COVID-19 in a Time of El Niño and Ecosyndemic Vulnerability: Insights from Latin America

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Abstract

Latin America has emerged as an epicenter of the COVID-19 pandemic. Brazil, Peru, and Ecuador report some of the highest COVID-19 rates. These countries also face dual threats from development challenges and El Niño, which impact local disease ecologies. A country like Peru, e.g., which is highly sensitive to El Niño, already copes with an ecosyndemic burden, i.e., co-occurring multiple infectious diseases, which heighten during climate extreme events. In this commentary, we highlight the importance of El Niño as a major factor that not only may aggravate COVID-19 incidence, but also the broader health problem of ecosyndemics in Latin America.

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Key Points:

- COVID-19 rates are highest in Latin American countries such as Brazil, Peru, and Ecuador, which are also most vulnerable to El Niño
- During and after El Niños, a myriad of climate-sensitive disease outrbeaks known as an ecosyndemic are reported
- Within a broader context of ecosyndemic vulnerability, COVID-19 becomes an additional health burden in El Niño-sensitive countries

Abstract

Latin America has emerged as an epicenter of the COVID-19 pandemic. Brazil, Peru, and Ecuador report some of the highest COVID-19 rates. These countries also face dual threats from development challenges and El Niño, which impact local disease ecologies. A country like Peru, e.g., which is highly sensitive to El Niño, already copes with an ecosyndemic burden, i.e., co-occurring multiple infectious diseases, which heighten during climate extreme events. In this commentary, we highlight the importance of El Niño as a major factor that not only may aggravate COVID-19 incidence, but also the broader health problem of ecosyndemics in Latin America.

1 Introduction

The COVID-19 pandemic, which first emerged in Wuhan, China, is a global health emergency, infecting approximately 6.5 million people, and killing 386,000 persons, as of June 3, 2020 (Johns Hopkins University, Center for Systems Science and Engineering [JHU CSSE], 2020). Like other disasters, not every country is equally vulnerable. In a recent analysis, the World Bank (2020) concluded, "with more people living close to the international poverty line in the developing world, low- and middle-income countries will suffer the greatest consequences in terms of extreme poverty." United Nations (UN) assessments (2020) already suggest that impacts of COVID-19 affect the most vulnerable countries, many in the Global South, which already face multiple human development challenges, including inadequate access to clean water, clean air, nutrition, sanitation, and shelter.

In the Global South, the Latin American region is an emergent epicenter for COVID-19 (Pan American Health Organization [PAHO], 2020a). Figure 1 shows COVID-19 incidence rates across Latin America and the Caribbean, as of May 29, 2020. Country-level rates were calculated using COVID-19 cases from the World Health Organization (WHO, 2020) and population estimates for 2019 from the U.S. Census Bureau (2020). In Brazil, Peru, Ecuador, Chile, and Mexico alone of which Brazil shared the greatest burden, the total number of cases were approximately 750,000 (WHO, 2020). COVID-19-related deaths were also accumulating across the region. Table 1 indicates that the highest death rates (deaths divided by cases, i.e., case fatality rate, %) were in most of the countries with greatest incidence, including Mexico (11), Ecuador (8.6), and Brazil (6.2). Moreover, PAHO estimates that one in four persons in the region may experience severe health outcomes, due to the growing prevalence of chronic conditions, such as diabetes and cancer (PAHO, 2020a).

