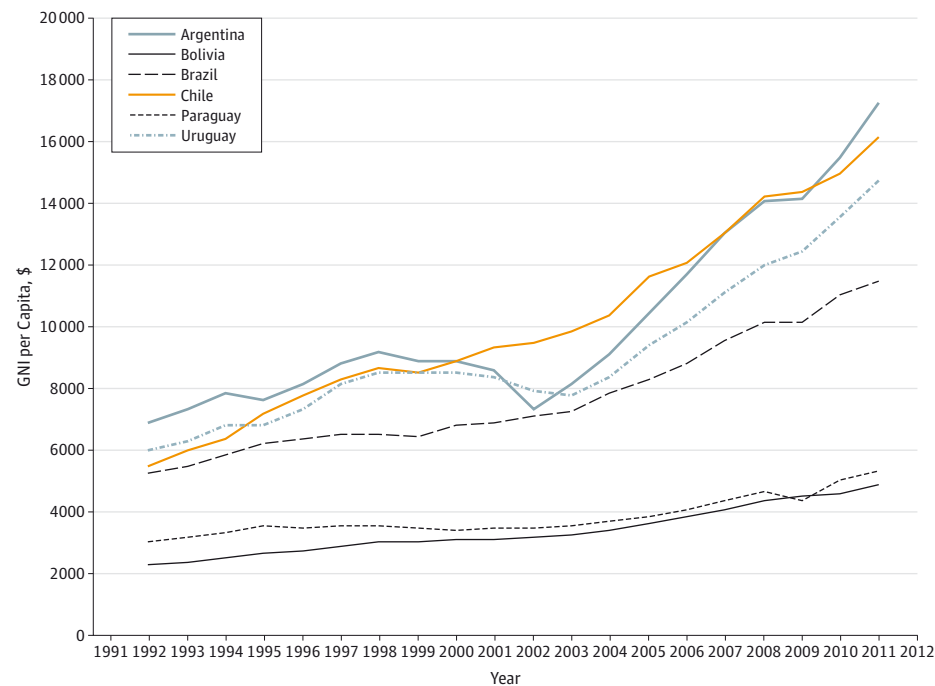
The 4 countries with the highest levels of and strongest growth in the GNI also showed the strongest increase in prison populations. Bolivia and Paraguay showed the lowest levels

of absolute numbers of the GNI and relatively modest growth in the GNI and also showed lower levels of and slower increases in prison populations. Over the 2 decades of our study, the levels of income inequality increased substantially in Bolivia and remained fairly stable in the other countries (Table).

Associations of Psychiatric Beds, Prison Populations, GNI, and Gini Index

The results of the fixed-effects regression analysis for panel data were based on 53 observations for the 6 countries, with an average of 8.8 observations per country. The univariate regression analyses showed a significant negative coefficient of -5.18 (95% CI, -7.26 to -3.10 ; $P = .001$) for the association of the numbers of beds with the sizes of prison populations. There was a positive significant coefficient of 0.012 (95% CI, 0.008 - 0.025 ; $P = .004$) for the association of GNI per capita and prison populations. This suggests that for every bed that was removed, there were, on average, 5.18 more prisoners, and that for every \$1 increase in GNI, there were 0.012 more prisoners

Figure 3. Gross National Income (GNI) per Capita in US Dollars in 6 South American Countries (1991-2011)



per 100 000 population, which results in an \$83 increase in GNI for 1 additional prisoner per 100 000 population. The regression with change in GNI as the independent variable and change in the numbers of beds as the dependent variable was not significant (-0.003 [95% CI, -0.01 to 0.0008]; $P = .11$). The Gini index was not significantly associated with the numbers of psychiatric beds (1.41 [95% CI, -1.10 to 3.91]; $P = .21$) or with the sizes of prison populations (-0.24 [95% CI, -12.68 to 7.81]; $P = .57$).

When the GNI was considered as a covariate, the coefficient for the association of numbers of psychiatric beds with sizes of prison populations remained statistically highly significant (-2.78 [95% CI, -2.97 to -2.59]; $P < .001$). The association between numbers of psychiatric beds and sizes of prison populations also remained practically unchanged when the Gini index was included as a covariate (-4.28 [95% CI, -5.21 to -3.36]; $P < .001$).

Finally, 4 data points based on WHO surveys were omitted to test the robustness of the findings. In this sensitivity analysis, the association between the numbers of psychiatric beds and the sizes of prison populations remained highly significant (-5.19 [95% CI, -7.28 to -3.10]; $P = .001$).

Discussion

Main Findings

Following the Caracas Declaration of 1990, Argentina, Bolivia, Brazil, Chile, Paraguay, and Uruguay substantially reduced the numbers of psychiatric hospital beds. During the same period, prison populations and GNI increased. Regression analyses suggested that changes in the numbers of beds

and in prison populations were associated. The numbers of hospital beds were more extensively reduced where and when the prison populations increased. The analyses also showed a positive association between economic growth and increased prison populations.

