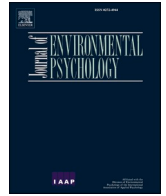




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## Space at home and psychological distress during the Covid-19 lockdown in Italy

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### ABSTRACT

Prolonged periods of restrictions on people's freedom of movement during the first massive wave of the COVID-19 pandemic meant that most people engaged in all their daily activities at home. This suggested the need for the spatial features of the home and its occupants' perception of them to be investigated in terms of people's wellbeing.

The present study was conducted on a large sample (N = 1354) drawn from different Italian regions. It examined the relationship between the "objective" and "subjective" dimensions of the home, measured in terms of objective home crowding and satisfaction with the space at home, in relation to perceived stress and the perceived risk of COVID-19 infection during the lockdown. The results showed that perceived stress is influenced by objective home crowding through the mediation of satisfaction with the space at home. These associations were more pronounced in younger generations. The negative association between satisfaction with the space at home and perceived stress was higher, the lower the perceived COVID-19 risk.

### 1. Introduction

During a national lockdown imposed by the Italian government from March to May 2020 to combat the first wave of the COVID-19 pandemic, people were obliged to stay at home all day (March 09, 2020, DPCM #iorestoacasa – I stay at home). They were only allowed to go out for necessities, such as to purchase food or medicines, or to work if smart working was impossible. The COVID-19 outbreak changed people's habits, routines and lifestyles, affecting human relationships and work productivity all over the country. Streets remained deserted and the fear of infection a constant companion. The experience of life at home was strongly affected too, especially during periods of enforced quarantine (Rogers & Power, 2020). Home became the place where most of the population conducted most or all of their daily activities. Its occupants

worked, studied, socialized, and engaged in physical exercise routines, sharing the available space throughout the day, sometimes not without family conflicts and tensions (Prime, Wade, & Browne, 2020). The arrival of the COVID-19 pandemic led to a 69% increase in the number of people in Italy working remotely (Savić, 2020). Numerous narratives have emerged regarding the meaning of 'home' in these pandemic times (Devine-Wright et al., 2020), some positive (home as a safe and healthy place, peaceful and restful, with more time to spend with the family), some negative (home as a place of isolation, loneliness, threat, oppression and imprisonment).

The central role of the home was dramatically emphasized during the COVID-19 lockdown, suggesting the need to see it as more than just a physical living space. It is important to its occupants' social and psychological wellbeing (Daniela et al., 2020). This has shifted the focus to

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the spatial adequacy of people's homes as a factor to consider in efforts to reduce the psychological distress caused by lockdowns.

The present study focused on the relationship between the space at home, residential satisfaction, and perceived stress during the first nationwide lockdown in Italy, between March and May 2020. These issues, and the specificity of any age-related differences, are addressed in the following sections.

### 1.1. Residential satisfaction

The literature describing research on individuals in relation to their residential environments has addressed various spatial levels applicable to the term "residential" (Marans, 2003), from the micro to the macro level (see also Bonaiuto & Alves, 2012; Lewicka, 2010), from the single dwelling (e.g., Gomez-Jacinto & Hombrados-Mendieta, 2002; Pasca, Aragonés, & Poggio, 2016; Anton & Lawrence, 2014) to the residential complex or facility (e.g., Cerina, Fornara, & Manca, 2017), the neighborhood (e.g., Hernández, Hidalgo, Salazar-Laplace, & Hess, 2007; Fleury-Bahi, Félonneau, & Marchand, 2008; Bonaiuto, Fornara, Ariccio, Cancellieri, & Rahimi, 2015; Fornara, Lai, Bonaiuto, & Pazzaglia, 2019), and the broader urban context (e.g., Brown & Kyttä, 2014; Casakin, Hernandez, & Ruiz, 2015).

Housing satisfaction has been examined as one of the facets of residential satisfaction (Francescato, 2002; Lu, 1999; Weidemann & Anderson, 1985), which contributes greatly to overall life satisfaction and happiness (Peck & Kay Stewart, 1985; Hu, 2013; Kahlmeier, Schindler, Grize, & Braun-Fahrlander, 2001). On the other hand, the spatial features of the home have rarely been the focus of research in the recent literature (Campagna, 2016; Aragonés, Américo, & Pérez-López, 2017).

