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Loreto Watkins[1], Estela Blanco[2,3], Javiera Barraza[1], Alejandra Díaz De León[4], Miguel Pérez[1], Teresita Rocha-Jiménez[5]*

[1] *Escuela de Antropología, Universidad Diego Portales, Santiago, Chile*

[2] *College y Escuela de Salud Pública, Pontificia Universidad Católica de Chile, Santiago, Chile*

[3] *Center for Climate and Resilience Research (CR2), Santiago, Chile*

[4] *Department of Sociology, University of Essex, Colchester, United Kingdom*

[5] *Society and Health Research Center, Escuela de Gobierno y Administración Pública, Universidad Mayor, Santiago, Chile*

***CORRESPONDING AUTHOR:** *Teresita Rocha-Jiménez, PhD teresita.rocha@umayor.cl Society and Health Research Center, Escuela de Gobierno y Administración Pública, Universidad Mayor, José Toribio Medina 29, Santiago, Chile.*

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Abstract

Migrants in urban areas of developing countries are among the most vulnerable populations to the impacts of the climate crisis. Already facing structural inequities, migrants must cope with limited access to stable housing, essential services, and climate-resilient infrastructure. In this paper, we explore the intersections of health, migration and the climate crisis through an exploratory qualitative study conducted in *Un Nuevo Amanecer*, an informal urban settlement in Santiago, Chile. This approach, involving 21 migrant residents, examined health vulnerabilities and community strategies in response to climate crisis conditions. We addressed the effects of extreme weather events and urban conditions among migrant populations, such as landslides, heat and cold waves, fires, floods, and air pollution. The settlement's location on unsafe land and poor infrastructure exacerbates residents' social and health vulnerabilities, including emerging illnesses, mental health impacts, and limited personal resources and institutional support to cope with climate events like fires and extreme weather. Our findings highlight the crucial role of urban environments in promoting health, well-being and resilience, while also guiding the development of more effective strategies to address the challenges of the climate crisis in vulnerable migrant populations.

Keywords: Health, migration, climate crisis, informal settlement, Chile

Introduction

Improving the health of migrants and reducing adverse health outcomes related to migration are growing concerns globally (Schütte *et al.*, 2018). The climate crisis, defined by changes in the planet's climate—including weather extremes and hazards, ocean acidification, sea-level rise, loss of biodiversity, food and water insecurity, health risks, economic disruption, displacement, and even violent conflict—has exacerbated these challenges (United Nations Development Programme, 2023; Barbieri and Confalonieri, 2010; Palmeiro-Silva *et al.*, 2020; Schütte *et al.*, 2018). Key international entities like the United Nations (UN), the International

Organization for Migration (IOM), the World Health Organization (WHO), the 26th Conference of the Parties (COP26), and Lancet Migration have emphasised the need to address the consequences for migrants' health and global public health due to the climate crisis (Khalid *et al.*, 2023). Yet, few attempts have been made to consider the complex associations between the climate crisis, migration, and health (Hunter and Simon, 2019; Khalid *et al.*, 2023; McMichael, 2023; Schütte *et al.*, 2018; Schwerdtle *et al.*, 2020; Silenzi *et al.*, 2023; Zanhouo and Nana, 2019). While some research has explored the climate crisis as a migration and displacement driver (Hasemann Lara *et al.*, 2024; Doering-White *et al.*, 2024), relatively little focus has been on the health effects on migrants who have already resettled in new locations.

The climate crisis has influenced the scale and patterns of human mobility as a driver of migration and displacement and interacts with and exacerbates migration's effects on health determinants (Silenzi *et al.*, 2023). Climate change-related hazards have well-documented adverse effects on displaced populations' physical and mental health (Hunter and Simon, 2019; Torres and Casey, 2017). These impacts are compounded by the broader disruptions that climate change causes across environmental, ecological, and social systems, affecting key determinants of health such as food yields, freshwater availability and quality, infectious disease patterns, air quality, social cohesion, and livelihoods (Schütte *et al.*, 2018; Safi *et al.*, 2024). Evidence suggests a broad spectrum of health challenges associated with migration and displacement in the context of the climate crisis, encompassing shifting disease patterns, increased malnutrition, noncommunicable diseases, and mental health impacts (Silenzi *et al.*, 2023). Moreover, many regions attracting migrants are situated in developing countries, where it has been demonstrated that mobile populations face barriers to accessing healthcare (Cabieses and Oyarte, 2020; Schütte *et al.*, 2018; Schwerdtle *et al.*, 2020).

Relationships between the climate crisis, migration, and health are strongly heterogeneous, influenced by factors like exposure, vulnerability, and adaptive capacity of populations (Williams *et al.*, 2023; Zerbo *et al.*, 2020). These effects are shaped by complex social, economic, political, and demographic dynamics; therefore, it is crucial to assess each case carefully, considering both health and health determinants (Schwerdtle *et al.*, 2020). Notably, the socioeconomic status of households plays a crucial role in determining residential vulnerability, given its direct correlation with resource accessibility (Welz and Krellenberg, 2016). This suggests a shift in focus from framing the climate crisis-related hazards as "natural" disasters and focusing more on resilience, lack of resources, and the role of human agency in prevention (Khalid *et al.*, 2023).

