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Measuring Overcrowding in Households with Children: Official vs. Actual Thresholds in the Ecuadorian Case

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Abstract

This paper reports research into the official (more than three people per bedroom, ppb) compared to the actual classification of household overcrowding using a developing country as a case of study. In this respect, the aim of this paper is two-fold. Firstly, using the official Ecuadorian household overcrowding threshold, we explore the association between household overcrowding and a well-being variable. Secondly, we identify and compare whether this official threshold corresponds to the actual level at which the well-being variable seems to be affected. To do so, we use a probit regression in which our well-being variable, young children's respiratory health, depends on household overcrowding. We find that overcrowding is positively associated with the incidence of respiratory diseases in children at a level of α=1%. Always using the official classification of overcrowding (3 ppb), marginal effect analysis indicates that, for two hypothetical households with at least one 0- to 5-year-old child with average values in terms of the other estimates, the predicted probability of having a child with a respiratory disease is 0.0022 greater for an overcrowded household than in one that is not. With respect to our second objective, we find that the threshold at which household density starts to affect the incidence of respiratory disease in children is 1.33 ppb, which is significantly lower than the official classification of over 3 ppb. In conclusion, the Ecuadorian government and other authorities that have established their household overcrowding classification arbitrarily should re-evaluate their official criteria, setting a threshold at which household density starts to deteriorate the health outputs of the household members. In fact, it may be useful to discuss and incorporate a refined definition of overcrowding, which could include other considerations than just density (e.g., an age limit for children for sharing a bedroom and gender separation), taking the restrictions of a developing country into account, in this case. Moreover, an official classification that reflects the social reality allows accurate policies, goals and strategies to be established to improve household overcrowding.

Keywords Respiratory diseases · Children · Household overcrowding · Ecuador

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1 Introduction

Ensuring access for all to adequate, safe and affordable housing is considered a global policy, to the extent that it is one of the targets of the UN's Sustainable Development Goals (United Nations, 2020). Moreover, Royuela et al. (2019) suggest that household overcrowding is a significant factor of well-being and detrimental to several domains of personal development. Therefore, all nations should be keen to improve their populations' living conditions by reducing household overcrowding rates. However, as discussed in the following section, overcrowding is not a globally standardized measure. Furthermore, the official classifications of overcrowding set by governments do not necessarily reflect public perception of overcrowding or, in other words, the number of people per area that is detrimental to health at a physical and/or psychological level. This lack of alignment between official and actual definitions can lead to failure when implementing housing improvement policies, both in terms of the execution and desired results.

With this in mind, the aim of this paper is two-fold. Firstly, by using an official government threshold, we explore the association between household overcrowding and a well-being variable. Secondly, we examine whether the official threshold corresponds to the actual limit at which the well-being variable seems to be affected.

To do so, we take Ecuador as a case of study. It has a small developing economy with significant levels of household overcrowding (INEC, 2019). A representative official data set, collected in the 2012 National Health and Nutrition Survey (ENSANUT), is used to examine the association between household overcrowding and a well-being variable defined as the prevalence of respiratory health conditions among 0- to 5-year-old Ecuadorian children. Children in their early years were selected as the object of study given the importance of the immediate environment, i.e., the housing conditions, at this stage of development. Indeed, the literature indicates that "the developing brain is influenced from the time the foetus is in utero and it continues to change through neuro-synaptic pruning over the first months and years of a child's life […]. Neuropsychological research suggests that rapid growth of children's brains during this time makes them particularly susceptible to environmental stimuli both positive and detrimental to development […]. Through a process called biological embedding, social and environmental experiences in a child's early years are theorized to shape physiological changes that have lifelong protective or detrimental effects on children's learning, behaviour, health and well-being" (Minh, Muhajarine, Janus, Brownell, & Guhn, 2017).

The remainder of the paper is organized as follows. The review of the literature on household density, overcrowding and its effects on well-being is presented in the second section. The case of study is presented in the third section. The methodological approach is introduced in the fourth section. The main empirical results are presented in the fifth section. Lastly, the sixth section concludes by summarizing the main findings and indicating some policy implications.