### 1.2. The spatial dimension of the home

There is empirical evidence of housing quality and the spatial adequacy of housing both affecting housing satisfaction (Levy-Leboyer & Ratiu, 1993; Lu, 1999; Elsinga & Hoekstra, 2005; Vera-Toscano & Ateca-Amestoy, 2008). On the role of a home's size in predicting residential satisfaction (e.g., Ibem & Aduwo, 2013; Zhang, Zhang, & Hudson, 2018 and the review on this topic by Aigbavboa & Thwala, 2016), a positive correlation has been reported between the number of bedrooms in a home and its occupants' general satisfaction (Cheshmehzangi, 2020). Crucially, in a study conducted on students during the lockdown in Lombardy (one of Italy's geographical regions most affected by the pandemic), living in small homes (less than 60 square meters in size) was associated with a higher likelihood of depressive symptoms (Amerio et al., 2020).

Besides the size of a home, another important issue concerns its spatial configuration (Campagna, 2016). Partitions convey separation and depth, protecting against unwanted stimuli and intrusions (Evans, Lepore, & Schroeder, 1996). This relates to social spacing aspects, such as crowding and privacy, which are closely related (Bell, Greene, Fisher, & Baum, 1996) because they both concern the interface between spatial layouts and people. As Gatersleben & Griffin (2017) reported, crowding and (lack of) privacy have been among the most often studied social-environmental stressors.

The stressful impact of crowded conditions has been demonstrated in various settings, such as offices (Veitch, 2012), correctional facilities (Wener, 2012), and students' dormitories (Baum, Singer, & Baum, 1981). In a sample of US college students, Evans et al. (1996) found smaller spaces at home associated with higher levels of psychological distress. This effect seems to emerge not only in noncontact cultures (as in Northern European and North American societies), but also in contact cultures (in Latin America, for instance), as shown by Evans, Lepore, and Allen (2000). The stressful influence of chronic residential crowding has been judged to be "moderately strong" (Evans & Stecker, 2004), though the evidence mainly concerned dormitories or laboratory studies. To be

more specific, research has demonstrated that the degree of psychological distress increases with the number of people per room (Evans, 2003), which has also shown to influence the support to anti-democratic political systems in Italy during the COVID-19 lockdown (Cavazza, Russo, Colloca, & Roccatò, 2021).

Amongst the indicators of crowding, Torshizian and Grimes (2020) mention the floor area per person used by the United Nations and World Health Organization as a quality of life indicator in judging sustainable human settlements. The people-per-room index, also known as the American Crowding Index (ACI), is another commonly used measure.<sup>1</sup> In their literature review on the relationship between crowding in homes and infectious diseases, Baker, McDonald, Zhang, and Howden-Chapman (2013) found that the people-per-room index was the most often used measure of crowding, followed by people-per-house and people-per-bedroom indexes. Studies that considered stress as the outcome variable also considered people per room as a measure of crowding (e.g., Campagna, 2016; Evans et al., 1996; Gomez-Jacinto & Hombrados-Mendieta, 2002). For instance, Gomez-Jacinto and Hombrados-Mendieta (2002) reported a multiplicative effect of crowding at home and in the community in influencing both psychological distress and residential satisfaction.