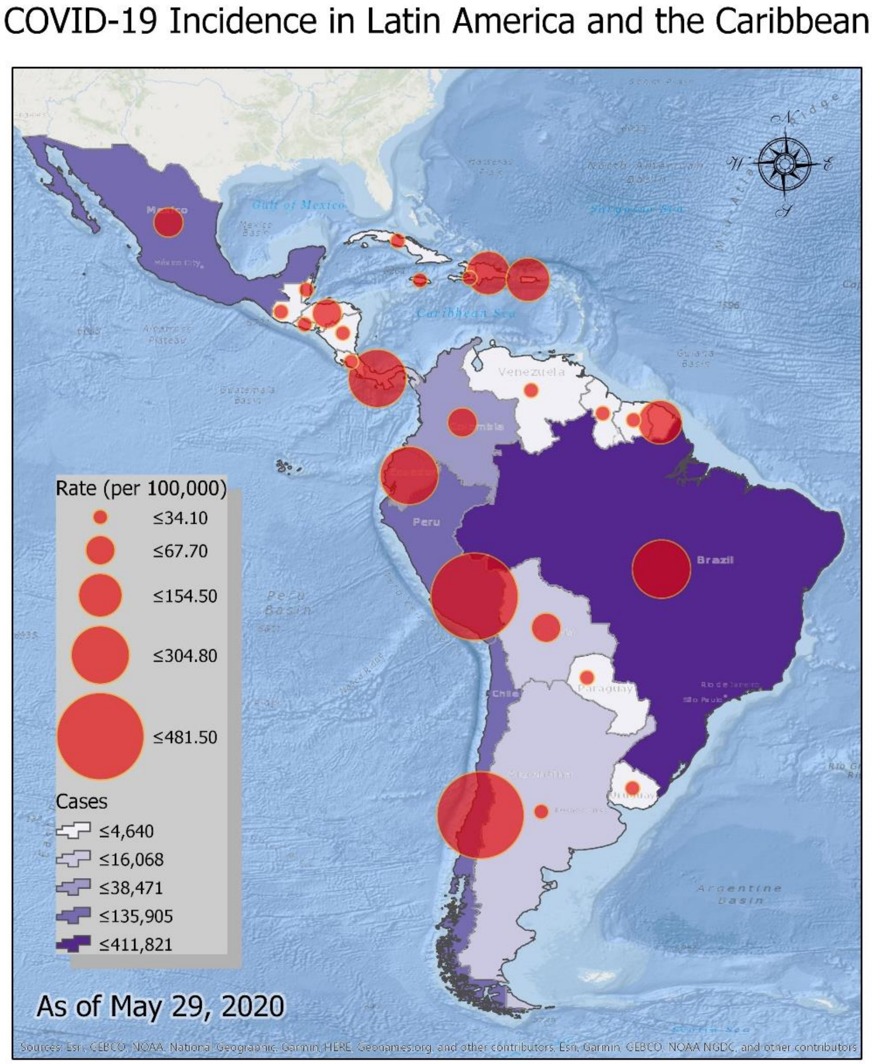


Figure 1. Map of COVID-19 Cases and Incidence Rates (per 100,000) in Latin America and The Caribbean. Data Source: WHO (2020), U.S. Census Bureau (2020)

Table 1. Ten Countries in Latin America and The Caribbean by Highest COVID-19 Incidence Rates (IR per 100,000) with Percentage of Deaths (%) and Case Fatality Rates (CFR) (%)

Country	IR (Per 100,000)	Deaths (%)	CFR (%)
Chile	481.5	2.0	1.0
Peru	429.7	8.8	2.9
Panama	304.8	0.7	2.7
Ecuador	230.3	7.3	8.6
Brazil	195.8	56.4	6.2
Dominican Republic	154.5	1.1	3.0
French Guiana	134.6	0.0	0.2
Puerto Rico	107.6	0.3	3.8

Bolivia	67.7	0.6	3.6
Mexico	61.3	18.9	11.0

Data Sources: WHO (2020), U.S. Census Bureau (2020)