Migrants in urban areas in developing countries may be one of the most vulnerable populations in climate crisis scenarios (Barbieri and Confalonieri, 2010). This vulnerability arises because these areas often lack the infrastructure and resources needed to support rapid population growth, leaving migrants exposed to greater risks from extreme weather events and other climate impacts (Hepburn *et al.,* 2023). In a context of increasing urbanisation driven by migration in most of the developing world, the scale of risk to the climate crisis will be affected by infrastructure and housing quality, by the population's ability to cope with changes (proxy of factors such as education, culture, solidarity) and by the quality of institutional responses (e.g., aid and medical care, urban planning) (Barbieri and Confalonieri, 2010; Pashayan, 2024). Migration may negatively affect the well-being of migrants and often disrupt the patterns of land use in urban areas, facilitating the occupation of risk areas and contributing significantly to an increased social and health vulnerability (Barbieri and Confalonieri, 2010; Pashayan, 2024). Currently, there is growing evidence of a strong link between migration and informality, with the most vulnerable and economically excluded migrants increasingly concentrated in informal settlements (Habitat for Humanity, 2024). These settlements are home to over 1

billion people and are projected to house the largest proportion of those most at risk from the impacts of climate change (IPCC, 2023).

While poor locals living in informal settlements are also affected (Hambrecht *et al.*, 2022), migrants experience heightened vulnerability. The climate crisis aggravates and accelerates the deterioration of health determinants before, during and after the migration process (Batista *et al.,* 2024). When migrants suffer declining physical or mental health, they often lack access to well-equipped clinics and hospitals and cannot afford private healthcare (Carreño Calderon *et al.,* 2020). In contrast, locals benefit from legal status certainty, knowledge of institutional systems, and social networks that provide a safety net during climate-related disruptions. When migrants tend to settle in peripheric and often irregular settlements, they lack sanitation, electricity and easy access, and their houses are often built with materials that are unlikely to withstand climatic stressors such as wind and rain (Hepburn *et al.,* 2023).

Evidence suggests that social relations reflected in a supportive community play a vital role in helping migrants cope with socio-environmental challenges, potentially enhancing health and well-being (Hogan *et al.*, 2024). Social ties can facilitate the exchange of resources (e.g., food, shelter) and information (e.g., early warnings regarding environmental risks), increasing resilience and buffering some of the adverse physical and mental health impacts of both short-term and prolonged climate events (Torres and Casey, 2017). Moreover, Barbieri and Confalonieri (2010) state that the "migration response" is not only a mechanism of adaptation but may also be the only mechanism available for those with insufficient resources or capital. This is particularly noticeable in situations with insufficient protection and a trend towards individualised risk management, as observed in contexts involving migration and informal settlements (Welz and Krellenberg, 2016; Hepburn *et al.,* 2023; Arteaga and Pérez,

2011; Pashayan, 2024). Therefore, community care and coping are essential to protect and support mental health and well-being, as they offer resources that mitigate the physical and psychological health stressors associated with climate events (Barbieri and Confalonieri, 2010; Khalid *et al.*, 2023; Hogan *et al.*, 2024; Chen *et al.*, 2022).

For Santiago, Chile's capital, the climate crisis involves increasing hydro-climatic hazards such as flooding, extreme heat, continued urban expansion, and changes in land use patterns (Welz and Krellenberg, 2016). These environmental challenges are intertwined with two major socio-demographic trends in the country: a sharp rise in migration and an escalating housing crisis. According to the 2024 Census, Chile's migrant population has more than doubled since 2017, rising from 746,000 to 1,608,650 people; now representing 8.8% of the total population. This increase is especially concentrated in Santiago, where 57% of migrants live (SERMIG, 2024). The rapid growth has contributed to the diversification of urban areas while placing additional strain on the city's infrastructure and housing systems.

Chile is currently undergoing a severe housing crisis due to the combined impact of the pandemic-induced economic crisis starting in 2020, the inefficiency of housing policies, and the sustained increase in land prices (Pérez, 2022). Official data suggest that the housing deficit reached 650,000 units in 2022 (Déficit Cero, 2022), forcing vulnerable families—especially migrants—to look for housing in informal settlements (Pérez *et al.*, 2024). An informal settlement is defined as a group of eight or more families forming a socio-territorial unit without access to at least one basic service (e.g., water, electricity, sewage), located in a squatter area, and that represents a housing requirement (TECHO, 2023).

Migrant families make up a significant share of those affected by Chile's housing crisis. Nationwide, 39% of households in informal settlements are headed by migrants, a figure that rises to nearly 60% in Santiago (TECHO, 2025). Among these residents, migrants from Latin

America and the Caribbean are particularly prominent (MINVU, 2022). These populations face significant barriers to accessing adequate housing, including discrimination and the widespread refusal to rent to foreigners (Mercado-Órdenes *et al.*, 2024; Barraza and Pérez, 2025). In addition, those with irregular migration status—such as expired visas or unauthorized entry—are ineligible for government housing subsidies and other financial assistance, excluding them from formal housing markets and contributing to their concentration in informal settlements.

In the context of these overlapping challenges, this paper examines the case of *Un Nuevo Amanecer* ("A New Dawn"), an informal settlement established in 2020 that is currently inhabited almost exclusively by migrants coming from Haiti, Venezuela, the Dominican Republic, Peru, and Bolivia (TECHO, 2023). Residents in *Un Nuevo Amanecer* live in severe conditions, including unstable soil, substandard self-built structures, lack of sewage systems, limited access to clean water, and absence of garbage disposal services, among other challenges impacting the quality of life (El Día, 2022). From a regulatory perspective, this site is restricted for urban development due to its designation as a landslide risk area, posing a significant danger to human settlements (Municipalidad de Cerrillos, 2023). Despite these conditions, this informal settlement exhibits a high level of community organisation based on resident's aspirations for living in a dignified neighbourhood (Pérez *et al.*, 2024). Consequently, there is a strong call for research and reporting on the significant health conditions resulting from socio-environmental adversities and acknowledging the role of individual and community resilience and adaptation in the face of the climate crisis (Torres and Casey, 2017).