2 Literature Review

2.1 Household density and overcrowding

There are two important concepts in the analysis of household composition: density and overcrowding. Density is an objective measure of people per area (e.g., people per room, people per bedroom, people per square metre or foot, etc.). Meanwhile, household overcrowding, which is subjective, occurs when socially accepted standards of density are surpassed. These standards are not fixed and they differ between countries and evolve over time as socioeconomic conditions change (Royuela et al., 2019). Moreover, they depend on cultural values and social living space requirements (Baldassare et al., 1995).

Since there is not a specific threshold at which household density becomes overcrowding, several classifications of household overcrowding can be found in the literature. For instance, UK, Canada and New Zealand consider that a household is overcrowded if there are more than two people per bedroom. In the USA and Western Europe, Koebel & Renneckar (2003) suggest that the overcrowding threshold is 1.5 people per room. In Latin America, including Ecuador, the majority of countries classify a household as overcrowded if there are more than three people per bedroom (PNUD, 2014) which is the definition provided by the ECLAC. Nevertheless, this definition is arbitrary and may be no accurate to generalize to all Latin American and Caribbean countries considering their social, economic, cultural and geographical heterogeneity.

The literature indicates that density, as a measure, has no ready interpretation in normative terms and it cannot, for example, be assumed that the lower the density, the better (Royuela et al., 2019). For instance, Díaz-Sánchez, Lanchimba, & Obaco (2020) have shown that higher levels of household density are negatively associated with teenage pregnancy in such households. In contrast, household overcrowding inherently has negative connotations. For instance, household overcrowding is positively related to academic failure (Evans, Lepore, Shejwal, & Palsane, 1998; Goux & Maurin, 2005), psychological deterioration and stress (Gove et al., 1979; Jacob, Ludwig, & Miller, 2013; Wells & Harris, 2007), troublesome familiar relationships (Evans et al., 1998); and decreasing physical well-being, especially in children (Solari & Mare, 2012). Moreover, overcrowding is usually related to the physiological sensation of feeling uncomfortable in one's own home (Royuela et al., 2019), lacking privacy, and an increase in unwanted social interactions in the household (Goux & Maurin, 2005; Gove et al., 1979).

To the best of our knowledge, there is no quantitative research that contrasts an official governmental classification of overcrowding to an actual threshold, that is to say, the point at which household density starts to have an impact on health at either a physical or psychological level. Therefore, this article aims to do so by applying Ecuador's official overcrowding definition (more than three people per bedroom, ppb) as a case study, as well as identifying the actual threshold. We will measure the effect of overcrowding on a particular welfare variable: prevalence of respiratory health conditions among 0- to 5-year-old

Ecuadorian children, taking into account the negative association between overcrowding and the health outputs of household members, as analysed in depth in the following section.

2.2 Overcrowding and well-being

Overcrowding has the potential to affect the health of household members' not only at a physical level, but also psychologically and emotionally. In the case of physical health, there is empirical evidence that overcrowding is a vehicle for disease transmission as people living in households with little space are more susceptible to becoming ill and, if they are already ill, they will have fewer possibilities to rest and heal. For instance, short- and long-term gastrointestinal problems, mainly caused by Helicobacter pylori, may be aggravated by overcrowding (Galpin et al., 1992; McCallion et al., 1996). Specifically, overcrowding is considered one of the main risk factors affecting the health and well-being of children (Goux & Maurin, 2005; Gove et al., 1979; Sandel, Sharfstein, & Shaw, 1999). Moreover, another set of studies shows the significant relationship between precarious housing conditions and childhood injuries (Evans & English, 2002; Krieger & Higgins, 2002; Shenassa, Stubbendick, & Brown, 2004). Overcrowding has also been associated with respiratory problems in children (Baker, Taylor, & Henderson, 1998; Mann, Wadsworth, & Colley, 1992). In fact, children's asthma is highly correlated with poor air quality and exposure to germs (Wu & Takaro, 2007), as well as the presence of mold and moisture at home (Fisk, Lei-Gomez, & Mendell, 2007) and exposure to noise (Hohmann et al., 2013). Furthermore, crowded and disorganized households have a strong impact on the sleep quality of minors (Quist et al., 2016) and encourage unhealthy eating habits among younger children (Lumeng et al., 2014). All these factors generate a stress load for the child that increases the risk of inflammation and obesity at early ages (McCurdy et al., 2010).

