

Housing, Social Cohesion and Well-Being: Evidence from Informal Settlements*

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Abstract

How do housing interventions affect subjective well-being? To study this question, we conduct a randomized intervention in informal settlements in Brazil that mobilizes slum squatters to build higher-quality prefabricated houses with neighbors and friends. We find that the intervention substantially improved subjective well-being. Assessing the mechanisms, we show that treated individuals have more trust in community members and a lower propensity to move out to other neighborhoods. Qualitative data from semistructured in-depth interviews reinforce our findings. The results highlight that social interactions are relevant for explaining outcomes of *in situ* improvements.

JEL Classification: I10, I30, R20, O18

Keywords: Housing, Subjective Well-Being, Informal Settlements, Social Interactions.

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1 Introduction

An enduring theme in the development agenda is how housing programs can reduce existing health inequalities. Quality housing protects from extreme weather, animal infestations, and many health hazards, also influencing residential stability and ties to communities. Over time, the housing debate has shifted from focusing on physical health to a more comprehensive view, including fighting existing mental well-being inequalities. Investigating mental well-being is particularly relevant for the low-income population since mental-related disorders are pervasive in lower-housing quality settings (Krieger and Higgins 2002; Barari et al. 2020; Ridley et al., 2020). Moreover, pressing times—such as epidemics and natural disasters—usually exacerbate health inequalities, putting marginalized groups with precarious housing at even higher risk. Yet, the mental well-being effects of housing interventions are understudied in such pressing, high-stake contexts.

This paper investigates the effects of a housing intervention in Brazilian informal settlements on subjective well-being.¹ More than one billion people live in slum settlements (United Nations, 2020), so studying housing interventions in these communities can inform about the living conditions of a sizeable part of the world’s population.² We partner with the non-profit organization TECHO, whose intervention mobilizes slum squatters to build higher-quality prefabricated houses. The slum settlements that TECHO assists are highly precarious, without access to basic services.

The intervention we study is notable for at least four reasons. First, TECHO provides a relatively higher-quality housing unit: wooden houses with solid foundations providing isolation against changing temperatures, adequate ventilation, and more satisfactory protection against floods. These characteristics represent an improvement as substandard houses in slums have non-durable structures, and many do not have windows. However, TECHO housing units are small, and beneficiaries must pay a small share of the construction cost. Second, unlike many other housing interventions, TECHO does not relocate residents but rather upgrades homes for residents in their original land plots. Third, TECHO’s intervention includes a collective effort to build new homes: beneficiaries must attend meetings and mobilize neighbors, friends, or family members to assist TECHO’s volunteers in building the houses. Therefore, we

¹We define subjective well-being as emotional well-being according to Kahneman and Deaton (2010). Emotions include happiness, sadness, loneliness, worriedness, among others. We use mental well-being, subjective well-being, and emotional well-being interchangeably throughout the paper. See Section 2 for definitions.

²Although the term “slum” may invoke negative connotations in some contexts, we use it (interchangeably with informal settlements) for two reasons. First, it is commonly used in Brazil (*favela*) and by the individuals in our setting. Second, the communities we examine fit the definition of a slum according to the United Nations: inadequate access to sanitation and other infrastructure, poor housing quality, overcrowding, and lack of tenure security (United Nations, 2020).

study a multifaceted intervention comprising a private good (the higher-quality housing unit) and a prosocial behavior component (that aims to promote social cohesion by incentivizing social interactions to build the housing unit). Finally, the intervention is reproducible and standard in 18 countries; hence, studying its impacts may provide useful lessons for other settings.

Housing interventions may or may not improve subjective well-being, as the impacts of underlying mechanisms are conceptually ambiguous. In our intervention, the effects of both the private and prosocial components are ambivalent. For instance, the higher-quality basic structure protects against weather shocks and animal-related infestations, but the housing payment may burden the beneficiaries. In addition, the intervention’s prosocial behavior component may positively affect well-being by increasing self-esteem and community cohesion, generating a greater sense of belonging and attachment. However, it may impose negative “positional externalities” and disrupt connections if neighbors dislike having an “inferior” housing unit (Undurraga, 2021). Given these conceptually ambiguous effects, the impacts of our housing intervention on mental well-being is ultimately an empirical analysis.

To test the effects of the intervention, we conducted a pre-registered randomized control trial with 611 families in 24 slums in Brazil. In each slum, applicants are ordered in a randomized waitlist, and the implementers make slot offers following that order until the program’s construction capacity is reached. The randomization took place in 2019 and early 2020 before the COVID-19 outbreak—see more details in Section 2. Professional enumerators conducted phone surveys during the early stages of the COVID-19 pandemic (between June and July 2020). Therefore, when interpreting the results, we take into account that we are analyzing a setting of dire times in which the better-quality housing unit may function as a “buffer.”

We find that the intervention substantially improved subjective well-being, with an effect size estimate of about 0.2 standard deviations relative to the control group. Importantly, the results are robust to alternative empirical models and the exclusion of control variables. The magnitude of our findings is greater than the average effect found in studies that designed experiments to assess the impacts of cash transfers and other anti-poverty programs on mental well-being (Ridley et al., 2020).

To understand how the intervention impacts subjective well-being, we study suggestive pathways related to housing quality and social interactions. First, concerning housing quality, we find no significant improvements in sanitary infrastructure; this works as a “sanity check” since the intervention does not aim to improve such infrastructure. The intervention, however, impacts other dimensions of housing quality that are conceptually more likely to be affected: for instance, beneficiaries report a lower incidence of pests such as rats. In addition, we assess how the better housing

structure is associated sleep deprivation. Although sleep could be crucial to a person’s well-being, the intervention does not affect sleep using a self-reported measure of sleep quality. Second, as for social interactions, we find increased trust toward community leaders and selected community members (such as friends). In addition, our findings indicate suggestive evidence of an impact on reducing outmigration—the magnitude of the intervention effects on squatters’ propensity to move to other neighborhoods is large but not precisely estimated in some specifications. Together, these results suggest that some measures of housing quality and social cohesion are likely to operate to trigger changes in subjective well-being.

We use qualitative data from semistructured in-depth interviews that reinforce our findings. We carry out subsequent follow-up work based on 42 interviews with (randomly-selected) beneficiaries. The qualitative interviews provide additional evidence that the channels we discuss are relevant. For example, greater housing quality and ties with community members are common factors brought up by the interviews. The interviews highlight that the intervention strengthened interpersonal bonds necessary for coping with the hardships imposed by pressing times.

One important takeaway from our findings is that one needs to consider all the intervention’s dimensions to explain the results: both the private component of the intervention (the quality housing unit) and the prosocial behavior component are crucial drivers. Furthermore, the results of increased mental well-being are consistent with ongoing discussions regarding the need for housing interventions to target a broader range of goals—e.g., going beyond the promotion of housing affordability by also stimulating social mobility and reducing inequalities (Da Mata and Mation, 2024).

Our paper connects to the extensive literature on housing and mental well-being. From psychology to public health and economics, the literature widely agrees that housing quality interferes with mental well-being (e.g., Evans et al., 2000). This literature is too large to be detailed here but recent systematic reviews in health include Singh et al. (2019). Within this literature, few papers have assessed how housing interventions affect subjective well-being using an experimental and lottery-based designs (e.g., Kling et al., 2007; Galiani et al., 2017; Galiani et al., 2018; Franklin, 2019; Andersen et al., 2022).³

We build on these existing experimental and lottery-based studies and fill three gaps. First, we add by showing that social interactions are also relevant for *in situ*

³These papers focus on one aspect of subjective well-being (life evaluation), while we examine emotional well-being (Kahneman and Deaton, 2010). Emotional well-being is better suited for our context since we study how both housing quality and social interactions affect well-being (see Section 2.2). We are closely related to Galiani et al. (2017) and Galiani et al. (2018), which study different outcomes exploring a TECHO intervention with a less-salient prosocial component and with a focus on life evaluation. Franklin (2019) and Andersen et al. (2022) study life evaluation and emotional well-being.

improvements, and not only for interventions that generate relocation to live in other areas (e.g., [Barnhardt et al., 2017](#)). Second, we contribute by providing experimental evidence on how a housing intervention affects an understudied challenge of slum dwellers: sleep deprivation.⁴ We find no effects on sleep after our intervention, contrasting with the results of [Bessone et al. \(2021\)](#), which find increased sleep duration after a sleep-related information and encouragement experiment. Third, we investigate the mental well-being impacts of housing during dire times, an underlying context much less studied by the literature. This is particularly relevant for lower-income families, who suffer more from mental-related issues and are disproportionately affected during crises. Besides, since the returns to a specific intervention are subject to aggregate shocks ([Rosenzweig and Udry, 2020](#)), it is crucial to evaluate slum interventions during economic downturns.

In addition, we connect to the broad literature on how anti-poverty programs affect mental well-being (see [Ridley et al., 2020](#) for a review). We contribute by providing experimental evidence on how a “lower-dosage” intervention can impact subjective well-being during a negative aggregate shock.⁵ Finally, we connect to the papers analyzing the effects of interventions in slums (e.g., [Field, 2005](#); [Field, 2007](#); [Di Tella et al., 2007](#); [Galiani and Schargrotsky, 2010](#); [Galiani et al., 2017](#); [Cavalcanti et al., 2019](#)) and those studying the role of policies in slums in the COVID-19 pandemic (e.g., [Brotherhood et al., 2022](#)). We add another piece of evidence by studying the role of social interactions in shaping the outcomes of *in situ* interventions.

This article proceeds as follows. Section 2 details the intervention. Section 3 presents the experimental design, while Section 4 reports the quantitative and qualitative results. Section 5 concludes.