This research explores the community experiences of migrant residents living in *Un Nuevo Amanecer* through a qualitative, locally-focused approach that explains how migrants experience the varied impacts of the climate crisis in this specific context. It highlights the climatic stressors migrants identify as most relevant and the specific health challenges they

associate with these conditions. By examining the intersections of the climate crisis, migration, and health (Schwerdtle *et al.*, 2020), we analysed the vulnerabilities and health risks faced by migrants from Latin America and the Caribbean, as well as the community responses that promote their well-being in the context of climate change. While extensive research has examined how climate change drives migration and affects health outcomes, little is known about how the climate crisis is experienced by migrants in destination settlements. Therefore, this study presents a novel approach and centres on migrants' narratives about how climate-related changes affect their health and daily lives. Such insights not only identify adaptation measures that protect this at-risk group; they also highlight the crucial role of urban environments in promoting health, well-being, and resilience, thereby guiding the development of more effective strategies to address the challenges of the climate crisis.

Methods

This study employed a qualitative approach to explore the health vulnerabilities and responses of migrant populations exposed to hazardous climate conditions in an urban settlement. Through ethnography, a focus group, and in-depth interviews, we analysed the experiences of migration, the climate crisis and health within the specific context of the *Un Nuevo Amanecer* community in Santiago, Chile.

Data collection

Primary data was collected through ethnography, a focus group (n=5), and semi-structured in-depth interviews (n=19) with migrant residents of the *Un Nuevo Amanecer* informal settlement. A total of 21 unique individuals were involved, with some taking part in both the focus group and an interview. The sample size was guided by the principle of thematic saturation, deemed sufficient given the relatively homogeneous living conditions and shared vulnerabilities in the settlement. This approach is consistent with empirical guidance on saturation in qualitative

research, which varies by topic complexity and population characteristics (Hennink and Kaiser, 2022).

An interview guideline was developed to align with the study's research objectives, emphasising descriptive analysis of the participants' experiences and perspectives. To explore the relations between health, migration, and the climate crisis, the interview guide drew on the *WHO Fact Sheet on Climate Change and Health* (2023). This resource provided an overview of climate-sensitive health risks, exposure pathways, and vulnerability factors, and allowed us to explore how these climate impacts affect health both directly and indirectly, heavily influenced by environmental, social, and public health determinants (World Health Organization, 2023). To ensure participant confidentiality and safety, informed consent was obtained following the protocol from the ATE230065 Anillos project, which received approval from the Scientific Ethical Committee of Universidad Diego Portales (N° 05-2024). Participants were recruited voluntarily, meeting the inclusion criteria of being 18 years or older, migrants from Latin America or the Caribbean, fluent in Spanish, and currently residing in the informal settlement. Initial recruitment was conducted through existing networks, followed by snowball sampling to identify additional key participants until saturation was reached (Sadler *et al.*, 2010). Specifically, we worked with a key informant who was a resident of the *Un Nuevo Amanecer* settlement, who helped identify additional participants through family, neighbours, and church contacts. Considering that most residents work Monday to Saturday and return late, fieldwork was primarily conducted on Sunday afternoons, a time when many community members were observed building their homes after attending church. Interviews, which lasted approximately 40–60 minutes, were audio-recorded after obtaining written informed consent from participants. As compensation for their time, participants received a 10 USD gift card. All in-depth interviews were transcribed for analysis.

Data analysis

We used discourse analysis to interpret the interview data, applying coding to identify and categorise themes relevant to our research (Mautner *et al.*, 2017). Qualitative analysis software (Atlas.ti) was employed to facilitate coding and organise data. We employed an inductive and interpretive approach (Thomas, 2006). We developed a coding framework consisting of 27 codes, organized into five thematic families: 1) Living in *Un Nuevo Amanecer* (5 codes), 2) climate crisis (9 codes), 3) health (7 codes), 4) care (3 codes), and 5) migration (3 codes). For the current analysis, we focused on residents' comments related to the climate crisis.

The study included 21 participants from five countries: Haiti (n=11), Peru (n=7), Colombia (n=2), and Venezuela (n=1). Among them, 12 were women and 9 were men, with ages ranging from 28 to 52 years and an average age of 40. To ensure confidentiality, all participants were assigned pseudonyms.

Results

Residents of *Un Nuevo Amanecer* in Santiago, Chile expressed vague familiarity with the concepts of climate change or the climate crisis. When asked about recent socio-natural disasters in Chile, such as wildfires and flooding, they rarely attributed these events to the climate crisis. However, they did identify several socio-environmental conditions affecting their health and well-being, including extreme heat, colds, rainfall, pollution, and increased fire risk. In the following subsections, we explore how residents described climate-related hazards and extreme weather events and their connections to health outcomes and their migrant status. Residents discussed their vulnerability to these hazards, as well as their responses and strategies for coping.

Poor infrastructure

Un Nuevo Amanecer is built on a former landfill. Rising housing costs in Santiago, combined with migrants' limited access to formal housing due to their migration status, force many low-income migrants to settle in precarious areas like this one. Migrant participants reported buying land from Chilean residents for approximately 1,044 USD before beginning construction on their homes, often incurring debt with people from their own communities to cover the cost.