Crowding at home might be addressed as both an "objective" and a "subjective" condition, as suggested by Bonnes, Bonaiuto, and Ercolani (1991). Thornock et al. (Thornock, Nelson, Porter, & Evans-Stout, 2019) made the point that, despite growing evidence of the prominence of perceived space over actual (objective) space, there have been few studies on the subjective aspect, or perceived crowding, which has to do with "feeling too close to others" and "how distant one feels from others in his or her space" (Thornock et al., 2019, p. 40). For instance, Rodgers (1982) found that the relationship between satisfaction with a community, neighborhood and dwelling related more to perceived crowding than to objective crowding. Torshizian and Grimes (2020) reported instead that perceived crowding and various objective crowding measures carried much the same weight in terms of people's residential satisfaction. The dichotomy between objective and subjective crowding recalls the broader distinction between objective and subjective assessment of environmental quality of places, e.g. concerning the urban contexts (Gifford, 2002; Bonaiuto & Alves, 2012) and the healthcare settings (Fornara & Andrade, 2012; Andrade et al., 2012). In this regard, some studies (Andrade et al., 2013; Fornara, 2005) found that users' perceived quality of hospital environmental features (i.e., a kind of subjective assessment) mediate the relationship between expert ratings of the hospital design (i.e., a kind of objective assessment) and a global response of users' satisfaction towards their experience.

### 1.3. Age-related differences in home satisfaction

Age needs to be borne in mind when addressing the influence of the spatial dimensions of homes. Zhang et al. (Zhang et al., 2018) found that several features of a home - such as ownership, type, size, number of bedrooms, and the presence of living rooms or bathrooms - predicted older adults' level of satisfaction with their homes, whereas only the size of the home and the number of bedrooms were significant predictors for younger people.

The Tiny House Community Survey conducted by Boeckerman and colleagues (Boeckerman, Kaczynski, & King, 2019) identified age as a significant sociodemographic predictor of respondents' satisfaction with their tiny homes: people from 40 to 66 years old were more satisfied than younger residents (from 19 to 39 years old). Other studies found

<sup>1</sup> These crowding indicators refer to what Veitch (2012) - for office environments - called "spatial density" (the area available to each office occupant) or "social density" (the number of occupants per office). For a given space, the two indexes are two sides of the same coin, of course: if one increases, the other decreases.

that residential satisfaction tends to increase with age (Lu, 1999; Mridha, 2020). The home probably tends to have a more central role in the lives of older adults, who are more likely to organize their daily activities around their place of residence than younger adults (Bonaiuto, Bonnes, & Continisio, 2004; Fornara & Manca, 2017; Fornara et al., 2019). The spatial adequacy of a home is therefore more crucial to the satisfaction of older people’s personal needs (Mridha, 2020). The home may also be more important to older people because it gives them a sense of continuity with the past (Korpela, 2012), helps them retain a positive self-image (Rubinstein & Parmelee, 1992), and sustains their sense of identity, independence and wellbeing (Eyles & Williams, 2008).

Both the above-mentioned research findings and the lifestyle changes prompted by the pandemic suggest that age could play a significant part in both residential satisfaction (in relation to the actual space available) and stress responses (in relation to satisfaction with the space at home). This is because during lockdown the home would presumably be the place where older people already conducted most of their activities, whereas younger people would have generally been obliged to change their habits and rearrange their daily routines.

**2. Study objectives and hypotheses**

The present study aimed to explore the relationship between home crowding, residential satisfaction, and perceived stress during a period of lockdown, when people were obliged to stay at home and environmental variables were likely to be more influential than usual. A first aim was to assess the impact of home crowding on perceived stress because very few studies have analyzed this specific issue (Evans et al., 1996, 2000). Our study drew theoretical and applicative support from the strong interest in the psychology of home environments (e.g., Graham, Gosling, & Travis, 2015) prompted by the COVID-19 emergency

and the associated restrictions on people’s movements (e.g., <https://www.covidfamilystudy.org/>). A second aim was to examine the link between home crowding and residential satisfaction. Various studies (e.g., Ibem & Aduwo, 2013; Zhang et al., 2018) found an influence of a home’s size and level of crowding on the prediction of residential satisfaction. The novelty of our work lies in that it analyzed the three variables - home crowding, perceived stress, and residential satisfaction, and the associations between them - in the same study. We focused on the spatial dimension of residential satisfaction, since it represents the “subjective” side of home crowding. In particular, we tested the hypothesis that the relationship between crowding and perceived stress could be mediated by satisfaction with the space at home. We also considered the moderating role of the perceived risk of COVID-19 and age, based on the relationships between perception of safety, age, and satisfaction with the space at home (Ahn & Hedge, 2011). To achieve our aims, we estimated a moderated mediation model (see Fig. 1) where perceived stress during lockdown was expected to be influenced by objective home crowding (an “objective” measure of the actual space available), both directly and also indirectly through the mediation of satisfaction with the space at home (i.e., a “subjective” measure of environmental satisfaction, including aspects related to perceived crowding, privacy, lighting conditions, and more generally of satisfaction with one’s home). We also considered the role of perceived risk of COVID-19 and age as moderators in the model.