2 Background

2.1 The intervention

Substandard housing is pervasive in many parts of the world, particularly in developing countries. In response, many interventions have been devised and implemented to improve the housing quality of slum dwellers. This paper studies a housing quality intervention led by a non-profit organization (NGO) called TECHO (“TETO” in

⁴To our knowledge, the papers studying housing and sleep use observational data (e.g., [Simonelli et al., 2013](#)).

⁵The intervention we study can be considered of “lower dosage” as housing units do not have sanitation and lack land tenure. We also relate to the literature on mental health and aggregate shocks, especially the growing branch documenting the detrimental impacts of COVID-19 pandemic on mental health—examples of meta-analyses in health include [Bueno-Notivol et al. \(2021\)](#) and [Robinson et al. \(2022\)](#).

Brazil). To understand the underlying context, we provide a detailed description of the intervention below.

TECHO’s mission is to reduce poverty in informal settlements by improving housing quality and building what the organization calls “community capacities” (a concept that involves leadership and civic engagement, network expansion, among others). TECHO argues that by improving housing quality and community capacities, slum dwellers can find their way out of poverty. The NGO started in 1997, and it has offices in most Latin American countries. We partner with TECHO in Brazil—where the NGO has offices in five states (São Paulo, Rio de Janeiro, Paraná, Minas Gerais, Bahia) and operates in another state with no office (Pernambuco).

One of TECHO’s most significant assets is its close relationship with local community leaders in informal settlements that are hard to access. TECHO’s volunteers have an essential role in establishing most of these relationships. Typically, outsiders cannot get involved in many of these slum settlements without permission, and TECHO succeeds in places where no other NGO reaches—in some cases, even government officials do not have equal access to communities. The slum settlements that TECHO assists are highly precarious, with limited access to water, no sanitation, improper quality housing, and lack of garbage disposal networks.⁶ Slums such as these are also characterized by a lack of property rights, insecurity, and lack of government presence (Cavalcanti et al., 2019).

TECHO’s intervention consists of mobilizing slum squatters to build higher-quality prefabricated houses with neighbors and friends. TECHO’s houses have relatively higher quality compared to substandard housing units in slums, which are mostly made of cardboard, inadequate pieces of wood or plastic, and some do not have floors or windows. For instance, TECHO’s wooden houses have a solid foundation and adequate construction materials. Walls and roofs are starkly more resistant and provide protection from frequent rains and storms. TECHO’s wooden houses also provide isolation against changing temperatures, have windows for ventilation, and are elevated, protecting against animals and floods. Anecdotal evidence indicates that pest infestations and floods are common in slums (Folha de São Paulo, 2021; G1, 2018). However, TECHO’s housing units are small (18 square meters), have just one room (families improvise a wall to create a living room and a bedroom), and are regularly overcrowded.

Beyond the housing unit (the private good), the intervention comprises a prosocial behavior component. More specifically, TECHO’s intervention includes a collective

⁶For instance, according to Brazilian Census data, the median per capita income of slum dwellers in the country is 865.40 (in 2020 Brazilian Reais), while the median per capita in our sample is only 210 Brazilian Reais. The slum settlements in our experiment are also significantly worse than the average Brazilian slum household in other dimensions (see Appendix Table A.1).

Figure 1: Phases of the Intervention



(a) Removal of old unit



(b) Meeting: mobilization of community members



(c) Construction of new unit



(d) TECHO unit before painting

Notes. The pictures show the phases of the intervention. Panel (a) shows the team removing the old housing unit. Panel (b) depicts the meeting with TECHO volunteers, neighbors, friends, and other community members to start the construction of the new housing unit. Panel (c) shows the construction of the TECHO housing units. Panel (d) depicts the TECHO unit before being painted. The pictures are of a housing unit built after the beginning of the COVID-19 Pandemic, and that is not in the sample of this study. Source: TECHO.

effort to build new homes: A one-month program that ends with two construction days. During the program, beneficiaries must attend meetings whose main objective is planning the construction. In addition, selected slum residents are directly responsible for the viability of the construction: They must access their networks to engage neighbors, friends, or family members to assist TECHO’s volunteers in planning the logistics for the housing construction, as well as helping to build the houses.

Figure 1 depicts the phases of the intervention, from the removal of the old housing unit to the meetings and construction of the new house. Notice that TECHO does not relocate residents but rather upgrades homes in their original land plots. In addition, Appendix Figure A.1a shows a typical housing unit that the NGO targets to be a beneficiary, while Appendix Figure A.1b depicts a typical TECHO housing unit.

More than 95% of the house cost is subsidized, and beneficiaries must pay around R\$200,00 (which represent approximately 55% of the monthly per capita income of a typical household in our sample). In summary, the multidimensional intervention comprises a bundle of private and social interaction components.

2.2 Subjective well-being

We are interested in assessing the impact of TECHO’s intervention on subjective well-being. Subjective well-being is a broad category of phenomena that includes people’s emotional responses and life satisfaction judgments. In this paper, we define subjective well-being as *emotional well-being*. Emotional well-being includes people’s everyday emotional experiences—the quality and frequency of joy, sadness, happiness, stress, anxiety, and other feelings (Kahneman and Deaton, 2010).⁷ The use of emotional well-being is relevant for our investigation because it is positively affected (i) when there is the fulfillment of basic needs (Kahneman and Deaton, 2010; Diener et al., 2010) and (ii) by social interactions (Sandstrom and Dunn, 2014).

Housing can affect emotional well-being through multiple channels. Given the characteristics of our intervention, the housing quality and prosocial components may help explain how housing affects subjective well-being.

Housing quality. Low housing quality is a gateway to mental-related illness (Krieger and Higgins 2002; Barari et al. 2020). Lower-quality units are more vulnerable to the impacts of environmental exposures. The threat of physical hazards like storms and floods are major stressors and can engender anxiety, worry, and stress (Wells and Evans, 1996; Wells, 2003). Other environmental stresses, such as exposure to extreme

⁷Apart from emotional well-being (an affective measure of well-being), studies on subjective well-being also use two evaluative measures of well-being: life satisfaction—referring to the thoughts that people have when they think about their life (Kahneman and Deaton, 2010)—and domain satisfaction—the extent to which beneficiaries are satisfied with the quality of their houses (floor, roof, walls, and other features of their residency)—see Diener et al. (2018a).

temperatures, also affect emotions (Berry et al., 2010; Patel et al., 2018; Liu et al., 2021). Since the intervention improves the quality of housing structure, one could expect a reduction of concerns of insecurity towards basic needs and an improvement in emotional well-being.

The higher-quality housing unit can also affect subjective well-being because it reduces the likelihood of animal-related contamination—as physical health interferes with mental well-being (Diener et al., 2018b)—and it may matter for sleep. These factors would also be associated with positive impacts on emotional well-being (Vandekerckhove and Cluydts, 2010; Gee et al., 2019).

Moreover, the higher-quality housing unit can act as a positional good (Frank, 2005; Foye et al., 2018), positively impacting self-esteem and well-being.⁸ However, it may impose negative positional externalities: neighbors may dislike having an “inferior” housing unit, which might disrupt connections. Another negative impact of the higher-quality housing unit on emotions could come from the fact that the cost of construction can compromise one’s financial situation, leading to emotional deterioration. Although the unit is highly subsidized, several other costs may affect subjective well-being—for instance, time costs and paying for utilities’ re-connection.⁹ The intervention could have been considered of “higher dosage” if the intervention had improved household sanitation or provided land titling (thus, households still fear evictions, a driver of emotional deterioration). The lack of property rights and sanitation could then generate no effects of the intervention.

In addition, individuals in slum communities migrate regularly, and people constantly seek better living conditions (Evans et al., 2003). By receiving a better-quality house, there might be a reduction in migration mobility. Reduced mobility would incentivize one’s willingness to invest in the community and strengthen interpersonal bonds—the happiest individuals usually have supportive social relations (e.g., Diener and Seligman, 2002).

Prosocial component. The intervention also affects social relations through a prosocial component. Since the intervention promotes *in situ* improvements (at the current land plot), disruption of social ties and networks is not a plausible mechanism in our setting. On the contrary, the intervention requires the neighbors to collaborate in the construction phase of the housing unit, so we expect an increased connection with the community. The collaboration may work as a social learning experience because beneficiaries must use their social assets and skills (trust, reciprocity, networks) to interact with other community members and volunteers if they want the intervention to be

⁸Positional goods are those whose value is determined relative to other goods, and therefore, concerns about local ranks matter for valuation.

⁹TECHO has waived households from paying for housing construction in some communities.

successful. Hence, participants may learn from practical, meaningful experiences that their collective effort can help their development. People that cultivate strong ties with friends, family, and even weak ties with community members could become relatively happier than less connected individuals (Baumeister and Leary, 1995; Helliwell and Putnam, 2004; Sandstrom and Dunn, 2014).

Other channels. Given our intervention’s characteristics, other potential mechanisms in the literature are less likely to operate. For instance, the labor market channel seems less prominent: housing interventions may affect labor market outcomes by changing job search efforts. However, this is more likely to operate where families are relocated or when there is a more significant wealth shock (van Dijk, 2019; Da Mata and Mation, 2024).

2.3 Timeline of the intervention and the COVID-19 pandemic

The selection of beneficiaries and construction of housing units started in 2019. During the selection of beneficiaries, we applied the baseline surveys. Because of the COVID-19 outbreak, the construction of additional housing units was interrupted in February 2020. For the families exposed to the program before that interruption, we decided to conduct the post-treatment surveys between June and July 2020. Professional enumerators worked remotely from home and conducted phone surveys; enumerators were unaware of the treatment assignment and our hypotheses. In addition, we perform 42 semistructured phone interviews between July and August 2021.