As residents gradually built their own homes, mostly with cement, plywood and wood, they questioned whether self-built structures could endure climate-related disasters and earthquakes. Participants had differing views on the sturdiness of their homes, reflecting concern about potential climate impacts:

> The material they build it out of is not very safe, apparently, from what I can see. They are materials that are not very safe. Unfortunately, I don't think we would be able to survive [a climate catastrophe] because the materials used are [...] very weak. (Liliana, Venezuela)

> Those houses in the settlement are not prepared, they are houses... people have made them to cover a need, but they are not houses that are prepared [...] to live in here, do you understand? Because here [in Chile] people know how to build [...] when the cold is outside, so that it doesn't penetrate too much inside, and if it is hot inside the house, so that the heat does not escape, but the houses here are not prepared for that. (Nadège, Haiti)

The limited local knowledge due to their migratory status makes it difficult for them to build houses suited to the climatic conditions of their new city. While some residents feel secure in their own homes, they are aware that other structures in the area are at greater risk: *"At any moment [they fall], because down below they are rubbish"* (Frantz, Haiti). Participants frequently expressed concerns about the stability of other homes in the settlement, highlighting the precarious building conditions:

> [The houses] can go down, because they are very close to the edge, they do not have much resistance or they have not made a safe base, moreover they say that this settlement is from a landfill, it has not been a fixed land, and it can cause them complications when living there with some... something that can happen, an earthquake, rain, all that. (Rodrigo, Peru)

Residents underscore the unevenness of risk within the community, shaped by factors such as access to resources, construction knowledge, and the hazardous legacy of the land itself. While some are confident in the resilience of their self-built homes, others express anxieties about the safety of the living conditions of their neighbours, expressing fear of disasters such as earthquakes, landslides and flooding of their homes:

> Look at the back of that house […]. It's the house that when it trembles or rains, I run there and worry. Now that I know that people live there, they have two girls. I told her, now you have left me worried, and we have to pray a lot so that nothing happens to them. 'You can't live in this house [...] it is very cracked, [...] I am leaving worried about your babies and about you. So, I don't know how you're going to do it. You have to fix this quickly. It's winter'—I told her. I said, 'please call me. If you feel anything, call me […] but you have to do better risk prevention, everything'—I told her. (Diana, Colombia)

But when asked about their satisfaction with living in *Un Nuevo Amanecer,* participants often cited the absence of rent as a major advantage, even as they cope with a lack of basic services: *"The truth, not happy, but because of the situation, I accept everything, because, because sometimes there is no electricity, no water, but I know that I will have to live with it"* (Frantz, Haiti); *"The obvious thing is that we don't have electricity, we don't have water, because everything is illegal here. But we were tired of paying rent, because a rent was like paying for, I don't know, a complete flat"* (Gloria, Peru).

Heavy rainfalls

In 2024, during our fieldwork, Chile experienced an unusually rainy year, which presented significant challenges for residents of *Un Nuevo Amanecer*. During visits, we observed

individuals actively repairing their roofs in response to flooding in their homes: *"Yes, in the rain. Yes, it got in about halfway across the room. I opened the door and, boom, it looked like it was a river, overflowing like that"* (Carmen, Peru). The heavy rains not only caused physical damage but also produced anxiety among the inhabitants:

> I'm afraid of that [...], the rainy weather, the floods, because now that it rained heavily and then they were not so prepared and it kind of flooded around here, the back, the streets and everything. (Carmen, Peru)

As we were told, self-built constructions and the heavy rains have led to severe flooding in the area: *"There are many passages that are so flat that the water is stagnant, I went there one day with a bicycle and I couldn't even get through because I saw so much water, I had difficulty passing"* (Enrique, Peru). Beyond impeding mobility, stagnant water can pose significant health risks; without proper drainage, it can create ideal conditions for disease-carrying organisms.

Just as we observed houses and streets flooding, we also saw residents actively working to repair roads and create water inlets to facilitate drainage: *"Look how the streets are flooded, all this is what we do so that the water can flow there*" (Diana, Colombia). While we were shown the community's efforts to get rid of the accumulation of water, these efforts also reflect the limited infrastructure and resources available to them. While the residents are resourceful in managing flooding, the reliance on self-built solutions and informal infrastructure highlights the precarious living conditions faced by migrants.

In a context where access to water is difficult at the settlement, the community have developed innovative strategies to manage their water needs, particularly by harnessing rainfall: *"Here there is no stream of water, just a little bit of water [...]. [With the rains] I put a plate and with that I wash the dishes, I have a big plate to take a shower"* (Diana, Colombia).

In addition, to manage drainage issues, residents have developed makeshift solutions, such as constructing moats around their homes:

> We built a moat [...]. There are some that form under the houses. But if they are under the houses, it is on the inside. And some put it, if they have a patio, they still work on it. They make it in the courtyard of their houses. If they don't have it, if they are under the houses [...]. It works well, normally. When it feels like it's going to fill up, we pay every year and a half to have it cleaned. (Carline, Haiti)

The moats built by residents reflect both resourcefulness and a forced adaptation to limited sanitation services. This poses additional sanitary risks given the proximity to living areas.