Strengths and Limitations

To our knowledge, this is the first study assessing trends in the numbers of psychiatric beds and in the sizes of prison populations, as well as their association in South America following the psychiatric reforms initiated by the Caracas Declaration of 1990. Our study includes the most populous countries in the region. To our knowledge, this is the first study providing evidence for an association between the numbers of psychiatric beds and the sizes of prison populations based on longitudinal data. The results further specify this association, which was first hypothesized by Penrose 75 years ago. The association was found across countries with very different histories and political contexts during the study period. The analysis considered the macroeconomic factor as a potential confounder and quantified the associations, estimating how many prisoners were incarcerated when 1 psychiatric bed was removed.

Our study has some limitations. Only 6 countries were included because we failed to obtain sufficient data from 4 other South American countries. For the 6 countries included in our study, not all data points were available, and the data sources varied. We considered, on average, 8.8 observations per country in the regression analyses, which should be sufficient for a reliable estimate of how changes over time were associated, but the overall number of observation is rather small for a panel regression analysis. We did not include data on the protocols

and capacities of the mental health services in the community. Finally, we did not consider further economic or societal measures beyond the GNI and the Gini index as potential drivers of investment and disinvestment in psychiatric hospitals and prisons.

Interpretation and Implications

The 6 countries studied over the period of 2 decades had some common social and economic conditions (eg, all were former military dictatorships in the 1980s that were replaced by democratic systems). All of them were struggling with external debts, economic adjustment programs, high poverty rates, and inequitable income distributions. At the same time, the degrees of these problems varied, and there were substantial differences in the exact political processes and contexts across countries. Our study was conducted in the context of decreasing numbers of psychiatric beds and increasing prison populations worldwide.^{2,21} The absolute level of prison populations in South America was higher than in Western Europe and was lower than in the United States.²¹ The association between decreasing numbers of beds and increasing prison populations found in our study cannot be explained by a simple overall trend to reduce numbers of beds and increase prison populations. Our study shows that the association is more specific: the numbers of beds tend to decrease more in those countries and at those times when the prison population is increasing. This is in line with and further specifies the Penrose hypothesis. Changes in capacities of psychiatric hospitals and prisons appear to be linked. The magnitude of the increase in the prison population is about 5 times larger than the decrease in the numbers of hospital beds. On average, there were about 5 more prisoners when 1 bed was removed.

How can the association be explained? Economic growth seems likely to have had some effect on prison populations in South America, but less so on the numbers of beds. The link between the numbers of beds and the sizes of prison populations was somewhat reduced when economic growth was also considered. Yet, it remained highly significant and, therefore, was not fully explained by economic changes as reflected in the GNI.

Data from the United States suggest that reductions in the numbers of psychiatric beds from a higher level than in South America may be associated with increased jail detentions for minor charges among people with severe mental disorders²² and that there may have been a shift of costs from health care to the penal justice system.²³ Yet, a study from the United States about policing mentally disordered suspects is not consistent with the criminalization hypothesis.²⁴ Prevalence studies of people with mental disorders among prisoners in South America indicate very high

rates of mental health and substance use disorders.^{25,26} So, the question arises as to whether there are large numbers of people with mental disorders in prisons in South America who would be in mental health services—as inpatients or outpatients—if there was more capacity. More data on the precise characteristics of prisoners with mental disorders and their pathways are required to say whether this is the case and, if so, to what extent this might explain part of the association between the numbers of beds and the sizes of prison populations seen in our study.

In any case, it is unlikely that the reduction in the numbers of psychiatric hospital beds directly and solely causes the increase in prison populations.²⁷ So, what other factors may have driven both changes and their association? Studies from the United States point to the importance of reimbursement arrangements, mental health, and welfare policies.²⁸ More research is required to explore the influence of further societal and political factors and the mediating processes leading to changes in the numbers of beds and in the sizes of prison populations.²⁹ Although we considered the GNI and the Gini index, a much more detailed analysis may be required of economic factors, which include indicators of poverty and investment in health and social care.

Conclusions

South American governments should regularly collect and publish data on the capacity of mental health services, including hospitals and community services, to facilitate the evaluation of policies and improve planning. More detailed analyses of the differences between countries and between different periods of time in each country are required to explore further the reasons for the association between the numbers of beds and the sizes of prison populations. These analyses need to consider more political, societal, and economic factors that might affect decisions to increase or decrease capacity in both mental health services and prisons. Detailed studies on the characteristics and pathways of prisoners with mental disorders could help to identify how many of them might be cared for in mental health services instead of prisons and to identify what types of treatment they should receive.

Our findings suggest the possibility that investment in mental health services might help to limit the growth of the penal justice system. Since there are no calls for a return to old-fashioned asylums—either in South America or elsewhere—there is a need for investment and research into modern community-based services to establish effective care for people with mental disorders who currently are imprisoned or at risk of imprisonment in the future.

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Drafting of the manuscript: Mundt, Priebe.

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