We tested the following hypotheses.

- H1.** The lesser the degree of Objective home crowding, the greater the Satisfaction with the space at home.
- H2.** The greater the degree of Objective home crowding, the higher the Perceived stress.
- H3.** The greater the Satisfaction with the space at home, the lower the

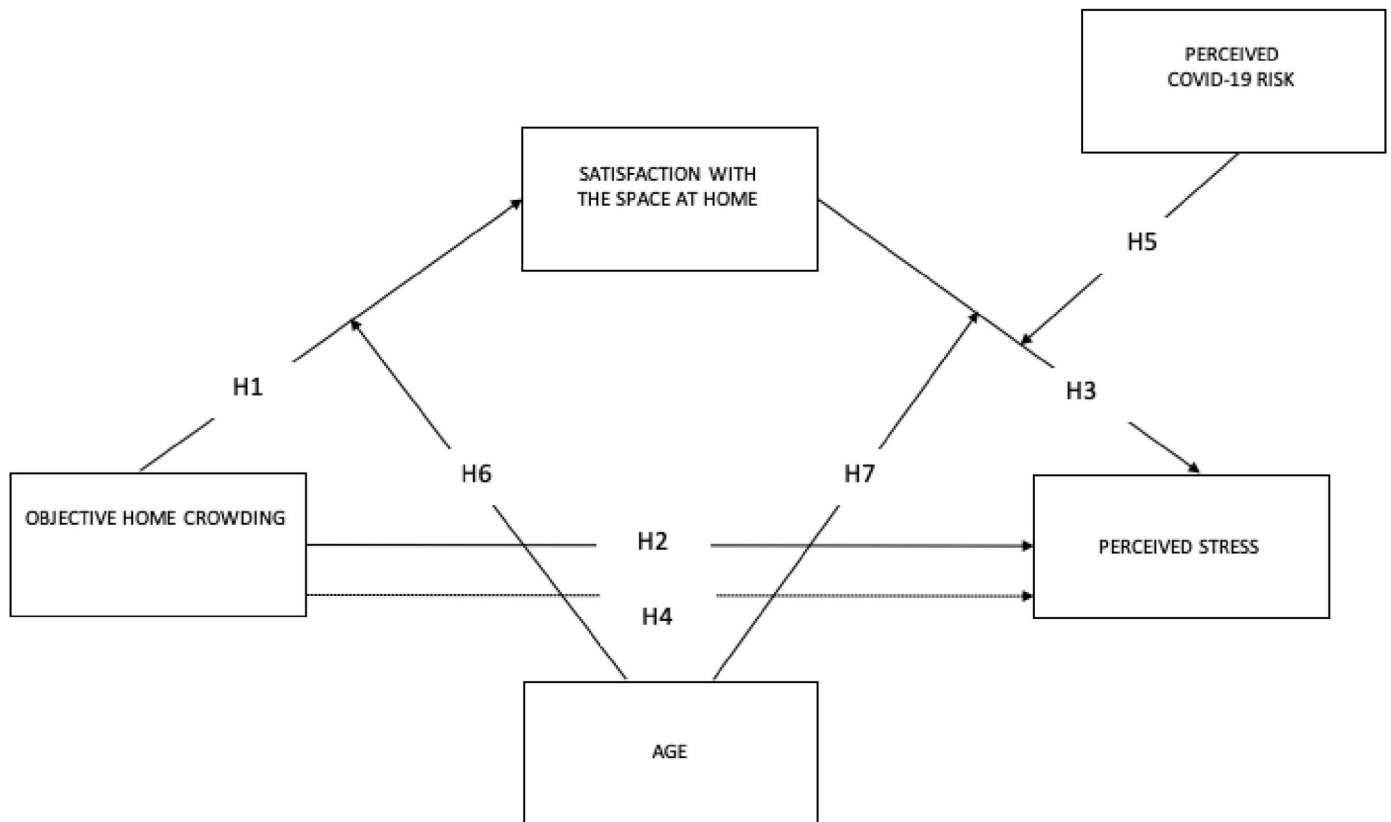


Fig. 1. Conceptual model.