With respect to physiological effects, the literature suggests that people living in overcrowded housing are more likely to suffer from psychological deterioration and stress (Gove et al., 1979; Jacob et al., 2013; Wells & Harris, 2007). Due to their greater vulnerability than other household members, research has tended to focus on the study of children in overcrowded spaces. For instance, the literature shows that reduced space at home diminishes children's creativity and ability to play (Maitland et al., 2013; Marino et al., 2012).

Besides the immediate negative effects of overcrowding on people's health, it also affects other dimensions of their lives in later years. For example, there is empirical evidence that household overcrowding constitutes an important limitation for the performance of the members of such households, particularly in relation to education and work activities (Goux & Maurin, 2005). Likewise, household overcrowding is associated with school absenteeism and low performance (Goux & Maurin, 2005).

3 The case of study

Ecuador is a small South American developing economy lying on the Pacific coast. The country covers an area of 283,561 km^2 and is inhabited by 17 million people. According to Royuela et al. (2019), 64% (36%) of households lie in urban (rural) areas and the average household size is 3.8 people. The country is politically and administrative divided into twenty-four provinces. Economically speaking, Ecuador has had a dollarized economy since 2000 and its GDP has grown constantly, with the World Bank (2019) considering it a medium-high income level country.

Using the ECLAC classification of overcrowding (more than three people per bedroom), which is also used by the Ecuadorian government, 17.5% of Ecuadorian households were overcrowded in 2010 (Díaz-Sánchez & Romaní, 2016), showing a declining trend over time (34.5% in 1990 and 27% in 2001) (SIISE, n.d.). Furthermore, these authors also indicate that overcrowding is more of a rural than an urban phenomenon: "64% (36%) of households live in urban (rural) areas, with 57% (43%) of overcrowded households living in these areas" (Royuela et al., 2019).

4 Methodological Approach

Our empirical model involves a probit regression, in which children's respiratory health (well-being) depends on household overcrowding, together with a large set of controls:

$$\Pr\left(Y = 1 | OC_i, X_i\right) = \varphi\left(\beta X_i + OC_i\right) \tag{1}$$

Where:

φ is the cumulative distribution function of the standard normal distribution;

OC_i is a measure proxying the concept of overcrowding in household I;

X_i is a vector of control variables, including information about the householder, the type of dwelling, geographical characteristics, household structure and observable environmental factors.

Firstly, our dependent variable is defined as discrete, taking the value of 1 if the household with at least one 0- to 5-year-old child has presented any respiratory disease (e.g., cough, flu, runny nose, shortness of breath) in the last 15 days, or 0 otherwise. By doing so, we are able to capture the factors that affect the probability of having a child with a respiratory condition in a given household. We have focused on this specific age group due to the importance of a healthy environment in early stages of development. Moreover, according to Surjadi (1993), household is an interesting unit of analysis due to three reasons. First, children spend most of their time at home. Second, household may themselves be the source of infections. Finally, there are similarities in the environmental problems found in residential areas.

In the same way, overcrowding is represented by means of a discrete measure, using a dichotomous variable that takes the value of 1 if the household is overcrowded or 0 otherwise, as Díaz-Sánchez & Romaní (2016) do in their study.

In addition, we are aware that endogeneity may arise as a result of an omitted variable problem in this relationship. We strive to avoid this by using a wide series of controls. Thus, we consider a list of household variables, including ethnic self-identification, as well as the mother of the household's age and its quadratic form. The mother's education (measured in years of formal education) is also taken into account, which can be considered as a proxy of income. Variables related to the child are also included: age (in months), and whether or not they have been dewormed in the last six months, which is taken as a proxy of care. We also consider the type of the dwelling (house, apartment, rooms, and local dwelling types), location (urban/rural) and natural region (Highlands, Coast, Amazon, and Galapagos). The descriptive statistics of these quantitative and qualitative variables are presented in Tables 1 and 2, respectively.