Extreme temperatures: heat

Heatwaves have severe effects on the health of people including dehydration and cardiovascular events. Residents of the settlement are experiencing this firsthand. Concrete-heavy environment intensifies the already high temperatures, creating conditions that feel stifling and difficult to bear: *"I feel that the heat is because the street is all concrete. And then there is no earth for it to rise, so the heat stays there. And then you obviously can't breathe in that heat"* (Carline, Haiti). Compared to other areas with municipal support for green spaces, the self-built *Un Nuevo Amanecer* on former private landfills limits public intervention, forcing residents to rely on their own resources to endure intensified heat:

> It's a little bit hotter here [at the settlement], because you know we don't have trees. You know that where there are no trees the heat is strong. Where there are trees the wind blows and it calms down a little, but not here, here it is pure heat. If we don't have a fan, we're screwed. (Esther, Haiti)

Beyond discomfort, extreme heat in the settlement also has consequences on residents' health:

> [At] the beginning, when I came here... hot weather you can't go outside. [...] I started having nosebleeds. I put my head like this, and blood comes out. [...] Yes, with the heat. I had to go, I went to the hospital, because it scares me a lot for the first time this happened

> to me, and the doctor told me it was normal because of the hot weather. It scares me, because in my country it's not like that. […] Every January, February, March [summer months], it's the same. But when the cold weather comes, nothing. (Yveline, Haiti)

The concrete surface of this informal settlement amplifies the heat, and the lack of natural cooling elements poses health conditions for residents that they struggle to endure.

Extreme temperatures: cold

As mentioned earlier, the settlement lacks formal access to electricity, which is particularly problematic in the winter months, which—as we are told—are getting increasingly colder. Many of the people interviewed were unaware of the exact source of their electricity, but all reported significant challenges related to power cuts or inadequate electrical supply. In winter months, participants reported the limited capacity of electrical infrastructure, as residents relied heavily on lighting and heating to cope with the cold: *"Sometimes many neighbours have things to heat their house, sometimes the light went down because [of the] very little power they have"* (Frantz, Haiti); *"Yes, it's cold, it's cold. So that, that's what sometimes causes us to run out of electricity, because people don't realise that and plug in, well no, and that's it, the fuses are out, all that, and we run out of electricity here. Sometimes three days, two days"* (Carmen, Peru). Frequent power cuts during the winter affect the community's overall well-being.

When discussing coping strategies for cold temperatures, participants expressed a sense of resignation and adaptability in the face of uncomfortable conditions:

> We were just cold [...]. We went to bed, what a horrible thing to do! [...]. And I bought little mittens and with that I warmed myself, with the little mittens I poured hot water and with that I warmed myself, and so on. (Diana, Colombia)

Furthermore, participants—especially those from the Caribbean—linked the cold to specific health issues: *"I have an illness called sinusitis. When it's cold, I don't feel well. Sometimes I have the flu, I can't breathe properly"* (Frantz, Haiti).

Without electricity to keep warm in winter, people also engage in practices prone to disasters and health risks: *"The cold is too much. We have a tank; there we burn small pieces of wood. We light a fire and then we warm up. As if it were a bonfire*" (Enrique, Peru). In acknowledgment to the risks involved some residents hesitate to use particular technologies available:

> I keep the child warm, and myself too. As the heater is a paraffin cooker, I don't use it inside because of the child. As she is very restless, I am afraid that if she touches it, it will burn her. And she is also allergic to paraffin. (Yveline, Haiti)

Other residents acknowledged the risks involved but reported: *"What else are you going to do!?"* (Diana, Colombia), pointing out the lack of less dangerous alternatives.

Risk of fires

Participants of this study expressed serious concerns about the fire safety of the electrical wiring installed within the settlement: *"The cable has already been cut, pieces have fallen and caught fire, and it's dangerous"* (Enrique, Peru), while they also reported that the wiring system of the settlement impedes stopping fires. During fieldwork, we observed that a fire truck would be unable to access the settlement—a risk residents attributed to the low-hanging, self-installed electrical wiring and because "*the streets are too narrow"* (Enrique, Peru). Participants stated that because people built their houses very close to each other, in case of fire: *"It is very difficult to save one thing, everything will burn down. If one day the house has a problem with fire, it will spread to many houses*" (Ronald, Haiti). An additional concern raised by the residents is the lack of access to water in the event of a fire, which significantly heightens the danger. Given the already unreliable water supply in the settlement, participants expressed their fear that if a fire were to break out, they would be unable to contain it or prevent it from spreading. Residents also mentioned preventive practices they engaged in:

> You know that houses are like a matchbox. One little spark, boom, boom, and everything burns. Because these are like little cardboard houses, because they are made of wood, and one burns and more fire, more fire, and all the houses burn. Obviously, it's very risky. So, in my case, when I go out, I turn off all the lights, I turn off the kitchen faucets, I even turn off the gas tap, just in case there is a leak. (Gloria, Peru)

Interviewees mentioned that fires have already occurred at the settlement. Despite the heightened fire risk in *Un Nuevo Amanecer*, no formal fire safety procedures are in place. Instead, residents rely on mutual vigilance and community support to manage fire hazards:

> Well, I can say that there is no evacuation plan [in case of fire], only one takes care of each other. If there is a fire there, everyone calls 'there is a fire!' before the firemen come, then they start to take out the most urgent things; the documents, in case the house burns down so they don't lose everything. (Emmanuel, Haiti)

Residents' ability to respond to these disasters depends on community cohesion and quick action. Additionally, the threat of another fire remains a constant source of anxiety for them:

> In summertime, fires. Yes. That's our fear […]. In summertime there might be a fire or something. Because that's what caused the fire up there [...], because it overheated a lot, I don't know, but that's what caused it to burn up there. Yes, and in wintertime too, because of the rain, the wires catch fire, and all that. […] Even at night I live thinking, my God, maybe the neighbour didn't put the candles off, or the neighbour might have a gas leak, or something, and it burns out quickly. (Carmen, Peru)

A point of anxiety relates to the risk of using candles, a frequent reality given the lack of reliable electricity, especially during heavy rains when power cuts become recurrent and prolonged:

> Last week I had about 4 days without electricity, it was raining, I had to buy candles […] for cooking. When I finish cooking, I have to put out those candles for the night. But the girl doesn't want to sleep in the dark. I have to leave the candle burning until morning. That scares me, with the candle, because of the child. (Yveline, Haiti)

These situations expose the residents to multiple dangers. The anxieties expressed highlight the constant balancing act between basic needs and safety.