As a result, the interpretation of our results must consider that the beneficiaries faced the COVID-19 pandemic during the data collection. Historically, low-income people are disproportionately affected by pandemics. The COVID-19 pandemic has hit Brazilian slums in an unprecedented way. For instance, slum areas engage in less social distancing and present higher fatality rates than non-slum neighborhoods (Brotherhood et al., 2022). Proper housing may be critical during a pandemic, as higher quality housing units may potentially reduce mental-related burden: TECHO’s housing unit may make the period of COVID-19 exposure more “bearable.” Although we study a period of pressing times, we consider that the channels discussed in Section 2.2 are still plausible to operate.

3 Empirical Strategy

3.1 Sample and Treatment Assignment

To test the intervention’s effects, we conducted a pre-registered experiment with 611 families in 24 slums in Brazil—217 families were randomly assigned to the treatment

group. Appendix Figure A.2 shows the location of the 24 slums across the Brazilian territory.¹⁰

The assignment into treatment worked as follows. In each slum, TECHO volunteers select the families eligible to participate in the program according to a vulnerability index. The vulnerability index comprises information such as physical health (e.g., chronic conditions and incurable diseases), income level, and risks (e.g., risk of eviction, vulnerability to natural disasters, and location adjacent to a landfill area). Some families live in such extreme conditions (i.e., with a very high vulnerability index) that TECHO prioritizes giving them the house—these beneficiaries are not part of the intervention. Other families voluntarily participated in a draw organized by TECHO to select beneficiaries if there was excess demand for housing units in a given community. In 24 slums, the demand lists for housing units were oversubscribed. In these cases, applicants are ordered randomly on a waitlist, and slot offers are made following that order until all housing units available are filled (all program’s construction capacity is reached). Conceptually, applicants can be partitioned then into two groups: “initial offer” winners (those who were randomly ranked up to the number of housing units—our treatment group) and “nonwinner” group (randomly ranked at lower positions—our control group).

A timeline of the housing unit construction and our surveys is presented in Figure 2. In each of the 24 slums, we applied a baseline survey before implementing the randomized waitlist. The post-treatment survey was conducted between 6 and 14 months after the intervention. In two slums, we created two waitlists a few months apart. Therefore, the number of blocks is given by the number of slum-waitlists. For ease of exposition, we refer to the number of blocks as the number of slum settlements. We did not perform any stratification within a given informal settlement. More details on the sample and randomization are in Appendix B.

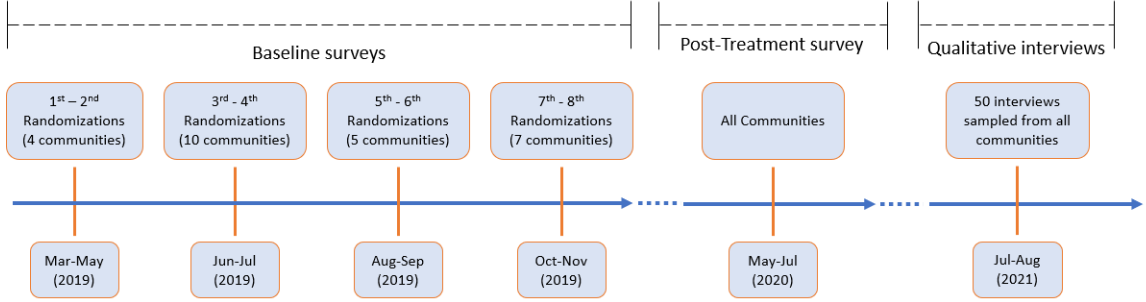
3.2 Empirical Specification

We estimate an intention-to-treat effect by using the following empirical specification:

$$y_{ij} = \alpha + \rho Treat_{ij} + \beta X_{ij} + \gamma_j + \varepsilon_{ij} \quad , \quad (1)$$

¹⁰During our meeting with TECHO regarding the research design, we asked the implementers for details about the beneficiaries’ selection. TECHO stated that selecting beneficiaries uniformly among its Brazilian offices would be an improvement. Besides, TECHO stated that most communities had excess demand for housing units. We suggested selecting the beneficiaries randomly to provide a uniform selection method in communities with excess demand, and TECHO said that this would work for their settings. Furthermore, leaders and volunteers could decide on priority cases that would not enter the random selection. We excluded households that were given priority from the analysis—for instance, pregnant women and people with disabilities. Using leaders’ and volunteers’ contextual knowledge improves priority decisions and addresses ethical concerns.

Figure 2: Timeline of the Intervention



Notes. This figure shows the timeline of the TECHO intervention.

where y_{ij} is the outcome variable for individual i in slum settlement j , and $Treat_{ij}$ is the randomization assignment dummy: the initial-offer winner dummy equals one for applicant i getting an initial offer at the draw in slum settlement j and zero otherwise. The parameter of interest is ρ , the impact of the assignment to the intervention; if the program has positive impacts, this coefficient should be positive and statistically significant. γ_j is a strata (informal settlement) fixed effect and ε is the idiosyncratic error term.

In Equation (1), we include three variables in the vector of baseline characteristics X_{ij} to improve the precision of the estimates: a health index, an indicator variable that equals one if the household has received a visit from a community leader and zero otherwise (“leader visit”), and a roof quality index. In the interest of full disclosure, we also report the results without these control variables.

In addition, we estimate a specification based on Lin (2013):

$$y_{ij} = \alpha + \rho Treat_{ij} + \phi Treat_{ij} \times \bar{\gamma}_j + \delta Treat_{ij} \times (X_{ij} - \bar{X}) + \beta X_{ij} + \gamma_j + \varepsilon_{ij} \quad , \quad (2)$$

where $\bar{\gamma}_j$ is a set of centered strata fixed effects and \bar{X} is mean covariate value for the entire sample. The intuition of the interaction terms is to allow for different treatment effects across blocks.

3.3 Outcomes

Appendix Table A.2 shows the outcomes used in this paper. Our primary outcome is a (pre-registered) index of subjective well-being. The measure of subjective well-being is based on Kahneman and Deaton (2010), which use the Gallup-Healthways Well-Being Index. More specifically, we use the emotional well-being questionnaire that asks about the frequency of positive and negative emotions (e.g., happiness, worry,

loneliness, stress). We adapt the phrasing of the questions to match our setting’s cultural and socioeconomic context. The original language is: “Did you experience the following feelings during a lot of the day yesterday?” We changed the wording to: “Thinking back to yesterday, would you say you felt [feeling] for most of the day?” The feelings are the following: happy, worried, sad, and lonely. We then include two additional measures of stress and depression: if the person uses any medicine for depression and the extent to which the person “felt more stressed yesterday than usual.” We also include a question about sleep quality using a five-point Likert scale.

All questions were standardized to take part in an *index of subjective well-being* with equal weights for each component (Kling et al., 2007). Variables that address negative feelings had the signal inverted (reverse-scored) to match positive emotions. Therefore, our approach to dealing with multiple hypothesis testing is to examine a single overall index variable that combines all outcomes belonging to a family.

We use several measures to understand (exploratory) mechanisms. First, a housing quality index, which is a standardized measure related to the presence of sanitation (presence of sinks, toilets, and showers), durable goods, pests, and a question of relative housing quality (“Do you think your house is better than the ones from your neighbors?”). Second, a trust index: a z-score of trust in government, community leaders, family, and friends. In addition, we examine labor market outcomes and the likelihood of staying in the community. Finally, we use a few individual questions that belong to indices to shed light on the interpretation of the results—with the caution that they must be corrected for multiple testing.

3.4 Assessing the research design

In this subsection, we perform different exercises to assess our research design.

Balancing. Table 1 presents the summary statistics of households in the assigned-to-treatment and control groups at baseline. Columns (I) and (II) display the mean and the standard deviation of several characteristics for the treated households (initial-offer winners), respectively. Columns (III) and (IV) show the mean and standard deviation of the same attributes for the control group (nonwinner group). Column (V) reports coefficients from regressions (estimated by OLS) of baseline variables on the treatment assignment indicator, controlling for strata fixed effects—a specification similar to Equation (1) but using each baseline characteristic as the dependent variable. Column (VI) reports standard errors. Results show that our sample is balanced on a wide set of variables; only a few of the coefficients are individually statistically significant. Besides, the F-statistics cannot reject the joint hypothesis that all coefficients are zero.