2 Co-occurrence of Infectious Diseases

Of urgent concern is the co-occurrence of COVID-19 with other infectious diseases in the region (Burki, 2020; Rodriguez-Morales et al., 2020). Countries in Latin America and the Caribbean are burdened with multiple infectious diseases (Sneider et al., 2011; PAHO, 2020b), many preventable, such as dengue, malaria, and leishmaniasis. Table 2 displays countries with a high number of vector-borne diseases, including several arboviruses. In 2016, some countries reported as many as nine (e.g., Ecuador) to eleven (e.g., Brazil) vector-borne diseases, as well as high rates of diarrheal and respiratory-related infections. Such an array of diseases is not only poverty-related (e.g., disproportionate exposure of groups of lower socioeconomic status) (McCormick and Lang 2016; Engels and Zhou 2020), but also climate-sensitive (Confalonieri et al., 2009; Campbell-Lendrum et al., 2015), which raises concern about another determinant in the region, El Niño, the warm phase of El Niño-Southern Oscillation (ENSO).

Table 2. Countries with High Number of Vector-borne Diseases in Latin America

Vector-borne Disease	Brazil	Ecuador	Peru	Guatemala
Chagas	x	x	x	x
Chikungunya	x	x	x	x
Dengue	x	x	x	x
Leishmaniasis	x	x	x	x
Lymphatic Filariasis	x			
Malaria	x	x	x	x
Onchocerciasis	x	x		x
Plague	x	x	x	
Schistosomiasis	x			
Yellow Fever	x	x	x	
Zika	x	x	x	x
Total	11	9	8	7

Source: PAHO (2020b)

3 The El Niño Factor in Latin America

The El Niño phenomenon, which stems from ocean-atmosphere interactions across the equatorial Pacific Ocean, affects regional to local weather patterns every few years (McPhden et al., 2006). El Niño is often associated with water, weather, and climate-related extremes and changes in seasonality (Naranjo et al. 2018), that in turn influence local disease ecologies and population exposure (Kovats et al., 2003; Anyamba et al., 2019). El Niño's impact on disease transmission occurs directly via ecological changes (e.g., hydrology and rising ambient and water temperatures), which may propogate a variety of pathogens and generate hazards. Indirectly, El Niño-related extremes are also sources of health vulnerability (see Ebi and Bowen, 2015), through physical impacts on the built environment and infrastructure (e.g., damaging, overwhelming water and sanitation systems), as well as the long-term stresses (e.g., societal impacts on livelihoods, population displacement) that follow post-El Niño years (Ramirez, 2019). Often, El Niño's impacts aggravate preexisting health burdens, and heightens social vulnerabilities (e.g., compromising potable water access and adequate sanitation). They also intersect with other disasters to increase disease transmission, as Sorensen et al (2017) demonstrated with Zika in Ecuador in 2016. Among countries in Latin America, some of the most affected by COVID-19, mentioned previously, are also vulnerable to the effects of El Niño. For example, Andean countries in South America such as Peru (e.g., northern coast) and Ecuador (e.g., southern coast), as well as Brazil (e.g., northeast) are highly sensitive to El Niño's teleconnections (Caviedes, 1984; Confalonieri et al., 2009; Stewart-Ibarra and Lowe, 2013; Sorensen et al., 2017; Cornejo and Zavala, 2017; Marengo et al., 2018).