The data source used in this analysis is the national survey ENSANUT for 2018, conducted by the Ecuadorian National Institute for Statistics and Censuses (INEC). The main objective of this data collection is to generate indicators about the main health and nutrition problems of the population of the Ecuadorian population, so government can evaluate and generate public policies. ENSANUT collects information using a probabilistic technique of sampling. The original sample is composed by 41,311 dwellings. The survey is representative at national, urban/rural and province levels. The cross-sectional survey contains information on health at an individual and household level. The sample includes all households with at least one 0- to 5-year-old child, resulting in a final sample for the analysis of 18,996 households. In addition, the weightings specified by the INEC as expansion factors are used, with a total of 1,332,197 households therefore being analysed.

5 Results

5.1 Using Ecuador's official definition of overcrowding

In Table 3, columns (1) to (4) show the probit results of the estimation. We find that, using the official classification, overcrowding is positively associated with the incidence of respiratory conditions in children at the 1% -estimations (1), (2), and (3)- and 5% -estimation (4)-. The estimated coefficient in column (1) indicates that an overcrowded household is more likely to have children who have had a respiratory disease in the past 15 days compared to a household that is not overcrowded. The sign of overcrowding persists even after controlling for other observable factors

Table 1 Descriptive statistics of continuous variables

Variable	Mean	Q1	Median	Q3	Std. Dev.	Min.	Max.
Age of the mother	28,62	23	28	34	6,94	13	49
Education of the mother (years)	10,81	7	12	13	4,04	0	22
Age of the child (in months)	29,92	15	30	45	17,15	0	59

Table 2 Descriptive statistics of categorical variables

Variable	Category	%
Overcrowding		
	Yes	20,5
	No	79,5
Ethnics of the mother		
	Indigenous	14,51
	Afro Ecuadorian	3,94
	Meztizo	76,35
	White	1,31
	Montubio and others	3,88
Deworming		
	Yes	38,73
	No	61,27
Type of dwelling		
	House	69,67
	Apartment	13,13
	Room	2,34
	Mediagua	8,73
	Rancho	5,23
	Choza	0,69
	Covacha	0,21
Area		
	Rural	39,6
	Urban	60,4
Natural region		
	Highlands	39,41
	Coast	36,06
	Amazon	22,7
	Galapagos	1,84

of the probability of respiratory conditions in children (columns 2 to 4). Therefore, we conclude that our results are robust. In addition, we intuit that the problem of endogeneity is solved by the inclusion of the large set of controls, specifically in regression (4), since the Hausman endogeneity test indicates so.

Marginal effects of the estimation with all covariates are presented in column (5). In the case of the overcrowding variable, its marginal effect indicates that, for two hypothetical households with at least one 0- to 5-year-old child with average values with respect to the other estimates, the predicted probability of having a child with a respiratory disease is 0.0022 greater for an overcrowded household than for one that is not. In practical terms, this result suggests that there exists a positive association between household overcrowding and having a child with respiratory incidence in the last fifteen days at home. Indeed, taking into account that overcrowding is considered a dimension of poverty (Royuela et al., 2019), we can conclude that the