Compliance. Of the 217 households randomly allocated to the treatment group,

Table 1: Pre-treatment Covariates: Balancing

Variable	Treated Group		Control Group		Δ (Treated - Control)	
	Mean	Std. Dev.	Mean	Std. Dev.	Δ	Std. Error
Household size	2.716	(1.842)	2.587	(1.512)	0.108	(0.149)
Gender	1.440	(0.497)	1.359	(0.485)	0.072*	(0.043)
Age	38.022	(15.332)	37.420	(15.009)	0.296	(1.250)
Race	4.044	(0.953)	3.930	(1.022)	0.130	(0.081)
Income	511.876	(535.832)	470.617	(542.360)	19.351	(45.838)
Per capita income	374.111	(376.672)	360.784	(423.154)	-1.512	(32.762)
Indicator: Employment	0.449	(0.498)	0.398	(0.490)	0.051	(0.043)
Indicator: Pregnant	0.053	(0.225)	0.061	(0.239)	-0.009	(0.018)
Indicator: Health problem	0.551	(0.828)	0.471	(0.784)	0.075	(0.069)
Indicator: Chronic diseases	0.373	(0.485)	0.333	(0.472)	0.046	(0.041)
Indicator: Sanitary diseases	0.276	(0.448)	0.303	(0.460)	-0.014	(0.037)
Indicator: Respiratory diseases	0.280	(0.450)	0.284	(0.451)	0.006	(0.040)
Indicator: Disability	0.916	(0.279)	0.908	(0.290)	0.007	(0.024)
Hospital visits	0.591	(0.493)	0.624	(0.485)	-0.032	(0.043)
Financial Expectation	0.773	(0.460)	0.750	(0.525)	0.031	(0.043)
Dream housing	1.800	(0.443)	1.835	(0.443)	-0.008	(0.037)
Institutional affiliation	0.729	(0.446)	0.677	(0.468)	-0.012	(0.027)
Leader visit household	0.356	(0.480)	0.306	(0.461)	0.064*	(0.038)
Authority claim-making	0.187	(0.391)	0.172	(0.378)	0.016	(0.033)
Leader claim-making	0.253	(0.436)	0.180	(0.384)	0.061*	(0.036)
Engagement Elections 2018	0.129	(0.336)	0.109	(0.312)	0.013	(0.027)
Engagement Elections 2016	0.138	(0.345)	0.090	(0.286)	0.041	(0.026)
Education level	2.338	(1.327)	2.371	(1.288)	0.030	(0.095)
Year arrived community	2014.42	(6.221)	2015.00	(4.994)	0.178	(0.357)
Location previous home	1.699	(0.482)	1.781	(0.436)	-0.060*	(0.034)
Ever evicted	0.116	(0.320)	0.133	(0.341)	0.005	(0.028)
Any Infrastructure problems	0.978	(0.148)	0.954	(0.210)	0.027*	(0.016)
Any household accident	0.382	(0.487)	0.427	(0.495)	-0.032	(0.041)
Adequate roof material	0.600	(0.491)	0.612	(0.488)	-0.008	(0.042)
House quality index (roof)	2.809	(0.781)	2.937	(0.739)	-0.096	(0.064)
Adequate wall material	0.022	(0.148)	0.017	(0.129)	0.005	(0.011)
House quality index (wall)	2.720	(0.783)	2.799	(0.695)	-0.071	(0.063)
Adequate floor material	0.409	(0.493)	0.451	(0.498)	-0.004	(0.038)
House quality index (floor)	3.062	(0.777)	3.036	(0.805)	0.055	(0.065)
F-test (H0: All coefficients = 0)	F-stat:	1.08	P-value:	0.36		

Notes. This table shows the balancing test between the group assigned to treatment and the comparison group. Columns (I) and (II): mean and the standard deviation of characteristics of the treated households (initial-offer winners). Columns (III) and (IV): mean and standard deviation of the characteristics of the control group. Column (V): coefficients from regressions estimating Equation (1) with each characteristic as the dependent variable. Column (VI): standard errors. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

87 declined or could not receive the housing unit, representing a 60% take-up rate. Part of the households assigned to treatment never gets to receive the house, either because they refuse to agree to TECHO’s conditions to build a new home or because the land plot would not be adequate for TECHO’s units.¹¹ Additionally, 13 units initially assigned to be in the control group ended up receiving treatment even though they were not eligible according to their position on the waitlist. The reason reported by the NGO’s volunteers was to accommodate community leaders’ will.

The fact that we are estimating an intention-to-treat effect with initial-offer winners and the non-compliance of units in the treated and control groups indicate that our estimates may be interpreted as lower bounds of the true effects.

Attrition. We surveyed 387 households during the post-treatment survey. The main reason for not obtaining more surveys was changing phone numbers between surveys; only a few households refused to answer the survey by phone. We minimized typo errors in phone numbers by checking the survey’s phone numbers with phone numbers from three suppliers. To check for differential attrition across groups, we create the variable $Interview_{ij}$, an indicator variable that equals 1 if a household i in community j is interviewed in the post-treatment survey and 0 otherwise. We then estimate a specification similar to Equation (1) using $Interview_{ij}$ as the dependent variable. Results are in Table 2. Importantly, our attrition rate is similar across treatment arms. There is no statistically significant difference in the likelihood that we conduct a follow-up survey by phone with households in the assigned-to-treatment and control groups. The difference in the re-survey rate is close to zero.

4 Results

We divide the results into three parts. First, we show the effects on the primary outcome: subjective well-being. Then, we discuss the exploratory channels. Finally, we close the section by detailing the key results from the qualitative analysis. Our tables have a common format: we present the results from estimating Equation (1) with and without controls and then present the results from estimating Equation (2) with and without controls.

4.1 Main Results

We start by examining the consequences of a housing intervention in Brazilian slums on mental well-being. The results are shown in Table 3. Column (I) indicates a large and statistically significant effect on well-being: exposure to the intervention triggers

¹¹Conditions vary from steep terrain, small plot size, and land composition (either too muddy or too rocky).

Table 2: Attrition Analysis

<i>Dependent Variable:</i>	<i>Interview (1=Yes)</i>	
	(I)	(II)
Variables		
Treat	-0.000 (0.042)	0.001 (0.043)
Resp. Health Index		0.021 (0.062)
Leader visit		-0.021 (0.046)
Roof qual. index		0.001 (0.028)
Slum Settlement Effects	Yes	Yes
Pre-treatment Controls	No	Yes
Number of Obs.	632	632

Notes. This table shows the results of the baseline empirical model (see Equation (1)). The dependent variable is an indicator variable that equals 1 if a household i in community j is interviewed in the post-treatment survey and 0 otherwise. *Treat* is the randomization assignment dummy, which equals one for applicants getting an initial offer at the draw in a slum settlement and zero otherwise. Control variables are community leader visits, quality of the house roof, and an index for respiratory diseases. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

a rise in subjective well-being of about 0.2 standard deviations. The point estimates on emotional well-being are uniformly large and positive after performing pre-specified analyses. For instance, Column (II) indicates that the results are robust to including control variables. In addition, Columns (III) and (IV) point out that the magnitude of the results increases when estimating the regressions with interactions (see Equation (2)). Those in the treatment group, relative to the control group, report having a greater subjective well-being index by 0.25 standard deviations.

The results show then that the group assigned to treatment presents improved subjective well-being. Next, we investigate which index components are associated with the positive effects—bearing in mind that this analysis is primarily suggestive because the index was meant to be a holistic measurement instrument for subjective well-being (Kahneman and Deaton, 2010). Results in Table 3 suggest that decreases in worry and the use of depression medication are large in magnitude and are likely to explain the positive impacts we observe on mental well-being.

To put our results' magnitude into perspective, we compare them with those from the literature analyzing anti-poverty programs. Ridley et al. (2020) provides a meta-analysis of the effects of anti-poverty programs on mental well-being. Our estimates

lie in the upper range of the positive results, highlighting that the large effects of our intervention are likely related to the fact that the survey data collection was conducted during pressing times. Aggregate crises such as the COVID-19 pandemic disproportionately affect the people living in poverty, with detrimental effects on mental health outcomes (Adams-Prassl et al., 2020). Our findings suggest that even in a highly vulnerable sample—overall more prone to the negative impacts of external shocks—the program helps alleviate adverse effects among the targeted group.

Table 3: Intention to Treat Estimates (Initial Offer) - Emotional Well-being

Dependent Variable	Baseline Model		Lin Model	
	(I)	(II)	(III)	(IV)
Subjective Well-being Index	0.197*	0.180*	0.258**	0.226**
	(0.103)	(0.105)	(0.103)	(0.104)
Index Components				
Happiness	0.137	0.121	0.155	0.140
	(0.106)	(0.109)	(0.112)	(0.110)
Worry	0.229**	0.208*	0.289**	0.247**
	(0.114)	(0.115)	(0.117)	(0.118)
Sadness	-0.017	-0.022	0.005	0.006
	(0.106)	(0.109)	(0.103)	(0.105)
Loneliness	0.110	0.109	0.169	0.166
	(0.110)	(0.111)	(0.107)	(0.109)
Sleep Quality	0.072	0.040	0.113	0.075
	(0.108)	(0.108)	(0.118)	(0.119)
Depression Medication	0.194**	0.190**	0.209**	0.183**
	(0.089)	(0.091)	(0.082)	(0.085)
Stress	0.144	0.148	0.198**	0.182*
	(0.105)	(0.109)	(0.094)	(0.100)
Fixed Effects	Yes	Yes	Yes	Yes
Pre-treatment Controls	No	Yes	No	Yes
Number of Obs.	369	369	369	369
Number of Blocks	25	25	25	25

Notes. Reported results: estimated coefficients and robust standard errors (in parentheses). Specifications (2) and (4) include pre-treatment control variables for community leader visit, quality of the house roof, and household index for respiratory diseases. Pre-registered models (1) and (2) are based on Equation (1). Pre-registered models (3) and (4) include interactions and are based on Equation (2). The pre-registered well-being index is an average of z-scores of Happiness, Worry, Sadness, and Loneliness, Depression Medication, Sleep Quality, and Stress. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

We perform two additional exercises to check the robustness of our results. Appendix Table A.3 shows that our findings are robust after applying other models: Gibbons et al. (2018)’s interaction-weighted estimator and regression-weighted estimator. In addition, there were two informal settlements in which few individuals had greater chance of winning the lottery—see Appendix B. Appendix Table A.4 indicates that

the results are robust to excluding all individuals of these two informal settlements—but notice that the results are less precisely estimated as the number of observations decrease in these regressions.

4.2 Channels

To better understand our findings, we examine suggestive mechanisms through which the intervention may affect subjective well-being. Our goal is to assess the role of channels related to the multifaceted intervention’s attributes (private and prosocial behavior). In this analysis, we work with pre-specified indexes and questions as well as specific components of those indexes—and, again, the interpretation of individual components should be done with caution since they must be corrected for multiple testing.