Pollution

Residents cited Santiago's high levels of air pollution as a health burden. Although air pollution in Santiago affects the entire population, migrant residents reported feeling its effects more acutely, as they are not accustomed to these environmental conditions in their countries of origin. Participants felt that relocating to places with better air quality would be beneficial for their well-being: *"In the countryside it would be better for me [than in Santiago, because of] so much pollution"* (Anderson, Haiti). This situation is aggravated by the environmental degradation specific to *Un Nuevo Amanecer*, where unpaved roads, persistent dust and waste contribute to unhealthy living conditions.

Living on unpaved land exposes residents to constant dust, making respiratory issues and allergens a persistent challenge. Gloria, for instance, emphasised her ongoing efforts to shield her children from the dust and dirt in their home environment: *"It's not that I'm [...] addicted [to cleaning], but I do it for my children"* (Gloria, Peru). Sandra, another migrant resident, directly associated the high pollution levels with recurring health problems: *"A lot of colds, coughing, all that congestion, all that happens to me"* (Sandra, Colombia). In addition, participants expressed how they felt that the lack of waste management in the settlement exacerbated air quality conditions:

> Because rubbish is something that should be far away, not as close to the houses as it was [...]. When the sun already hits that rubbish, then that pollutes. As much as they can pollute the air, they can pollute the fumes, there are a lot of children. I think that yes, yes, they can pollute a lot. (Carline, Haiti)

Another resident connected waste management and air quality with respiratory health, especially among children:

> Before, when I moved here with my sister, the children [...] coughed a lot; they coughed a lot, as if there was contamination in the rubbish and they kept coughing and we were

> ready to leave because we said, no, the children are going to get sick with that rubbish, but until we finally saw that the problems with the rubbish were no longer there. (Liliana, Venezuela)

Such accounts highlight how pollution directly affects residents' health, particularly that of children. These risks are heightened for migrants, who lack the resources or institutional support to relocate, adapt or improve their situation. Yet, in the face of these constraints, residents have taken collective action to improve their environment. During our visits, we observed a notable improvement: while the landfill entrance was initially littered with waste, it was later kept clean by rotating guards who prevented illegal dumping and helped reduce related health risks:

> Now [the community guards] take care that on Sundays the neighbours don't leave their garbage there, because [there is] a sea of garbage out there, and that makes flies come and obviously flies bring diseases, rats also, cockroaches and that. At least that has been avoided. (Nayra, Peru, Focus group)

Discussion

Few attempts have been made to consider the complex associations between the climate crisis, migration, and health. In our study conducted among residents of an informal settlement, *Un Nuevo Amanecer* in Santiago, Chile, we found that while residents had a vague understanding of climate change, they did identify several specific climate-related conditions that significantly affected their health and well-being (Doering-White *et al.*, 2024). Residents shared general observations about their capacity to respond to climate disasters, along with specific examples of how heavy rainfall, extreme temperatures, fires, and poor air quality contribute to their anxieties and affect their health and well-being. These underscore the importance of qualitative approaches for examining the experiences of communities facing climate-related challenges.

In sum, our findings revealed numerous vulnerabilities associated with living in the settlement, alongside the community care practices and coping strategies employed by residents. The findings suggest that concerns about health and well-being conditions are deeply linked to processes of climate injustice, which reinforce existing inequalities and threats (Fisher, 2015). In this context, climate justice underscores how those least responsible for climate change often bear its harshest impacts, raising critical social, political, and ethical questions about the unequal distribution of climate-related harm (Sasser, 2023).

Our research confirms that migrants in urban areas of developing countries, such as Santiago, Chile, are among the most vulnerable populations in climate crisis scenarios (Barbieri and Confalonieri, 2010; Habitat for Humanity, 2024). Already experiencing structural vulnerabilities linked to their migrant status, residents in the settlement face compounded risks due to inadequate infrastructure, self-built homes on a former landfill site, and heightened exposure to extreme weather events and other climate impacts (Hepburn *et al.*, 2023). Previous work, focused on the health of migrant families from Latin America and the Caribbean with small children, has highlighted how migrants living in informal settlements are often exposed to environmental contaminants, parasites and lack access to sanitation and drinking water (Carreño Calderon *et al.*, 2024).

Studies have also shown that informal settlements in Latin America and the Caribbean are particularly vulnerable to the effects of the climate crisis, including drought, heavy rainfall, and landslides (Hussanainzad and Gou, 2024). This holds for *Un Nuevo Amanecer*, where residents face multiple vulnerabilities due to poor infrastructure and limited knowledge of local climate risks. Their self-built homes are at high risk of collapse during extreme weather, causing potential physical danger and ongoing anxiety. Excluded from formal housing by financial and legal barriers, migrants in *Un Nuevo Amanecer* lack basic services like water,

electricity, and sewage. Other studies have shown that this absence of essential infrastructure can increase residents' exposure to health risks, particularly gastrointestinal and respiratory illnesses (Sverdlik, 2011). As noted earlier, this urban settlement is being built on land that was once a landfill site, a setting that amplifies health vulnerabilities for its residents. Once they acquired the land in the informal market, they began building their own houses through a process referred to by some scholars as *autoconstrucción* [self-construction] (Holston, 1991; Caldeira, 2017). Studies have shown that the groups that are more vulnerable to experiencing housing hazards including landslides or flooding are people who live in self-built settlements (O'Hare and Rivas, 2005).