Table 3 Probit results and marginal effects

	(1)	(2)	(3)	(4)	(5)
Dep. Var. Respiratory diseases					
Overcrowding (OC = 0,1)	0.0359***	0.0310***	0.0161***	0.00622**	0.00227**
	(0.00281)	(0.00287)	(0.00304)	(0.00308)	(0.00112)
Ethnics of the mother (Indigenous as base)					
Afro Ecuadorian		0.130***	0.125***	0.0952***	0.0345***
		(0.00664)	(0.00667)	(0.00692)	(0.00252)
Mestizo		0.0921***	0.0928***	0.0709***	0.0255***
		(0.00408)	(0.00411)	(0.00437)	(0.00155)
White		0.340***	0.343***	0.318***	0.119***
		(0.0100)	(0.0100)	(0.0102)	(0.00392)
Montubio and Others		0.114***	0.0993***	0.0554***	0.0199***
		(0.00634)	(0.00642)	(0.00678)	(0.00244)
Age of the mother		0.0180***	0.0188***	0.0193***	0.00705***
		(0.00131)	(0.00132)	(0.00132)	(0.000482)
Age2 of the mother		-0.000447***	-0.000456***	-0.000461***	-0.000168***
		(2.19e-05)	(2.19e-05)	(2.20e-05)	(8.00e-06)
Education of the mother		-8.18e-05	-0.000412	0.000970***	0.000499***
		(0.000291)	(0.000292)	(0.000306)	(0.000111)
Age of the child (in months)		0.00220***	0.00223***	0.00230***	0.000837***
		(7.09e-05)	(7.09e-05)	(7.10e-05)	(2.59e-05)
Deworming (Yes=1)		-0.0176***	-0.0168***	-0.0213***	-0.00779***
		(0.00258)	(0.00258)	(0.00259)	(0.000946)
Type of dwelling (House as base)					
Apartment			-0.0162***	-0.00774**	-0.00281**
			(0.00310)	(0.00320)	(0.00116)
Room			0.154***	0.170***	0.0636***
			(0.00752)	(0.00757)	(0.00291)
Mediagua^			-0.0115**	0.000442	0.000161
			(0.00492)	(0.00496)	(0.00180)
Rancho^			0.124***	0.110***	0.0410***
			(0.00514)	(0.00522)	(0.00197)
Choza^			-0.0164	-0.0167	-0.00604
			(0.0166)	(0.0167)	(0.00603)
Covacha^			0.374***	0.367***	0.141***
			(0.0234)	(0.0234)	(0.00929)
Area (Rural=1)				0.00792***	0.00289***
				(0.00278)	(0.00101)
Natural region (Highlands as base)					
Coast				0.0549***	0.0200***

Table 3 (continued)

	(1)	(2)	(3)	(4)	(5)
				(0.00257)	(0.000936)
Amazon				-0.00976*	-0.00351**
				(0.00498)	(0.00179)
Galapagos				-0.0720*	-0.0256**
				(0.0372)	(0.0130)
N	1,332,197	1,332,197	1,332,149	1,332,149	1,332,149
% correcyly classified	0,66	0,66	0,66	0,66	
Log-Likelihood:	-853863	-851344	-850687	-850431	
Chi-squared	163.6	5185	6456	6937	
Prob Wald:	0	0	0	0	

Standard robust errors in parentheses. ***, **, * denote significance at 1%, 5%, and 10% levels, respectively. ^ indicates a housing unit representation with no translation in English. These types of dwellings are characterized by a lack of basic services and are usually located in rural or urban marginal areas.

higher the level of poverty, the higher the persistence of respiratory diseases in 0-to-5-year-old children.

In addition, the other estimated coefficients also present interesting results. For instance, households with mothers that identify themselves as Afro-Ecuadorian, *mestizo*, white or *Montubio* are more likely to have children with respiratory conditions at home than households with mothers who identify as indigenous. The marginal effects suggest that when mothers identify themselves as member of one of this ethnics, the probability of having at home a child who have presented respiratory diseases in the previous fifteen days increases 0.034, 0.025, 0.119, 0.019, respectively, compared to those household where mothers self-identify as indigenous. Interestingly, all marginal effects associated to ethnic categories are statistically significant at α=1%.

Further, the marginal effect of the area variable points out an interesting result. It indicates that if a household is located in a rural environment, then the predicted probability of having a child with a respiratory disease is .0028 higher compare to a household located in an urban area. The marginal effect is statistically significant at α=1%.

5.2 Identification of the actual overcrowding threshold

As mentioned previously, the threshold at which household density is considered overcrowding is a subjective consideration that depends on social conventions. However, we propose identifying the threshold of household density at which the incidence of respiratory conditions among children starts to increase, which is an

objective matter. Thus, our model is run in subsamples defined by percentiles[1]. In this regression, we also propose considering household density (people per bedroom), rather than the dichotomous definition of overcrowding used above. Results of these regressions are presented in Table 4.