Table 4: Intention to Treat Estimates (Initial Offer) - Channel housing

Dependent Variable	Baseline Model		Lin Model	
	(I)	(II)	(III)	(IV)
Housing Index	0.102 (0.098)	0.113 (0.099)	0.133 (0.094)	0.140 (0.097)
Index Components				
Less pests	0.178* (0.099)	0.168* (0.099)	0.177** (0.088)	0.155* (0.088)
Home has sink	0.028 (0.108)	0.028 (0.110)	0.044 (0.105)	0.053 (0.110)
Home has bathroom	-0.093 (0.109)	-0.079 (0.109)	-0.073 (0.098)	-0.050 (0.098)
Shared bathroom	0.013 (0.110)	0.043 (0.113)	0.038 (0.099)	0.056 (0.101)
Relative house quality	0.181* (0.108)	0.161 (0.111)	0.212* (0.117)	0.206* (0.118)
Home has TV/Fridge	0.005 (0.101)	0.024 (0.100)	0.008 (0.098)	0.008 (0.098)
Fixed Effects	Yes	Yes	Yes	Yes
Pre-treatment Controls	No	Yes	No	Yes
Number of Obs.	369	369	369	369
Number of Blocks	25	25	25	25

Notes. Reported results: estimated coefficients and robust standard errors (in parentheses). Specifications (2) and (4) include pre-treatment control variables for community leader visit, quality of the house roof, and household index for respiratory diseases. Pre-registered models (1) and (2) are based on Equation (1). Pre-registered models (3) and (4) include interactions and are based on Equation (2). *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 5: Intention to Treat Estimates (Initial Offer) - Additional Channels

Dependent Variable	Baseline Model		Lin Model	
	(I)	(II)	(III)	(IV)
Sleep quality (Subjective Well-being Component)	0.072 (0.108)	0.040 (0.108)	0.113 (0.118)	0.075 (0.119)
Worked Last Week?	0.055 (0.066)	0.041 (0.066)	0.068 (0.063)	0.051 (0.067)
Living in the same community?	0.132 (0.110)	0.135 (0.108)	0.159* (0.090)	0.181** (0.088)
Trust Index	0.165*** (0.062)	0.159** (0.063)	0.160** (0.064)	0.146** (0.066)
Fixed Effects	Yes	Yes	Yes	Yes
Pre-treatment Controls	No	Yes	No	Yes
Number of Obs.	369	369	369	369
Number of Blocks	25	25	25	25

Notes. Reported results: estimated coefficients and robust standard errors (in parentheses). Specifications (2) and (4) include pre-treatment control variables for community leader visit, quality of the house roof, and household index for respiratory diseases. Pre-registered models (1) and (2) are based on Equation (1). Pre-registered models (3) and (4) include interactions and are based on Equation (2). *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

First, we analyze the role of housing quality in Table 4. The intervention increased the housing quality index by 0.1 standard deviations relative to the control group, but the estimates are not precisely estimated. Analyzing the index’s components, we find improvements in small magnitudes in housing structures (such as the presence of bathrooms and sinks). These results can be interpreted as a “sanity check” since the intervention does not aim to improve such dimensions. However, the intervention seems to impact other dimensions of housing quality that are conceptually more likely to be affected: for instance, beneficiaries report a lower incidence of pests such as rats. Another component that was large in magnitude was the indicator variable that equals one if beneficiaries find their housing unit better than that of their neighbors (“Relative house quality”). These results suggest that the relatively better housing unit can increase self-esteem, but it can also generate positional externalities.

Table 5 shows the results for an understudied topic: sleep quality. The better structure provided by the intervention (ventilation, isolation against environmental stressors) may improve the sleep of the treated group compared to the control group. Yet, we find no effects of the program on the quality of sleep.¹²

¹²Notice that we pre-registered the sleep outcome as one component of the subjective well-being index. However, the coefficient on sleep is not significant even before correcting for multiple hypotheses.

We check the effects on labor market outcomes to provide further evidence of the mechanisms. More specifically, we investigate whether the intervention interferes with labor market participation. Table 5 indicates no statistically significant effect on the employment likelihood. By contrast, the intervention led to meaningful average increases in the likelihood of being attached to the community. The results show that the group assigned to treatment is more likely to be located in the community where the housing unit was constructed—the magnitude of the intervention effects on squatters’ propensity to move to other neighborhoods are large but not precisely estimated in some specifications. Our findings thus suggest a reduction in outmigration. However, the attachment to slum neighborhoods can also have negative aspects: it may be associated with continuous exposure to health hazards and violence (which negatively affect mental well-being).

By examining data on trust in community members and leaders, we find a disproportionate effect of the intervention on the trust index. Squatters who mobilized their neighbors in the process of building their own homes will likely have higher levels of solidarity toward neighbors and other community members. The results in Table 5 suggest that social interactions may be a relevant channel underlying our findings. Appendix Table A.5 shows the components of the trust index. The large magnitude of trust in community leaders and friends suggests that these factors likely drive the positive effects we observe on the trust index. The low magnitude of the impact on trust in the government can be explained by the fact the intervention is not associated with the public sector.

4.3 Qualitative Interviews

We use qualitative data to complement previous quantitative findings regarding the causal link between the intervention and mental well-being. The idea is to investigate the mechanisms further and understand the nuances that could explain our causal results. We conducted 42 semi-structured interviews with (randomly-selected) individuals from our sample.¹³ To contrast the effects of the intervention between groups, we interviewed 22 individuals from the treated group and 20 from the control group. Because characteristics usually differ between communities, we interviewed at least one control and one treated family in each slum. We also tried to maintain a balanced number of male and female interviewees. When we could not conduct interviews in a small community, we transferred interviews to larger ones. Interviews were, on average, 60 minutes long and ranged from 33 to 105 minutes. They were conducted via WhatsApp, a widely used instant messaging application that also allows for phone

¹³See Figure 2 in Section 3.

calls, and they were recorded and then transcribed.¹⁴ We rewarded our interviewees in the qualitative interviews with cash transfers in the amount of R\$100.00 (Brazilian reais) as an acknowledgment of their time.

Our interviews covered various topics, partly driven by participants' narratives about their TECHO experience and housing situation. More specifically, for those treated, we asked open-ended questions about the home-building process and the connections made with TECHO volunteers, leaders, and other community members. We also asked about the experience with the new home (and their non-TECHO home for the control group). For treated and control individuals, we asked about everyday concerns, family and community relationships, and views about their residence.

We analyzed these interviews via both a deductive and an inductive process. We determined themes connecting subjective well-being and housing that we believed would be relevant based on the existing literature (safety, dignity, status, self-esteem, self-efficacy, life control, land tenure, sense of property, sleep quality). We also proceeded inductively by discovering themes that connected subjective well-being and housing that we did not anticipate (shelter, comfort, infestation, visits, tranquility, robbery/violence). Below, we present quotes that illustrate how better quality housing and social connection boosted by participation in TECHO's program connect to better subjective well-being. Furthermore, in Appendix C, we show a systematization of the qualitative evidence by examining the frequency in which our codifications of these themes were found in the interviews and how proximal they appear in the transcriptions.

The in-depth interviews offer evidence consistent with the quantitative findings. For instance, a wide range of interviewees in the treatment and control groups confirmed that housing collapse is a risk in the slums where TECHO acts. Storms and floods increase the risk of collapse or trees falling into people's houses. Additionally, when such events happen, households are expected to end up without electricity because networks are informal and poorly installed. Our respondents also indicate that the housing unit increases the sense of housing safety, reducing anxiety and worries about families' physical integrity. People from the control group are constantly afraid of losing their homes and belongings after storms and floods. The following interviews highlight how safe a TECHO house is:

Interview Nm. 6 (Treatment unit)

Q – How was the experience during the first rain after you moved into this

¹⁴We conducted interviews when COVID-19 was prevalent, and in-person interviews were not advisable. While phone interviews are relatively new for semi-structured qualitative interviews, we pre-tested the script, and our respondents were all well acquainted with WhatsApp. As a result, we did not encounter challenges in conducting qualitative interviews via phone.

house?

A – Well, for the first one, I was kind of uneasy, thinking: “I’m gonna wait, but will this wind not even bend these tiles, or rip something off?”

Q – And then, what happened?

A – [The tiles] stayed there. The rain passed. Then I thought to myself: “Thank God, that rain is over.” As for the other rains, I started to lose my fear of the roof ripping off, because it’s a very safe house.

Interview Nm. 42 (Treatment unit)

Q – What do you think is the best thing about this TECHO house?

A – About TECHO? Well, it is better; the best thing is that it is safer, you know?

Q – How so? What do you mean by safer?

A – [Safer] From rain, wind, you know? Like, if it rains, water doesn’t get in because of the underside, you know? Because the house is elevated.

More subtly, TECHO’s units are considered more comfortable and better looking. There were many reports (among treatment and control) that the house was beautiful and nice to live in. Notably, even residents in the control group find TECHO’s houses good-looking. From a theoretical perspective, this could connect to previous evidence on the role of social status in housing programs. This mechanism could lead to feelings of self-esteem, as this respondent answered:

Interview Nm. 20 (Treatment unit)

Q – Did your feelings about yourself change after you obtained your house?

A – A little bit, yes. Because for me, it’s a new little house. I’ve always had, thank God, my own little house; I’ve always managed to make ends meet in the community. But [the previous house] wasn’t new as this one that I won is. So, this gives a lift to our self-esteem.

Q – And did you have a feeling like, as you said about self-esteem, that now you could do more, you know?

A – Yeah, now it’s mine; look at my house. I have my house; look at my cute little house that I won. I was the one who got it.

In addition to safety and status, the housing unit generates comfort, which can impact our measures of emotional well-being. In our qualitative analysis, the word “comfortable” was salient for at least two reasons. First, the house is well structured to avoid problems related to weather events. Second, the housing unit protects residents from rats, insects, and other small animals that can carry diseases and that residents find disgusting.

Interview Nm. 2 (Treatment unit)

Q – And issues related to insects, cockroaches, ants, rats, do you have this type of problem there? Do you think I have less than I had before, or is it the same? How are you?

A – Look, mouse here, when I came here, there were no mosquitoes up here. Rat, mosquito, that sort of thing, came along with the residents. Amazingly, the rats came along with the villagers themselves. Here, what we had a lot of was snake, scorpion, lizard, spider... And it improved a lot. I used to sleep with a spider on my side. Nowadays, it doesn't have that anymore. Because, in the past, it was eucalyptus and madeirite. And, today, the roof shack is completely fenced, everything just right, there's no way to get in the insect; it's all closed, all right. “Noh”, so good. I already woke up with a scorpion on the side of my head.