Perceived stress.

**H4.** The relationship between Objective home crowding and Perceived stress is indirect, mediated by Satisfaction with the space at home.

**H5.** The relationship between Satisfaction with the space at home and Perceived stress is moderated by Perceived COVID-19 risk. In particular, we expected the influence of any dissatisfaction with the space at home on perceived stress to be weaker in cases of a high perceived COVID-19 risk.

**H6.** The relationship between Objective home crowding and Satisfaction with the space at home is moderated by Age. To be more specific, we expected a weaker influence of objective home crowding on any dissatisfaction with the space at home in older adults.

**H7.** Age has a moderating role in the relationship between Satisfaction with the space at home and Perceived stress. In particular, we expected the influence of any dissatisfaction with the space at home on perceived stress to be weaker for older adults.

We also considered the possibility of gender-related differences in people's satisfaction with the space at home and psychological distress under lockdown, as a few studies found females more satisfied with their homes than males (Hu, 2013; Huang, Du, & Yu, 2015; Mridha, 2020; Vera-Toscano & Ateca-Amestoy, 2008). Recognizing the extent to which disease outbreaks affect women and men differently is a fundamental step towards understanding the primary and secondary effects of a health emergency on different individuals and communities, and devising effective, equitable policies and interventions (Wenham, Smith, & Morgan, 2020). Wang et al. (2020) found that gender influenced symptoms of stress, anxiety and depression in a Chinese sample during the initial stage of the COVID-19 outbreak, though only a minority of the participants reported having been obliged to stay at home. In another study on Italian healthcare workers during the COVID-19 outbreak, women expressed higher levels of anxiety (but not of stress) than men (Mazza et al., 2021). Gender was consequently input as a covariate in our model.

### 3. Method

#### 3.1. Participants and procedure

Data were collected between April 23rd and May 2<sup>nd</sup> 2020, during "Phase 1" of the Italian lockdown to mitigate the spread of COVID-19. The sample size required was estimated with G\*Power 3.1 (Paul, Erdfelder, Buchner, & Lang, 2009). The  $\alpha$  was set to 0.05 and the power to 0.95. Analysis indicated that a total of 1145 participants was needed to detect a small effect size (0.02), 160 for a medium effect size (0.15), and 74 for a large effect size (0.35). A convenience sample of 1354 participants ( $F = 896$ ,  $M = 458$ ) aged 18–82 years ( $M = 35.44$ ,  $SD = 15.95$ ) took part in the study. Informed consent was obtained from all participants. Recruitment and testing were done in accordance with the ethical standards of the Institutional Review Board at the Department of Psychology (University of Campania L. Vanvitelli, Caserta, Italy; N. 8 prot. #16.20) and with the Declaration of Helsinki. Participants answered an online questionnaire using the PsyToolkit, a free online platform for demonstrating, programming and performing psycho-cognitive experiments and investigations. A link to the electronic survey was distributed worldwide by consortium colleagues (i.e., the Universities of Bologna, Bari, Cagliari, Campania, Milano-Bicocca, and Padova) using various methods: e-mail invitations, the official pages of the consortium's faculties, and other social media platforms such as Facebook™, WhatsApp™, and Twitter™. Participants were also involved in the plans to disseminate the research through the promotion of the survey in their networks. The questionnaire included an introductory page containing the background and aims of the survey. All participants completed the questionnaire, answering all the items, after reading the instructions and digitally signing the informed consent form.