Residents of our study reported feeling particularly vulnerable to exposure to extreme heat due to the construction materials of their self-built homes (e.g., cement). The reliance on concrete surfaces amplifies the heat, and the lack of natural cooling elements poses health risks for residents, especially given that central Chile has experienced more severe heat waves since 2010 (González-Reyes *et al.*, 2023). As our results show, heatwaves worsen health issues such as dehydration, respiratory problems, and nosebleeds, as the concrete-heavy settlement traps Santiago's summer heat. In addition, the urban heat island (i.e., the difference in temperature between rural and urban sites) is an important problem with related environmental justice components (Stewart and Oke, 2012). Exposure to extreme heat is related to a variety of both short- and long-term health effects of differing magnitudes of severity (e.g., shortness of breath, headaches, heart attack, and premature death) (Pan American Health Organization, 2020). In Santiago, recent work has highlighted how lower-income neighbourhoods experience more intense urban health island effects during both day and night and how the effect is mitigated by green space (Sarricolea *et al.*, 2022). While green space represents a potential point of intervention to reduce the urban heat island effect, given the informal nature of *Un Nuevo Amanecer*, the planting of trees and the related maintenance (e.g., watering and pruning) would

be the responsibility of residents, rather than the local government. Efficient insulation, coupled with using resilient materials in housing, enhances mitigation and resilience to disaster risks and extreme weather events. Evidence indicates that recognising the intrinsic value and multidimensionality of the right to adequate housing positively impacts the quality of life and health (Frediani *et al.*, 2024). Testimonies related to extreme heat shed light on the unique vulnerability of migrant communities in informal settlements, where inadequate infrastructure and unfamiliar climatic conditions create health risks for residents.

In winter, lacking formal electricity, residents rely on wood fires and paraffin cookers, increasing health risks, especially for those with allergies or respiratory illnesses. Research on inhabitants of informal settlements has shown a strong link between prolonged exposure to cold and increased years of life lost, as well as a rise in cold-related illnesses (Hambrecht *et al.*, 2022). In *Un Nuevo Amanecer*, migrants often face a difficult trade-off: avoiding the cold by using unsafe heating methods that, in turn, jeopardize their health. This situation reflects a broader issue of energy poverty that affects many communities across Chile, not only those in informal settlements (Calvo *et al.*, 2021).

During the winter of 2024, multiple climate vulnerabilities interacted in the settlement: heavy rainfalls caused frequent electrical cuts, which, in turn, related to the reduction of heating options. Heavy rains also caused flooding in these fragile structures, leaving stagnant water that residents try to manage with improvised moats—though these pose additional sanitary risks. This example demonstrates how the climate crisis is a threat multiplier. Individuals who were already living in precarious conditions when faced with intense cold and relentless rain, were unable to adapt quickly, exacerbating their health vulnerabilities (Schütte *et al.,* 2018). Resident observations highlight how access to electricity is not enough in itself, but rather than the insufficiency of the infrastructure around this service relates to the lower ability to use the

technology to heat and cool their homes, a common problem in Latin America and the Caribbean (Carvajal *et al.*, 2020). Furthermore, research indicates that periods of heavy rainfall and cold correlate with higher mortality among informal settlement populations (Egondi *et al.*, 2015).

A key issue that emerged in the interviews was the use of fire as both a necessary response to extreme cold temperatures during winter and a significant safety risk. The reliance on open flames, particularly in densely populated areas with informal housing, increases the likelihood of fires. The settlement's low wires, narrow streets, and densely packed houses heighten fire hazards and obstruct emergency response, worsened by the absence of reliable water access. While all participants were aware of this risk, only some took preventive measures. This issue has been documented in other irregular settlements in neighbouring countries like Brazil (Lemmertz *et al.*, 2023), as has the urgent need to understand more about fire conditions and prevent them. Fires expose the residents to multiple health dangers. The anxiety some express, like worrying about the potential danger of leaving the candle burning overnight, highlights the precariousness of their living conditions and, again, the constant balancing act between basic needs and safety. Fires and their consequences have shown today more than ever the need for community-based disaster risk mitigation and a higher level of organization (Adiba, 2023), specifically in vulnerable locations such as *Un Nuevo Amanecer*.

Lastly, migrants, unaccustomed to Santiago's pollution, reported worsened respiratory problems that were compounded with the settlement's unpaved streets and abundant garbage, which generated excessive dust and poor air quality. The city has long suffered from high levels of ambient air pollution, exacerbated by geographical constraints (i.e., being surrounded by mountain ranges), meteorological conditions (limited dispersion in winter months), and anthropogenic sources characteristic of urban areas (Seguel *et al.*, 2020; Gallardo *et al.*, 2018).

Residents of the settlement alluded to air quality on the macro-scale, while also connecting specific features of their micro-environments (e.g., dirt roads leading to high levels of environmental dust) that are unique to informal settlements. Participants mentioned respiratory health effects of exposure to environmental air pollution, which has a large body of evidence in Chile (Ciciretti *et al.*, 2021; Franck *et al.*, 2015; Prieto-Parra *et al.*, 2017).