Interview Nm. 19 (Control unit) Q – I understand. And has anything worse, you being bitten, attacked, something like that?

A - Yes, my wife has already been bitten by a snake.

Q - And how did you solve it?

A – He took it to the hospital; I managed to kill the snake and took the snake with me.

The qualitative data also add several pieces of evidence supporting that trust is a potential mechanism. During the interviews, we identify how the housing program brings benefited families closer to leaders. TECHO and other organizations have raised campaign funds to buy aid packages for families, and leaders were responsible for distributing those packages. Thus, having a close relationship with leaders could facilitate the delivery. Not only do residents get to know the leaders better because of the housing program, but the opposite direction is also verified. The following dialogue illustrates this point:

Interview Nm. 26 (Treatment unit)

Q – As a leader, has she ever helped you with anything other than this housing issue?

A – Yes, she helps me. When we were building the house, she came to talk to me, and now with the pandemic, [she helps with] donations of things we needed and such.

Q – What other kind of help has she given besides the house?

A – Basic food basket, whenever the TECHO NGO manages to raise funds, she always comes to see if we need anything. And then she helps.

Q – And is she still helping you now?

A – Yes.

We also asked what beneficiaries could remember from their meetings with TECHO's volunteers. Interviews reinforced the perception that meetings are not only about teaching families how to build houses. They connect people on some stances, even though this connection can be temporary. Meetings also enhance the values of cooperation and community engagement among participants. They practice collective action by dividing tasks and asking friends, family, and neighbors to help in the construction. The ties that strengthen the most are those previous connections with friends and members of institutionalized organizations (such as churches). Beneficiaries get to know each other during meetings and construction day, especially in recent settlements. Some became friends and nurtured networks of social support during the COVID-19 pandemic.

Interview Nm. 7 (Treatment unit) Q – Before building the house, did you participate in a meeting, workshop, or any activity? What activity did you participate in?

A – Yes, we participated. We went from an activity to a game of getting a bottle and asking “what dream do you have”... And then she kept that bottle so that when it was construction day, and the house was ready, everyone would take it and read that little piece of paper right away. It could be mine (dream) or a colleague's, and we would do it all together.

Q – Did you think it was good?

A – Yes.

Q – Why?

A – Because it was something for us to get to know everyone there. There are people there that we... Like, five years, we live in this community, but

there are residents that we say to each other like “hi, hi”, and that’s it, it’s over. I didn’t know them, I didn’t have friendship with or anything. And we learned about each person’s story there, about each dream they had... So it was good.

The role of housing costs was also noted during the interviews. Recall that although more than 95% of the house cost is subsidized, beneficiaries must pay for the construction. Our fieldwork during the selection of beneficiaries indicates that, in some slum communities, TECHO has waived households from paying for housing construction. However, we have also identified during fieldwork that most families bear an extra cost because they must rebuild utilities such as energy connections and existing, self-made sanitary infrastructure. On the other hand, this later autoconstruction triggered by the intervention is sometimes seen as another opportunity to strengthen social ties. Some of our interviewees highlight that they count on neighbors and friends to improve housing conditions further. This feature of the program is especially salient to single mothers or families without adult males because construction activities require strength and knowledge usually associated with men.

Finally, to complement the analysis, we code important concepts and count the frequencies in which they appear in the open-ended interviews. Appendix C describes in more detail the coding process and the rationale behind each code. Appendix Figure C.1 presents the percentage of citations of each code. “Shelter” was cited in 85% of the documents, while “Infestation” comes next with 72.5% citations. These results reinforce that the housing unit indeed represents a material improvement. “Visual content,” “Good sleep,” and “Self-esteem” represent the second group of codes that appear as most relevant. Nearly half of the cases cited them during the interviews. Appendix Figure C.3 shows the text proximity between each code. If a code is less than one paragraph apart from another in a given transcript, then both are considered proximate. Next, we calculate the frequency of the codes that are proximate. “Shelter” seems to be the code with more correlates. It is intensely co-cited with “infestation,” “bad sleep,” and “safety.” Last, Appendix Figure C.4 shows citations by interviewee group. “Self-esteem” and “self-efficacy” are more cited in transcripts of individuals in the treatment group than those in the control group.

In sum, qualitative analysis reinforces that the TECHO intervention reduces physical risks, provides better comfort for families, and is associated with relevant incentives for social interactions. Combined, the results suggest that these features of the intervention help beneficiaries cope with threatening physical conditions, increase their sense of self-esteem and efficacy, and promote social ties that ultimately may function as mechanisms to improve psychological health.

5 Concluding Remarks

The lack of access to proper housing is a problem afflicting millions of people with far-reaching consequences on health. We study a low-cost, reproducible intervention that mobilizes slum squatters to build higher-quality prefabricated houses. Using an experimental design, we show that the intervention improved subjective well-being. Testing for potential mechanisms that could be driving the results, we find that social interactions and attachment to the community are important factors. Qualitative evidence from in-depth interviews reinforces our quantitative results.

Our findings have several implications. First, one takeaway from our analysis is that social interactions are relevant for in-situ improvements and not only for interventions whose primary goal is to relocate families to remote areas. In particular, social cohesion can be an important mechanism to be aware of when designing policies, as this may enhance or block welfare gains. Second, even interventions not considered as of “higher dosage” can have overall positive effects on mental well-being—in our setting, housing units do not have sanitation, lack land tenure, and residents are continuously exposed to community problems (e.g., crime and health hazards). Third, since returns to policy and programs may vary depending on shocks and “business cycle” moments, it is relevant to study how interventions perform in pressing times—in our case, the outbreak of the COVID-19 pandemic. Last, housing interventions that affect mental health can have longer-term consequences. For instance, adult mental health also influences children’s cognitive development (Ridley et al., 2020), so housing interventions can have longer-term welfare impacts and far-reaching consequences by indirectly influencing subsequent human capital accumulation.

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Online Appendix to
“Housing, Social Cohesion and Well-Being:
Evidence from Informal Settlements”

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A	Extra Tables and Figures	A-2
B	More Details on the Sample and Randomization	A-9
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A Extra Tables and Figures

Figure A.1: Housing units in the comparison and treatment groups



(a) Typical dweller's unit



(b) Typical TECHO unit

Notes. The pictures show typical housing units in the comparison group (left) and treatment group constructed by TECHO (right). Source: TECHO.

Figure A.2: Location of Slum Settlements



Notes. The picture shows the location of the slum settlements where the intervention was conducted. The 24 slum settlements are located in 15 Brazilian municipalities. These municipalities are in the 6 states where TECHO operates in Brazil.

Table A.1: Comparison of characteristics of households in our sample with those in other slum settlements in Brazil

<i>Variable</i>	All slum settlements in Brazil	Slum settlements in our sample
Median monthly <i>per capita</i> income (2020 Reais)	865.40	210.00
% of households with a bathroom	99.0%	88.5%
% of households with access to clean water	94.2%	82.8%
% of households with a refrigerator	95.1%	80%
% of households with a TV	96.7%	80.5%

Notes. This table compares characteristics of households in the universe of slum settlements in Brazil with those of the communities targeted in the intervention. Data for the universe of slum settlements comes from the 2010 Brazilian Census (data on *per capita* income, the existence of bathrooms, and access come from the universe of responses, while data on the property of TVs and refrigerators comes from the sample questionnaire). Data for the experimental settlements comes from the baseline survey. The indicator for the percentage of households with access to clean water considers exclusively access within the property (for the Census, we sum those that have access through the general water distribution system and through a water well in the property).

Table A.2: Outcomes

<i>Primary Outcome</i>	<p>Subjective well-being index, average z-scores of:</p> <ul style="list-style-type: none"> Feel happiness during most of the day? Feel worried during most of the day? Feel sad during most of the day? Feel alone during most of the day? How was your sleep? Take any medicine for depression, stress, or anxiety? Were you more stressed yesterday than normally
<i>Exploratory mechanisms</i>	<p>Housing quality index, average z-score of:</p> <ul style="list-style-type: none"> Have you found rats in the last two weeks? Do you have a sink? Do you have a toilet or shower? The toilet you use is just for your family or do you share it? Do you think your house is better than the ones of your neighbors? Do you have a TV or fridge? <p>Trust index, average z-score of:</p> <ul style="list-style-type: none"> Do you believe in the government’s information on what to do about the coronavirus? Do you believe in the community leaders’ information on what to do about the coronavirus? If you had a major health problem due to coronavirus, how much do you think you could count on your family for help? If you had a major health problem due to coronavirus, how much do you think you could count on your friends for help? <p>Worked last week?</p> <p>Living in the same community?</p>

Table A.3: Robustness: Alternative Models — Intention to Treat Estimates (Initial Offer)

Dependent Variable	IWE Model		RWE Model	
	(1)	(2)	(3)	(4)
Subjective Well-being Index	0.258*** (0.098)	0.237** (0.099)	0.263** (0.104)	0.237** (0.106)
Index Components				
Happiness	0.155 (0.104)	0.140 (0.106)	0.156 (0.108)	0.141 (0.112)
Worry	0.289*** (0.110)	0.266** (0.112)	0.294** (0.115)	0.268** (0.115)
Sadness	0.005 (0.099)	0.010 (0.102)	0.007 (0.112)	0.019 (0.115)
Loneliness	0.169* (0.101)	0.165 (0.103)	0.173 (0.109)	0.160 (0.112)
Sleep Quality	0.113 (0.109)	0.072 (0.109)	0.119 (0.114)	0.068 (0.114)
Depression Medication	0.209*** (0.081)	0.195** (0.082)	0.215** (0.084)	0.191** (0.083)
Stress	0.198** (0.092)	0.199** (0.096)	0.198** (0.099)	0.198* (0.102)
Fixed Effects	Yes	Yes	Yes	Yes
Pre-treatment Controls	No	Yes	No	Yes
Number of Obs.	369	369	369	369
Number of Blocks	25	25	25	25

Notes. Reported results: estimated coefficients and robust standard errors (in parentheses). Specifications (2) and (4) include pre-treatment control variables for community leader visit, quality of the house roof, and household index for respiratory diseases. Models (1) and (2) are based on . Pre-registered models (3) and (4) include interactions and are based on Equation (2). ***p<0.01, **p<0.05, *p<0.1.