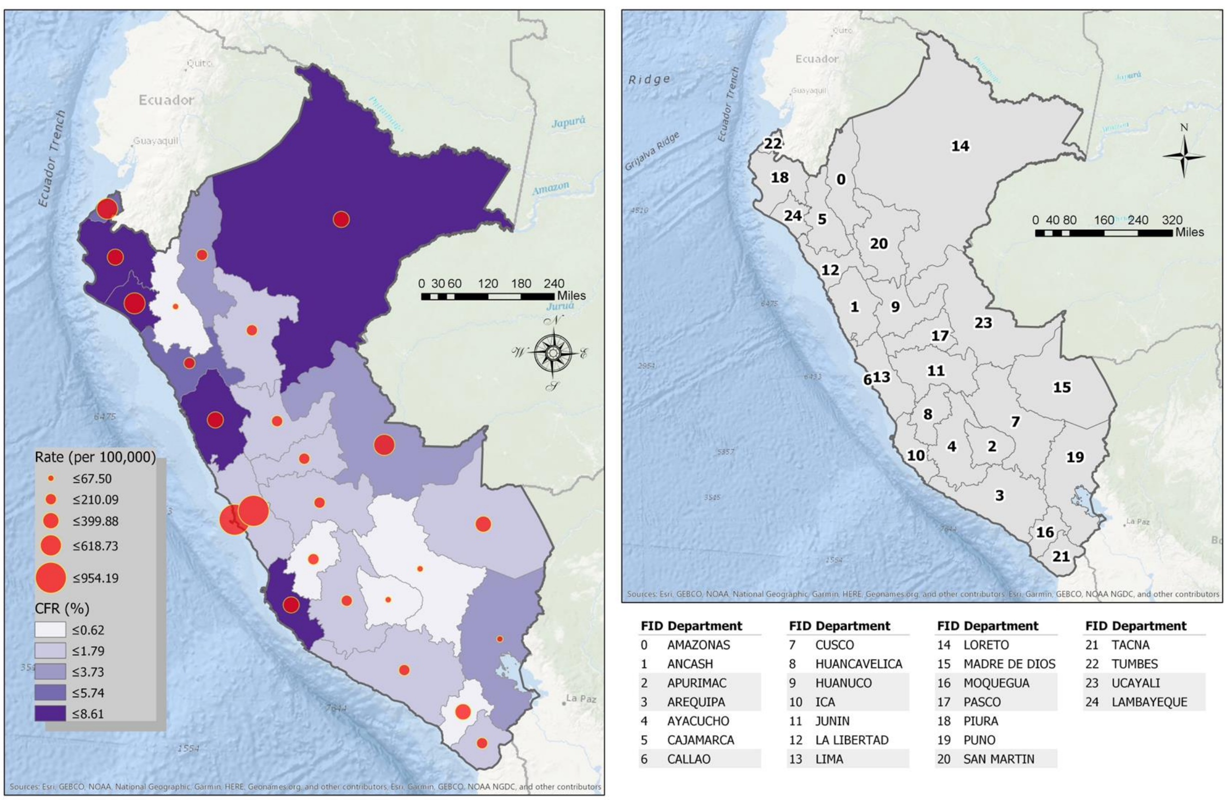
4 COVID-19, El Niño, and Ecosyndemic Context: The case of Peru

Peru is historically and exceptionally vulnerable. For example, during the 1982-83 and 1997-98 El Niños, Peru reported catastrophic flood-related disasters and multiple infectious disease outbreaks, including rises in malaria, cholera (1998 only), pneumonia, conjunctivitis, and diarrheal diseases (non-cholera) (Gueri, 1984; Ministry of Health Peru, 2015; Hijar et al., 2016; Ramirez, 2019). More recently, Peru experienced a localized coastal El Niño in 2017 (Rodriguez-Morata et al., 2018). Compared to the mega event of 1998, the 2017 El Niño came with limited warning to the Andean region (Ramirez and Briones 2018), and contributed to epidemics of various arboviruses (e.g., dengue and chikungunya) and leptospirosis in Peru (PAHO, 2017). What is troubling from these examples is not only the burden of disease, but that said epidemics cluster in place and time during and in the aftermath of El Niños. Singer (2010) refers to such phenomenon as "ecosyndemic" to highlight co-occurring diseases and excess health burden influenced by anthropogenic environmental or climate-related changes. The concept of ecosyndemic also highlights social inequalities that underlie patterns of multi-disease risk.