#### 3.2. Measures

The study tools inserted in the online questionnaire included the following measures, among others.<sup>2</sup>

*Perceived stress* - assessed with the Italian version of the Perceived Stress Scale (PSS: Cohen, Kamarck, & Mermelstein, 1983), the most widely-used psychological tool for measuring the degree to which situations in one's life are perceived as stressful. Psychological stress can be defined as the extent to which people perceive that demands placed on them exceed their ability to cope. The PSS consists of 10 items (e.g. "In the last month, how often have you been upset because of something that happened unexpectedly?"; "In the last month, how often have you found that you could not cope with all the things that you had to do?") rated on a 5-point Likert scale, ranging from 0 = "never" to 4 = "very frequently". These items relate to feelings and thoughts during the previous month (i.e. during lockdown in our case), and participants indicated how often they had felt or thought a certain way ( $\alpha = .87$ ).

*Satisfaction with the space at home* - four questions investigated respondents' satisfaction regarding the spatial aspects of their homes: 1) "How satisfied are you generally with your home?"; 2) "How satisfied are you with the space, or square footage, of your home?"; 3) "How satisfied are you with your privacy at home?"; and 4) "How satisfied are you with the natural light in your home?". These items were rated on a Likert scale ranging from 1 = not at all satisfied to 5 = completely satisfied ( $\alpha = .78$ ).

*Objective home crowding* - this was operationalized in terms of the number of occupants divided by the number of rooms in the home, i.e., the people-per-room ratio most often used in the literature (e.g., Baker et al., 2013; Campagna, 2016; Evans et al., 1996; Gomez-Jacinto & Hombrados-Mendieta, 2002). Two questions were asked: 1) "How many people live in your home, including you?"; and 2) "How many rooms are there in your home (excluding the kitchen, bathrooms, toilets, and utility rooms)?".

*Perceived COVID-19 risk* - four questions investigated how dangerous people felt the COVID-19 virus could be in the present and in the future, and in general and in their local area, i.e.: "How dangerous do you consider the coronavirus in general in the present/future?"; and "How dangerous do you consider the coronavirus in the area where you live in the present/future?" Participants had to indicate the degree of perceived risk by moving a slider. Scores could vary from 0 (no risk) to 100 (maximum risk) ( $\alpha = .84$ ).

Sociodemographic information was also collected, including age, gender, education level, marital status, having children or not, and place of residence (see Table 1).

#### 3.3. Statistical analysis

Data analyses were performed with SPSS version 25, including the PROCESS model macro (Hayes, 2013). PROCESS is a modelling tool that calculates the direct and indirect effects of mediation models, as well as the interactions and conditional indirect effects in moderation and moderated mediation models (see <http://www.processmacro.org/index.html> for more details). It generates not only an ordinary least squares regression-based path analysis similar to structural equation modeling (SEM), but also additional useful statistics and safeguards against irregular sampling distributions (Hayes, 2017). Continuous measures involved in the interaction term (Age, Satisfaction with the space at home, Objective home crowding, and Perceived COVID-19 risk) were mean-centered prior to the analysis (Aiken, West, & Reno, 1991). We calculated descriptive statistics and zero-order correlations, which are given in Table 1. Then, we conducted dual moderated mediation

<sup>2</sup> This study was part of a wider research project (Iachini et al., 2021), and the questionnaire included a set of other measures that are not the focus of the present report.

**Table 1**  
Sociodemographic data.

Variables	N	Frequency (%)
<b>1. Sex</b>		
Males	458	33.8
Females	896	66.2
Total	1.354	100.0
<b>2. Education level</b>		
Primary school	9	0.7
Middle school	64	4.7
High school	603	44.5
Bachelor's degree	252	18.6
Master's degree	338	25.0
PhD/Specializations	88	6.5
Total	1.354	100.0
<b>3. Marital status</b>		
Single/Unmarried	812	60.0
In a relationship/Living together	121	8.9
Married	357	26.4
Divorced/Separated	46	3.4
Widowed	18	1.3
Total	1.354	100.0
<b>4. Region of residence</b>		
Lombardy	218	16.1
Emilia-Romagna	212	15.7
Veneto	184	13.6
Campania	315	23.3
Apulia	210	15.5
Sardinia	156	11.5
Other regions	59	4.4
Total	1.354	100.0
<b>5. Having children</b>		
Yes	960	70.9
No	394	29.1
Total	1.354	100.0