Table A.4: Robustness: Dropping communities “Piquete” and “Terra Nossa” - Intention to Treat Estimates (Initial Offer)

Dependent Variable	Fixed Effects Model		Lin Model	
	(1)	(2)	(3)	(4)
Subjective Well-being Index	0.187*	0.172	0.233**	0.199*
	(0.108)	(0.111)	(0.111)	(0.112)
Index Components				
Happiness	0.145	0.128	0.163	0.144
	(0.111)	(0.116)	(0.121)	(0.119)
Worry	0.226*	0.202*	0.260**	0.205
	(0.118)	(0.120)	(0.126)	(0.126)
Sadness	-0.003	-0.001	0.017	0.023
	(0.109)	(0.113)	(0.100)	(0.102)
Loneliness	0.095	0.095	0.142	0.139
	(0.117)	(0.119)	(0.116)	(0.119)
Sleep Quality	0.050	0.015	0.076	0.038
	(0.113)	(0.114)	(0.126)	(0.128)
Depression Medication	0.194**	0.199**	0.205**	0.183**
	(0.095)	(0.098)	(0.088)	(0.091)
Stress	0.118	0.120	0.165	0.148
	(0.111)	(0.117)	(0.101)	(0.108)
Fixed Effects	Yes	Yes	Yes	Yes
Pre-treatment Controls	No	Yes	No	Yes
Number of Obs.	337	337	337	337
Number of Blocks	23	23	23	23

Notes. Reported results: estimated coefficients and robust standard errors (in parentheses). Specifications (2) and (4) include pre-treatment control variables for community leader visit, quality of the house roof, and household index for respiratory diseases. Pre-registered models (1) and (2) are based on Equation (1). Pre-registered models (3) and (4) include interactions and are based on Equation (2). *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table A.5: Intention to Treat Estimates (Initial Offer) - Trust Index

Dependent Variable	Fixed Effects Model		Lin Model	
	(1)	(2)	(3)	(4)
Trust Index	0.165*** (0.062)	0.159** (0.063)	0.160** (0.064)	0.146** (0.066)
Index Components				
Trust: Government	0.059 (0.110)	0.079 (0.113)	0.058 (0.115)	0.059 (0.116)
Trust: Community Leaders	0.243** (0.111)	0.226** (0.112)	0.214** (0.096)	0.206** (0.098)
Trust: Friends	0.154*** (0.054)	0.146*** (0.055)	0.142** (0.058)	0.130** (0.057)
Trust: Family	0.014 (0.048)	0.012 (0.049)	0.034 (0.045)	0.022 (0.046)
Fixed Effects	Yes	Yes	Yes	Yes
Pre-treatment Controls	No	Yes	No	Yes
Number of Obs.	369	369	369	369
Number of Blocks	25	25	25	25

Notes. Reported results: estimated coefficients and robust standard errors (in parentheses). Specifications (2) and (4) include pre-treatment control variables for community leader visit, quality of the house roof, and household index for respiratory diseases. Pre-registered models (1) and (2) are based on Equation (1). Pre-registered models (3) and (4) include interactions and are based on Equation (2). *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

B More Details on the Sample and Randomization

We build our sample by aggregating waitlists from lotteries of different construction moments and places. Most communities received only one construction task force during the research period (from March 2019 to February 2020), that is, only one lottery. However, in some communities, TECHO decided to build houses twice, leaving room for a second lottery after a couple of months. As we should not prevent losers from the first lottery from taking part in the second, we pooled them in the new lottery with dwellers that had recently moved to the settlement. Consequently, some households were more likely to be treated within the same community. If we pool all households of two different lotteries within a given community, we would wrongly attribute them equal weights. We circumvent this issue using a *community-lottery* unit of analysis. In other words, we duplicate households (or individuals) that appear in two different lotteries and use fixed effects not at the slum settlement level but at the slum settlement-lottery level. Communities in which TECHO performed two lotteries appear twice in our data set as if they were distinct communities.

Although lotteries went on well and TECHO’s volunteers succeeded in delivering houses according to the waitlist, the take-up rate of the intervention was not high. One reason for the non-compliance was the fact that the land plot often did not fit TECHO’s house, or the terrain was steep. Other examples of non-compliance include individuals in discordance with the program’s rules, families moving out of the community or giving up on receiving the intervention, and people going to jail and dying. Volunteers almost always guaranteed that the waitlist was respected.

We used the results from an audited national Brazilian lottery to randomize our waitlists. The randomization worked as follows. First, we would receive the list of eligible families from TECHO and assign random ticket numbers to each family. We sorted the tickets and used the audited national lottery number as a cutoff point from where we started delivering the housing units. All but two lotteries happened according to plan. In “Terra Nossa” and “Piquete”, we had repeated members of the same household running for the lottery, which accidentally gave them a greater chance of being assigned to treatment. Our full sample analysis includes these two lotteries, but we dropped the two communities mentioned above in a robustness check.

C Qualitative Analysis: Coding

The codes were decided in an inductive process based on their relative importance throughout the interviews. While reading the first ten transcripts, we paid extra attention to the main topics raised by the interviewees and tried to create new codes that were not necessarily related to previous literature. We then ceased creating inductive codes and revised the initial ten interviews. Conversely, part of the codes was previously determined by concepts from the literature. Since the beginning of the coding process, we had them in mind, and every time they appeared, we would highlight them in the transcripts. We created two groups of codes. The first refers to concepts directly linked to psychological well-being. The second group refers to social constructs that are indirectly related to mental health and which were asked in a separate part of the qualitative interviews.

The list of Well-being codes is the following:

- Shelter (inductive)
- Safety (literature)
- Comfort (inductive)
- Infestation (inductive)
- Visits (inductive)
- Dignity (literature)
- Status (literature)
- Self-esteem (literature)
- Self-efficacy (literature)
- Life control (literature)
- Tranquility (inductive)
- Land tenure (literature)
- Property sense (literature)
- Bad sleep (literature)
- Good sleep (literature)
- Robbery/violence (inductive)

The list of socialization codes is the following:

- Community engagement (literature)
- Positive leadership (inductive)
- Negative leadership (inductive)

- Neighbors social connection (inductive)
- No social connection (inductive)
- Neighbors autoconstuction (inductive)
- Family autoconstuction (inductive)

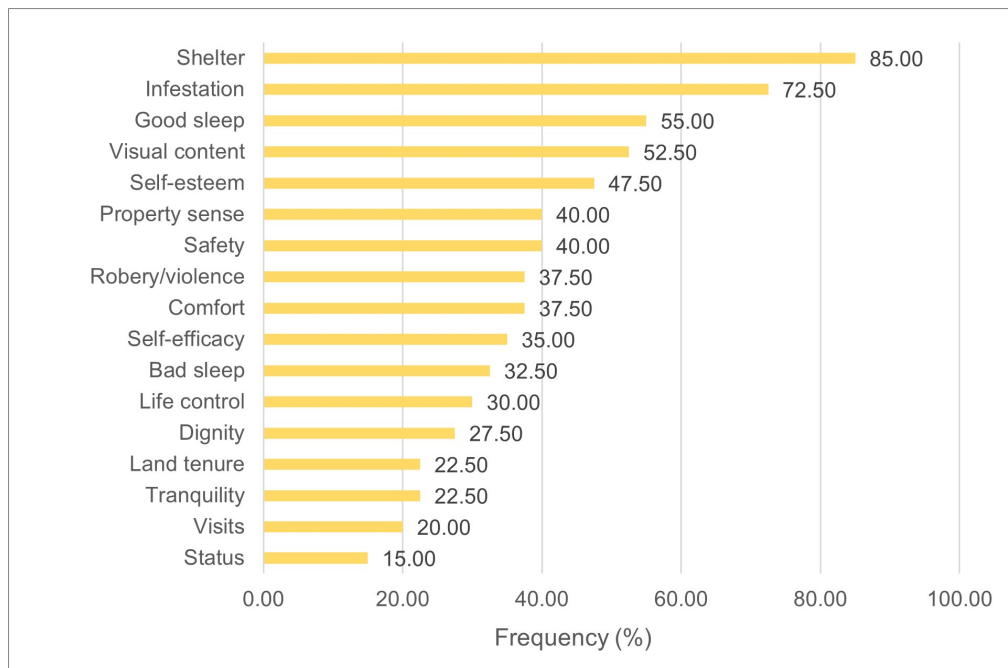
A brief description of the rationale of each code is as follows:

- Shelter: this code relates to how the physical structure of TECHO's housing unit is better than the other shacks in Brazilian slums. Almost all interviewees (treatment and control) recognize that the house provides a much better shelter, especially regarding exposure to bad weather conditions. Hence, this code captures the views about protection against storms, intense wind, floods, cold, heat, etc.
- Safety: feelings of protection and safety that are connected to the housing unit. Safety can refer to protection from bad weather or urban violence (robbery, for example). Sometimes it is unclear which type of safety the interviewee refers to, so we kept this generic code in the list.
- Comfort: the extent to which people feel their home is comfortable and cozy. A place where they like to stay.
- Visual content: how TECHO's housing unit looks like. Usually, this is a positive evaluation.
- Infestation: exposure to insects, snakes, rats, and the extent to which TECHO prevents infestation from these animals.
- Visits: being able to receive visits from friends and family at home.
- Dignity: how poor housing conditions can be viewed as a lack of dignity, often associated with the shame of being in extreme poverty. In other words, a sense of humiliation.
- Status: how housing can be a symbol of status within slum communities. This is a notion of social position frequently related to leaving extreme poverty. The extent to which one evaluates how other people view him/her.
- Self-esteem: how you feel about yourself. The extent to which people like and value themselves. The way housing can impact this assessment.
- Self-efficacy: feeling capable of evolving and improving.
- Life control: the extent to which people feel they can control their lives. In the context of the present study, how people find life burdensome and deal with challenges.
- Tranquility: feelings of serenity, calmness, and lack of worry or stress.