Responses to environmental hazards and climatic events were framed primarily in individual or community-level terms, with little reference to public or governmental agencies. Our findings highlight the essential role of social cohesion and support for residents of *Un Nuevo Amanecer*, which may also be the only mechanism available for those with insufficient resources (Barbieri and Confalonieri, 2010). While research suggests that upgrading irregular communities and providing services through governmental efforts is the most effective approach (Jiusto and Kenney, 2015), it is also important to address the unique needs and concerns of migrant communities in this process.

This study is a very early and novel exploration, as it attempts to link migration, health and the climate crisis within a settled urban population, focusing on how climate-related conditions affect the residents of *Un Nuevo Amanecer* in Santiago, Chile. The findings reveal that while migrants are actively developing strategies to cope with climate-related adversities, their lived experiences also expose the difficulties in clearly linking these challenges to broader environmental crises. Issues such as flooding, heat-related discomforts, lack of electricity, and respiratory conditions emerge as pressing concerns, yet these are often shaped by intersecting factors—poverty, precarious housing, and social exclusion—that complicate efforts to attribute them to the climate crisis. This reveals that relationships between the climate crisis, migration, and health are influenced by factors like exposure, vulnerability, and adaptive capacity of populations (Williams *et al.*, 2023). These effects are shaped by complex social, economic,

political, and demographic dynamics (Schwerdtle *et al.*, 2020), where the socioeconomic status of households plays a crucial role in determining residential vulnerability, given its direct correlation with resource accessibility (Welz and Krellenberg, 2016). In this context, the debate about the climate crisis must account for an interplay of scales, where individual and community perceptions play a crucial role in shaping how people understand and respond to the impacts of climate change (Crate, 2011; Fisher, 2015). As Khalid *et al.* (2023) suggested, the focus should shift from framing climate crisis-related hazards as "natural" disasters to focusing more on resilience, lack of resources, and the role of human agency in prevention.

While these findings shed light on critical climate-related health challenges faced by a migrant population, this study has several limitations. As an exploratory effort employing qualitative methods in a small sample, its findings cannot be generalized to all irregular settlements in Chile or the broader region. Additionally, the inclusion of participants from four different nationalities limits the ability to generalize or focus on specific cultural responses to the climate crisis. However, there is a strong need for research that highlights the health impacts of socio-environmental adversities, while recognizing the role of individual and community resilience and adaptation in responding to the climate crisis (Torres and Casey, 2017). These settlements should be seen as emergent communities that respond to a specific need of lodging, community, and safety (Jiusto and Kenney, 2015).

Our research calls for an urgent focus on local community responses. As our results show, community support is crucial in helping migrants cope with socio-environmental challenges, potentially enhancing health and well-being (Hogan *et al.*, 2024). However, a trend toward individualized risk management (Welz and Krellenberg, 2016; Hepburn *et al.*, 2023; Arteaga and Pérez, 2011; Pashayan, 2024) may be risky, as it can exacerbate health disparities, particularly for those without sufficient resources. It is therefore crucial for public entities to

recognize and address these vulnerabilities, ensuring interventions that do not further marginalize those already at a disadvantage.

Future research must deepen our understanding of these complex relationships between health, migration and the climate crisis by addressing the multifaceted and overlapping drivers of vulnerability in migrant populations. In particular, more attention is needed on the recent, growing but under-researched phenomenon of South-South migration, exemplified by Chile's significant influx from other Latin American and Caribbean countries. This requires not only acknowledging the indirect and context-specific nature of the links between health and climate crises but also expanding the lens to incorporate structural inequalities that amplify these risks. By doing so, we can better understand the relations between migration and the climate crisis, and ultimately inform policies that focus on prioritising the health and well-being of those most affected.

Conclusions

This study explores the relationship between migration, health, and the climate crisis, in the context of an urban informal settlement such as *Un Nuevo Amanecer* in Santiago, Chile. Our study shows that migrant residents face multiple vulnerabilities due to poor infrastructure and limited knowledge of local climate risks. Their self-built homes are at high risk of collapse during extreme weather, causing both physical danger and ongoing anxiety. Excluded from formal housing by financial and legal barriers, migrants lack basic services like water, electricity, and sewage, which threatens their health. Heavy rains cause flooding in these self-built structures, leaving stagnant water that residents try to manage with improvised moats—though these pose additional sanitary risks. Heatwaves worsen health issues such as dehydration, respiratory problems, and nosebleeds, as the concrete-heavy settlement traps Santiago's summer heat. In winter, lacking formal electricity, residents rely on unsafe heating

methods like wood fires and paraffin cookers, increasing health risks, especially for those with allergies or respiratory illnesses. The settlement's low wires, narrow streets, and densely packed houses heighten fire hazards and obstruct emergency response, worsened by the absence of reliable water access. Lastly, migrants, unaccustomed to Santiago's pollution, reported worsened respiratory problems that were exacerbated by ongoing construction and the accumulation of garbage in the settlement, which generated excessive dust and poor air quality. While migrants are developing community strategies to cope with climate-related challenges, their experiences are shaped by significant vulnerabilities, including inadequate housing, limited resources, and social exclusion. These conditions are compounded by environmental factors like extreme heat, cold, poor air quality, and fire risks, exposing residents to heightened health risks and affecting their well-being. Understanding the climate crisis requires looking beyond environmental conditions to also recognise the social and economic inequalities that influence the capacity of the most vulnerable communities to cope with its impacts.

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The authors report there are no competing interests to declare.

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