Although ecosyndemics are underexamined in public health, a few studies have explored such phenomena in Peru and Brazil (Ramirez et al., 2018; Tallman et al, 2020; also see Confalonieri et al., 2009). In Peru, for example, Ramirez et al (2018) investigated ecosyndemics comprised of seven infectious diseases (e.g., cholera, malaria and conjunctivitis) during the 1997-98 El Niño in northern Peru. Using an index mapping approach, the authors showed that that patterns of an ecosyndemic intensified over time and varied spatially as the extreme event (e.g., heavy rains) progressed. Furthermore, urbanization and population affected by floods (e.g., proxy for disaster impacts) were correlated with the overall ecosyndemic index in northern Peru. In a more recent study, Tallman et al. (2020), using a more complex approach to ecosyndemics in Brazil and Peru, examined the relationships between human activities like dam construction and roads with an ensemble of vector-borne and sexually-transmitted diseases. In this study, the findings suggest that ecosyndemics varied by place, but overall were explained by a complex intersection of environment change and psycho-social stressors.

For El Niño-sensitive countries like Peru, COVID-19 presents an additional health burden within a broader context of ecosyndemic vulnerability. Figure 2 shows COVID-19 rates of incidence (per 100,000) and deaths in Peru at the department-level, as of May 29, 2020.

Department-level rates were calculated using COVID-19 cases and deaths (deaths divided by cases, i.e., case fatality rate, %) and population estimates for 2020 from the Ministry of Health in Peru (2019; 2020). The distribution of COVID-19 in Peru is widespread, but the highest incidence rates are mainly located along the arid low-lying coast as well as jungle regions (e.g., Loreto) in the east. Among departments, Piura and Tumbes which border Ecuador in the north, standout as areas well known for El Niño-related health impacts (Bayer et al., 2014; Ramirez, 2019). Table 3 compares spatial patterns of COVID-19 incidence with patterns of two significant infectious diseases, one waterborne (cholera), the other mosquitoborne (dengue), during extreme El Niños in 1998 and 2017. Cholera (1998) and dengue (2017) rates (per 100,000) were calculated using cases from the Ministry of Health in Peru (2008; 2018) and population estimates from the INEI in Peru (2002) and the Ministry of Health in Peru (2019). The ten departments with the highest COVID-19 incidence rates are shown. As the Table displays, at least six out of ten departments with high rates of COVID-19 are also places with high rates of cholera and dengue in 1998 and 2017 (bold and italicized values), respectively. These includes Tumbes, Piura, and Loreto, for example. While it is unknown how El Niño will affect COVID-19 incidence in the future, it is foreseeable that climate extremes such as floods and droughts may exacerbate transmission in certain geographic regions, although this may vary with the strength and dynamics of a particular El Niño, and changing social and health system vulnerabilities.



FID	Department	FID	Department	FID	Department	FID	Department
0	AMAZONAS	7	CUSCO	14	LORETO	21	TACNA
1	ANCASH	8	HUANCAVELICA	15	MADRE DE DIOS	22	TUMBES
2	APURIMAC	9	HUANUCO	16	MOQUEGUA	23	UCAYALI
3	AREQUIPA	10	ICA	17	PASCO	24	LAMBAYEQUE
4	AYACUCHO	11	JUNIN	18	PIURA		
5	CAJAMARCA	12	LA LIBERTAD	19	PUNO		
6	CALLAO	13	LIMA	20	SAN MARTIN		

Figure 2. Map of COVID-19 Incidence Rate (per 100,000) and Case Fatality Rates (CFR, %) in Peru, as of May 29, 2020. A Department Reference Map is also shown. Data Sources: Ministry of Health, Peru (2019; 2020)

Table 3. Comparison of COVID-19 (Highest Rates) with Cholera and Dengue Cases and Incidence Rates (IR, per 100,000) during Extreme El Niños by Department in Peru.