- Land tenure: having the land title, land ownership. In the context of the present study, security against eviction.
- Property sense: the extent to which interviewees value not paying rent and having their own place to stay (property of the house). Not necessarily related to land tenure.
- Bad sleep: not sleeping well at night.
- Good sleep: being able to sleep well at night.
- Robbery/violence: specific threats to one’s physical well-being or to property values. How the house may protect against crimes.
- Community engagement: the extent to which residents get involved in community activities related to social mobilization (e.g., attend community board meetings, help distribute aid, help construct infrastructure, engage in solidarity networks).
- Positive leadership: positive assessments of how participants evaluate the work of community leaders.
- Negative leadership: negative assessments of how participants evaluate the work of community leaders.
- Neighbors social connection: the extent to which participants create new social connections with neighbors and strengthen previous connections.
- No social connection: lack of social ties with neighbors
- Neighbors autoconstruction: the extent to which neighbors helped interviewees construct their homes.
- Family autoconstruction: the extent to which family members helped interviewees construct their homes.

Having decided on the main components that could explain the relationship between the intervention and subjective well-being, we now turn to evaluate how codes might be interconnected. The goal is to identify possible pathways through which causal chains operate.

Figure C.1 presents the percentage of citations that each code appears in the total number of interviews (for the Well-being codes). Codes are ranked from the most cited to the less cited. It does not matter how many times each code was cited in a given document; what matters is the number of interviews in which it appears. For example, “Shelter” was cited in 85% of the documents, making this code the most salient. “Infestation” comes next with 72.5% citation. These two codes are far ahead when compared to the others. These results suggest that the housing unit represents a material improvement, with impacts on protection from weather and animal infestations.

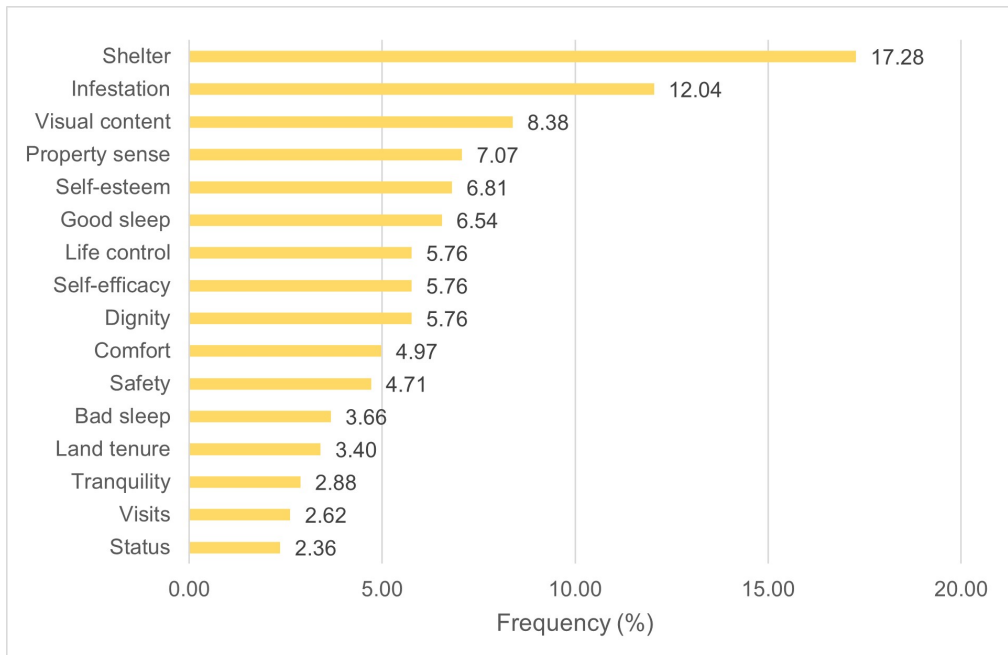
Figure C.1: Codes: Frequency in Interviews - universe of interviews

Notes. The picture shows the frequency at which each code appears in the 42 interviews.

“Visual content,” “Good sleep,” and “Self-esteem” represent the second group of codes that appear as most relevant. Nearly half of the cases cite them during the interviews. At least conceptually, sleep quality should be more correlated with stress, tiredness, and productivity than with how people think of themselves. The remaining codes in Figure C.1 vary from being cited by nearly a third and a fourth of the sample. Although some of them are less cited, it does not mean they are irrelevant. Take the case of the last two codes: “visits” and “status” may not appear much, but they may be essential to better explain some of the mechanisms we aim to understand in the analysis. C.2 shows similar patterns but now considering the universe of text fragments that were coded in all the interview documents.

Figure C.3 shows the text proximity between frequencies of each code. The measure of text proximity is the following: if a code is less than one paragraph apart from another in a given transcript, then both are considered proximate. They receive frequency one each time they are proximate. Several patterns in Figure C.3 are salient. “Shelter” seems to be the code with more correlates. It is intensely co-cited with “infestation,” “bad sleep,” and “safety.” If the housing unit represents a substantial quality improvement, it should alleviate the risk of storm hazards and animal invasion inside the house.

The second cluster of correlates can be viewed in the middle of Figure C.3. “Visits,” “dignity,” “status,” “self-esteem,” and “self-efficacy” all have high levels of co-citation relative to others. One possibility is that all these categories represent how residents

Figure C.2: Codes: Frequency in Interviews - universe of code fragments

Notes. The picture shows the frequency at which each code appears relative to the sum of all fragments coded.

rationalize their position within society. For example, if housing works as a cue of the minimum standards of life quality, residents can look at their situation and think of how they are positioned in terms of poverty. Thus, self-esteem and self-efficacy may be how people see themselves compared to social norms of dignity and status.

Figure C.4 shows a heat measure of how many citations for each type of interviewee. “Self-esteem” and “self-efficacy” are more cited in treatment transcripts than controls. To a lesser extent, “Dignity,” “status,” “visits,” “sleep quality,” and “comfort” also seem to be more salient among treated individuals. By contrast, “Shelter” and “Infestation” are cited irrespective of treatment assignment status but slightly skewed toward treatment. This is because everyone recognizes that not having proper protection from weather conditions and animal invasion is a negative thing.

Figure C.3: Codes: Proximity Analysis

Codes	Shelter	Safety	Comfort	Visual content	Infestation	Visits	Dignity	Status	Self-esteem	Self-efficacy	Life control	Tranquility	Land tenure	Property sense	Bad sleep	Good sleep
Shelter		15	12	16	26	7	10	5	17	13	12	7	7	14	13	19
Safety	15		4	8	11	2	5	1	9	7	5	4	3	9	6	11
Comfort	12	4		9	13	4	2	3	9	5	3	4	6	5	4	10
Visual content	16	8	9		14	4	5	4	9	6	6	7	6	8	5	13
Infestation	26	11	13	14		7	9	5	16	12	11	7	8	12	11	16
Visits	7	2	4	4	7		4	4	8	6	2	3	2	3	2	5
Dignity	10	5	2	5	9	4		3	8	5	8	3	4	7	4	7
Status	5	1	3	4	5	4	3		6	3	2	3	3	3	1	6
Self-esteem	17	9	9	9	16	8	8	6		11	7	5	4	8	5	14
Self-efficacy	13	7	5	6	12	6	5	3	11		6	4	2	6	6	8
Life control	12	5	3	6	11	2	8	2	7	6		3	4	7	8	5
Tranquility	7	4	4	7	7	3	3	3	5	4	3		3	6	2	8
Land tenure	7	3	6	6	8	2	4	3	4	2	4	3		4	3	6
Property sense	14	9	5	8	12	3	7	3	8	6	7	6	4		6	10
Bad sleep	13	6	4	5	11	2	4	1	5	6	8	2	3	6		5
Good sleep	19	11	10	13	16	5	7	6	14	8	5	8	6	10	5	

Notes. The picture shows a heat frequency of codes that are located less than one paragraph distance.

Figure C.4: Codes: Frequency per Treatment Status

Qualitative codes	Treatment	Control
Shelter	20	14
Safety	10	6
Comfort	9	6
Visual content	10	11
Infestation	18	11
Visits	7	1
Dignity	8	3
Status	6	0
Self-esteem	18	1
Self-efficacy	11	3
Life control	7	5
Tranquility	6	3
Land tenure	4	5
Property sense	8	8
Bad sleep	5	8
Good sleep	16	6

Notes. The picture shows the frequency at which each code appears during the interviews per treatment status.

Figure C.5: Codes: Segment Frequency - Social codes

	Num. Segments	Percentage
Neighbors autoconstruction	11	9.40
Negative leadership	14	11.97
Neighbors social connection	22	18.80
Family autoconstruction	11	9.40
Positive leadership	29	24.79
No social connection	11	9.40
Community engagement	19	16.24
TOTAL	117	100.00

Notes. The picture shows the frequency at which each social code appears during the interviews.

Figure C.6: Codes: Segment Frequency - Social codes per treatment status

Social Codes	Treatment	Control
Neighbors autoconstruction	9	0
Family autoconstruction	9	2
Negative leadership	4	7
Positive leadership	14	12
Neighbors social connection	8	10
No social connection	3	7
Community engagement	9	7

Notes. The picture shows the frequency at which each social code appears per treatment status.