Each column from (1) to (12) in Table 4 considers cumulative subsamples by percentiles. As shown in (1), the estimated parameter of household density is statistically significant at 1% and negative, which suggest that, in a household density interval from 0 to 1.33 people per bedroom (ppb), there is no positive association between the number of household members and the incidence of respiratory disease among children. In other words, household density is not harmful for children up to 1.33 ppb. However, the scenarios presented from (2) to (12) indicate that there is a positive and significant relationship between household density and respiratory diseases among children when household density is higher than 1.33 people per bedroom.

In addition to establishing the threshold at which household density is detrimental to children's health, the estimates shown in Table 4 can also be used for robustness checks. In our main model, the overcrowding measure was defined as a dichotomy variable (OC= 0, 1); however, in the regressions in Table 4, the overcrowding measure, household density, is a continuous variable that can take values from 0 to 8 representing the number of people per bedroom. The fact that the sign and significance of the parameter of interest persist when adding several subsamples once the threshold has been surpassed leads us to infer that the relation between overcrowding and incidence of respiratory diseases among children is robust.

6 Conclusion and discussion

Using information from the 2018 ENSANUT survey conducted in Ecuador and its official threshold of household overcrowding (3 ppb), we have explored the association between household overcrowding and a well-being variable. In addition, we also have examined whether this official threshold reflects the actual level at which the well-being variable is affected. With respect to our strategy for sample selection, Ecuadorian households with at least one 0- to 5-year-old child were selected in order to estimate a probit regression model. A significant relation seems to be confirmed between household overcrowding and respiratory diseases in children. In fact, the predicted probability of having a child with a respiratory disease is 0.0022 greater for an overcrowded household than for one that is not.

With respect to the threshold at which household density starts to affect the incidence of respiratory disease in children, we identified a level of 1.33 ppb, which is significantly lower than the official classification of over 3 ppb.

[1] In this subsample estimation strategy, we propose keeping households with a density between 0 and 8 people per bedroom, eliminating the 1% far right values of the distribution. Therefore, using weightings, we keep 1,323,477 observations.

Table 4 Threshold analysis

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Overcrowding rate	-0.184***	0.130***	0.0819***	0.0819***	0.0417***	0.0346***	0.0388***	0.0214***	0.0211***	0.0172***	0.0172***	0.00777***
	(0.0207)	(0.0101)	(0.00514)	(0.00514)	(0.00457)	(0.00347)	(0.00232)	(0.00207)	(0.00154)	(0.00127)	(0.00106)	(0.000978)
Ethnic self-identification (Indigenous=0)												
Afro Ecuadorian	0.298***	-0.191***	-0.106***	-0.106***	-0.0875***	-0.0478***	0.0461***	0.0261***	0.106***	0.119***	0.107***	0.0995***
	(0.0245)	(0.0144)	(0.0109)	(0.0109)	(0.0105)	(0.00949)	(0.00822)	(0.00801)	(0.00731)	(0.00714)	(0.00699)	(0.00694)
Mestizo	0.186***	-0.228***	-0.0570***	-0.0570***	-0.0368***	-0.000762	0.0344***	0.0280***	0.0655***	0.0791***	0.0845***	0.0783***
	(0.0170)	(0.00909)	(0.00664)	(0.00664)	(0.00642)	(0.00588)	(0.00507)	(0.00492)	(0.00466)	(0.00452)	(0.00444)	(0.00439)
White	0.663***	0.222***	0.309***	0.309***	0.325***	0.329***	0.386***	0.395***	0.367***	0.330***	0.325***	0.322***
	(0.0338)	(0.0205)	(0.0141)	(0.0141)	(0.0138)	(0.0130)	(0.0115)	(0.0113)	(0.0107)	(0.0103)	(0.0102)	(0.0102)
Montubio and Others	0.922***	-0.338***	-0.240***	-0.240***	-0.170***	-0.0827***	0.00352	0.0277***	0.0505***	0.0932***	0.0971***	0.0553***
	(0.0297)	(0.0153)	(0.0107)	(0.0107)	(0.0103)	(0.00931)	(0.00809)	(0.00782)	(0.00736)	(0.00709)	(0.00689)	(0.00680)
Age of the child (in months)	0.00214***	0.00487***	0.00409***	0.00409***	0.00418***	0.00223***	0.00237***	0.00224***	0.00258***	0.00257***	0.00232***	0.00224***
	(0.000228)	(0.000142)	(0.000104)	(0.000104)	(0.000100)	(9.14e-05)	(8.22e-05)	(8.02e-05)	(7.51e-05)	(7.38e-05)	(7.25e-05)	(7.12e-05)
Age of the mother	0.0117**	0.0262***	-0.00469**	-0.00469**	0.00304	0.00134	0.0137***	0.0114***	0.0121***	0.0125***	0.0148***	0.0182***
	(0.00490)	(0.00265)	(0.00196)	(0.00196)	(0.00188)	(0.00169)	(0.00150)	(0.00147)	(0.00139)	(0.00135)	(0.00133)	(0.00132)
Age2 of the mother	-0.000249***	-0.00056***	-1.49e-05	-1.49e-05	-0.00014***	-0.00011***	-0.00033***	-0.00031***	-0.00032***	-0.00034***	-0.00038***	-0.00044***
	(7.71e-05)	(4.31e-05)	(3.19e-05)	(3.19e-05)	(3.07e-05)	(2.77e-05)	(2.49e-05)	(2.43e-05)	(2.31e-05)	(2.25e-05)	(2.21e-05)	(2.20e-05)