regression analyses (Hayes, 2017, Model 64), assuming that the indirect effects of the independent variable (Objective home crowding) on the dependent variable (Perceived stress during lockdown), through the mediator (Satisfaction with the space at home) depends on two moderators, namely Age and Perceived COVID-19 risk. As reported in the Hypotheses section, we assumed that age would have an effect at both the first- and the second-stage mediation, and that Perceived COVID-19 risk would have an effect only in the second stage of the dual moderated mediation analysis. Gender was input as a covariate in the model.

### 3.3.1. Test of mediation

Recent methodological approaches suggest that mediation analysis should be conducted on a formal significance test of the indirect effect “ab”, obtained from the product of the regression coefficients between the predictor and mediator variables (“a”) and the mediator and outcome variables (“b”). Bootstrap confidence intervals afford a superior test of the significance of indirect effects in mediation models, however (Hayes, 2013; MacKinnon, Lockwood, Hoffman, West, & Sheets, 2002). We thus tested our mediation hypothesis using the PROCESS program made available by Hayes (Hayes, 2013). Table 2 shows the regression coefficients for the model with Objective home crowding (Y), Satisfaction with the space at home (M) and Perceived stress during lockdown (Y), controlling for Gender, based on the PROCESS output reported in the Appendix.

### 3.3.2. Test of moderated mediation

Assuming that the mediation hypothesis is supported by the data (i. e., that the relationship between Objective home crowding and Perceived stress is indirectly mediated by Satisfaction with the space at home), the strength of the indirect effect (mediation) may be influenced by the value of the moderators, Age and Perceived COVID-19 risk. This is termed a conditional indirect effect, or moderated mediation (Hayes, 2017; Preacher, Rucker, & Hayes, 2007). As recommended by Preacher

et al. (2007), we estimated the conditional indirect effects using ordinary least squares regression, and tested these effects with bootstrap confidence intervals, assessing whether the indirect effects differ from zero for various values of the moderator. We used 5000 bootstrap estimates to generate 95% bias-corrected confidence intervals for the conditional indirect effects observed. The conditional indirect effects of Objective home crowding on Perceived stress were assessed for three different levels of Age (16th, 50th and 86th percentiles<sup>3</sup>) and Perceived COVID-19 risk (16th, 50th and 86th percentiles).

## 4. Results

Table 2 shows the descriptive statistics concerning the model measures and zero-order correlations between variables, Table 3 shows the results of the moderated mediation analysis, and Fig. 2 presents the path model with parameter estimates for all variables.

Perceived stress is negatively associated with Satisfaction with the space at home ( $r = -0.25, p < .001$ ) and Age ( $r = -0.38, p < .001$ ), and positively associated with Objective home crowding ( $r = .14, p < .001$ ) and Perceived COVID-19 risk ( $r = .12, p < .001$ ).

Central to the mediation hypothesis, the effect of Objective home crowding on Satisfaction with the space at home (H1) is significant ( $B = -0.7405, t = -10.5570, p < .001$ ), as is the effect of Satisfaction with the space at home on Perceived stress (H3) ( $B = -0.1917, t = -8.5399, p < .001$ ). On the other hand, there is no significant direct effect of Objective home crowding on Perceived stress (H2) ( $B = -0.0570, t = -0.9546, p = .339$ ). These results confirm H4, showing an indirect effect of Objective home crowding on Perceived stress through the mediation of Satisfaction with the space at home.

Regarding the moderator Perceived COVID-19 risk, the effect of Satisfaction with the space at home on Perceived stress is significant for both high and low levels of Perceived COVID-19 risk. As concerns the direction of this moderating effect, the ‘Satisfaction with the space at home x Perceived COVID-19 risk’ interaction reveals a significant effect in the expected direction (H5) on Perceived stress ( $B = 0.020, t = 2.24, p < .001$ ), since the moderated relationship is stronger the lower the Perceived COVID-19 risk (see Fig. 3).