	COVID-19		Cholera (1998)		Dengue (2017)	
Department	Cases	IR	Cases	IR	Cases	IR
Callao	10781	954.2	547	74.3	15	1.5
Lima	92057	866.1	10248	***142.4***	370	3.9
Ucayali	3645	618.7	816	***206.6***	1118	***225.2***
Lambayeque	7060	538.6	6398	***609.2***	1622	***135.5***
Tumbes	1219	484.7	286	***155.8***	5432	***2415.7***
Loreto	4109	399.9	2570	***306.0***	1229	***139.1***
Piura	7180	350.6	6716	***445.7***	48675	***2621.4***
Ancash	3384	286.6	2425	***231.9***	1895	***174.9***
Ica	2691	275.9	752	119.6	4531	***532.6***
Madre de Dios	450	258.9	3	3.8	522	***370.0***

Departments that are Common with Highest COVID Rates are bold and italicized.
Data Sources: INEI (2002), Ministry of Health, Peru (2008; 2018; 2019; 2020)

5 Conclusions

Coincidently, as COVID-19 emerged globally, so too was the onset of a weak El Niño, which lasted 7 months and collapsed in March 2020 (see National Oceanic and Atmospheric Administration, 2020, for the Oceanic Niño Index). This commentary highlights the importance of El Niño not to suggest that climate triggered the COVID-19 pandemic, but rather to place the emergence within a broader public health context of climate, social vulnerability, and multi-disease exposure (i.e., ecosyndemic). Many countries worldwide, including the ones we focused in Latin America, grapple with increasing societal exposure to climate-related extremes and hazards, and subsequent adverse health outcomes, including simultaneous infectious disease outbreaks, which we described earlier.

In many cases, COVID-19 is one of many infections co-circulating, that not only burdens populations, but also the public health system. Thus, COVID-19 vulnerability not only encompasses exposure, but also sensitivity of populations to ecosyndemic risk, including several water-related infections. Many countries in Latin Americas face challenges with prevention, e.g., via adequate hygiene practice, due to infrastructure disparities. For example, according to UNICEF (2020), the region reports that 39.0% of populations do not have or have limited handwashing facilities with soap and water. In El Niño-sensitive countries like Peru, at least 26.0% of the healthcare facilities do not have hand hygiene facilities, while Ecuador reports 3 million people without basic handwashing facilities in homes. In Brazil, 35.0% of schools do not have hygiene facilities for handwashing. Furthermore, country-level capacities to cope with and respond to COVID-19 along with a preexisting ecosyndemic burden may be limited. As one researcher states, “Brazil has an excellent public health system, but it cannot cope with competing crises…and could easily end up in a situation where there is a surge of all vector-borne diseases” (as quoted in Burki, 2020).

Although it has been argued that climate may constrain the spread of COVID-19 (e.g., Araujo and Naimi, 2020), the emergence of Latin America, particularly South America, as an epicenter of COVID-19, suggests that even equatorial regions are at great risk, as some preliminary research shows (O'Reilly et al., 2020). Thus, examination of COVID-19 within a broader scope of ecosyndemic vulnerability including quasi-periodic El Niño-related threats may provide new insights and benefits for prevention strategies that address a broader public health problem.

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Data for this research are available in these citation references with weblinks: INEI (2020), https://www.inei.gob.pe/media/MenuRecursivo/publicaciones_digitales/Est/Lib0467/Libro.pdf, Ministry of Health, Peru (2020), https://covid19.minsa.gob.pe/sala_situacional.asp, Ministry of Health, Peru (2019), https://www.minsa.gob.pe/reunis/data/poblacion_estimada.asp, Ministry of Health, Peru (2018), https://www.dge.gob.pe/portal/index.php?option=com_content&view=article&id=647, PAHO (2020b), http://ais.paho.org/phip/viz/cha_cd_vectorborndiseases.asp, U.S. Census Bureau (2020), https://www.census.gov/data-tools/demo/idb/informationGateway.php, WHO (2020), https://www.who.int/docs/default-source/coronaviruse/situation-reports/20200529-covid-19-sitrep-130.pdf?sfvrsn=bf7e7f0c_4. The authors have no financial disclosure to report.

Conflict of Interest

The authors declare no conflicts of interest in this study.

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