Table 4 (continued)

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Education of the mother	0.00183*	0.00472***	0.00163***	0.00163***	0.00356***	0.00487***	0.00625***	0.00490***	0.00532***	0.00362***	0.00259***	0.00147***
	(0.000992)	(0.000640)	(0.000454)	(0.000454)	(0.000438)	(0.000400)	(0.000355)	(0.000347)	(0.000327)	(0.000319)	(0.000313)	(0.000311)
Deworming (Yes=1)	0.187***	0.0876***	-0.00363	-0.00363	-0.0148***	0.00483	0.00605**	-0.00854***	-0.0220***	-0.0210***	-0.0263***	-0.0229***
	(0.00796)	(0.00502)	(0.00376)	(0.00376)	(0.00364)	(0.00334)	(0.00297)	(0.00290)	(0.00274)	(0.00266)	(0.00261)	(0.00260)
Type of dwelling (Apartment=0)												
House	0.175***	0.0621***	0.0527***	0.0527***	0.0646***	0.0126***	-0.00274	0.00741**	0.0152***	0.00964***	0.0136***	0.0108***
	(0.00937)	(0.00559)	(0.00429)	(0.00429)	(0.00420)	(0.00386)	(0.00349)	(0.00345)	(0.00329)	(0.00325)	(0.00322)	(0.00320)
Room	-0.270***	0.344***	0.217***	0.217***	0.220***	0.154***	0.227***	0.228***	0.165***	0.150***	0.163***	0.173***
	(0.0636)	(0.0350)	(0.0151)	(0.0151)	(0.0150)	(0.0141)	(0.0101)	(0.00997)	(0.00853)	(0.00811)	(0.00792)	(0.00791)
Mediagua		0.475***	0.175***	0.175***	0.209***	-0.0322**	0.0497***	0.0719***	0.0288***	-0.00532	-0.0260***	-0.000641
		(0.0411)	(0.0162)	(0.0162)	(0.0161)	(0.0139)	(0.00804)	(0.00789)	(0.00638)	(0.00591)	(0.00570)	(0.00566)
Rancho	-0.188***	-0.0577***	0.103***	0.103***	0.117***	0.153***	0.106***	0.121***	0.172***	0.138***	0.123***	0.140***
	(0.0471)	(0.0218)	(0.0126)	(0.0126)	(0.0121)	(0.0102)	(0.00798)	(0.00771)	(0.00680)	(0.00642)	(0.00615)	(0.00608)
Choza		0	0.672***	0.672***	0.712***	-0.0655	0.0139	-0.00333	0.00922	-0.0626***	-0.0233	-0.0228
		(0)	(0.0586)	(0.0586)	(0.0586)	(0.0422)	(0.0314)	(0.0307)	(0.0216)	(0.0189)	(0.0173)	(0.0171)
Covacha			2.418***	2.418***	2.454***	2.408***	1.049***	1.053***	0.825***	0.0356	0.0840***	0.393***
			(0.204)	(0.204)	(0.205)	(0.206)	(0.0530)	(0.0525)	(0.0444)	(0.0297)	(0.0273)	(0.0239)
Area (Rural=1)	0.00348	-0.137***	-0.0494***	-0.0494***	-0.0465***	-0.0358***	-0.0264***	-0.0237***	-0.0140***	0.0127***	0.00373	0.00454
	(0.00920)	(0.00578)	(0.00410)	(0.00410)	(0.00397)	(0.00361)	(0.00318)	(0.00311)	(0.00292)	(0.00283)	(0.00279)	(0.00278)

Table 4 (continued)

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Natural region (Highlands=0)												
Coast	-0.0735***	-0.0363***	0.0474***	0.0474***	0.0535***	0.0593***	0.0159***	0.0286***	0.0334***	0.0475***	0.0501***	0.0531***
	(0.00804)	(0.00488)	(0.00362)	(0.00362)	(0.00351)	(0.00322)	(0.00288)	(0.00283)	(0.00269)	(0.00262)	(0.00259)	(0.00258)
Amazon	-0.260***	-0.0809***	-0.0455***	-0.0455***	-0.0407***	-0.0399***	-0.0724***	-0.0544***	-0.0269***	-0.0103**	-0.00565	-0.0145***
	(0.0182)	(0.0107)	(0.00773)	(0.00773)	(0.00746)	(0.00678)	(0.00590)	(0.00570)	(0.00533)	(0.00515)	(0.00504)	(0.00501)
Galapagos	0.163*	0.0813	-0.108**	-0.108**	-0.0645	-0.0784*	-0.127***	-0.105**	-0.101***	-0.0771**	-0.0739**	-0.0730**
	(0.0922)	(0.0616)	(0.0516)	(0.0516)	(0.0495)	(0.0461)	(0.0411)	(0.0409)	(0.0380)	(0.0372)	(0.0370)	(0.0372)
Density (people per bedroom)	1,33	1,66	2	2	2,333	2,5	3	3,66	4	5	7	8
Percentile	p10	p20	p30	p40	p50	p60	p70	p80	p90	p95	p99	p100
Observations	140,914	356,451	643,655	643,655	689,109	818,495	1,022,453	1,068,865	1,200,925	1,270,220	1,312,986	1,323,477
Percent of correctly classified	69,51	67,40	66,63	66,6365,90	66,84	66,77	66,20	66,28	66,04	65,96	65,90	65,95

Standard robust errors in parentheses. ***, **, * denote significance at 1%, 5%, and 10% levels, respectively.

From a public policy perspective, Ecuadorian government may be interested in re-evaluate its official overcrowding perspective considering a threshold according to its own needs. Indeed, a refined overcrowding definition, which may include further considerations than density (i.e. a limit age for children for sharing bedroom and gender separation, environmental conditions, income level, transmissibility of other respiratory diseases) may be debated and incorporated taking into account the restrictions of a developing country. Moreover, an official characterization that is according to its social reality may allow to establish accurate policies, goals and strategies to ameliorate housing overcrowding.

Furthermore, this research also suggests that Ecuadorian and other developing economies should improve and guarantee access to adequate living conditions, especially for young children. In words of Silver & Singer (2014), "Not getting the early years 'right' is linked to violent behaviour, depression, higher rates of non-communicable disease, and lower wages, and it negatively affects a nation's gross domestic product. Unless early child development is addressed effectively […], countries will be locked into poverty, and sustainable development will not be achieved".

Lastly, this research is not free of limitations. Here, we have compared the official and actual overcrowding definitions using a single measure of well-being in a specific population segment. Therefore, further research could usefully be targeted at identifying differences, if they exist, in other key aspects of personal development, such as quantity/quality of sleep, or measures of psychological well-being in other populations of interest.

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Declarations

Conflict of Interest Authors declare they do not have neither conflict of interests nor competing interests.

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