As concerns Age, the conditional effect of this moderator is verified in both stages of the model. In the first stage, the effect of Objective home crowding on Satisfaction with the space at home is significant for both younger and older respondents. Regarding the direction of this moderating effect, the ‘Objective home crowding x Age’ interaction has a significant effect in the expected direction (H6) on Satisfaction with the space at home ( $B = .0157, t = 3.72, p < .001$ ), as the moderated relationship is weaker for older respondents (see Fig. 4).

In the second stage of the model, the effect of Satisfaction with the space at home on Perceived stress is significant for both younger and older respondents. As for the direction of this moderating effect, the ‘Satisfaction with the space at home x Age’ interaction has a significant effect (H7) on Perceived stress ( $B = 0.0032, t = 2.29, p < .01$ ), and the moderated relationship is stronger for younger respondents (see Fig. 5).

The conditional effects postulated (moderated mediation) were significant for both Perceived COVID-19 risk ( $B = -0.002, CI = -0.0037, -0.006$ ) and Age ( $B = -0.002, CI = -0.0055, -0.006$ ).

Finally, when the covariate Gender was inserted in the model, there was no significant effect on the relationship between Objective home crowding and Satisfaction with the space at home ( $B = .0311, t = .6733, p = .500$ ), whereas its effect on Perceived stress was significant ( $B = .339, t = 8.97, p < .001$ ), with women feeling more stressed under lockdown than men.

<sup>3</sup> The 16th, 50th and 84th percentiles of Age correspond to 22, 28 and 56 years, respectively.

**Table 2**

Means ± standard deviations, skewness, kurtosis, and zero-order correlations (Pearson's r) for variables included in the model.

	Mean (SD)	Skewness	Kurtosis	1	2	3	4	5
Objective home crowding (1)	0.72 ± 0.33	0.85	1.08	1				
Perceived stress (2)	1.91 ± 0.74	0.03	-0.38	.14***	1			
Satisfaction with the space at home (3)	3.67 ± 0.86	-0.54	.10	-.30***	-.25***	1		
Perceived COVID-19 risk (4)	64.02 ± 21.16	-0.49	-0.19	.06*	.12***	-.01	1	
Age (5)	35.44 ± 15.95	.89	-0.53	-.22***	-.38***	-.25***	.017	1

Notes. \* p < .05, \*\* p < .01, \*\*\* p < .001.

**Table 3**

Moderated mediation analysis. Estimated coefficients, t-values and 95% confidence intervals (CI) for each effect, R<sup>2</sup> and ΔR<sup>2</sup> for mediator and dependent variable.

	Mediator variable model		
	Satisfaction with the space at home		
	B	t	CI
Objective home crowding	-0.7405	-10.5570***	[-.8781, -.6029]
Age	0.011	8.1500***	[.0084, .0138]
Objective home crowding*Age	0.0157	3.7202***	[.0074, .0239]
R <sup>2</sup>	0.1441		
ΔR <sup>2</sup>	.0081 [ΔF (1, 1349) = 13.5704, p < .001]		
	Dependent variable model		
	Perceived stress		
	B	t	CI
Objective home crowding	-0.0570	-0.9546	[-.1742, .0602]
Age	-0.0142	-11.9520***	[-.0165, -.0119]
Perceived COVID-19 risk	0.0033	3.8681 ***	[.0016, .0049]
Satisfaction with the space at home	-0.1917	-8.5399***	[-.2358, -.1477]
Satisfaction with the space at home*Perceived COVID-19 risk	0.0020	2.2379*	[.0002, .0037]
Satisfaction with the space at home*Age	0.0032	2.2936*	[.0005, .0059]
R <sup>2</sup>	.2560		
ΔR <sup>2</sup> <sub>1</sub>	.0027		
ΔR <sup>2</sup> <sub>2</sub>	.0025		
	Satisfaction with the space at home*Age [ΔF (1, 1346) = 5.2604, p < .05]		
	Satisfaction with the space at home*Perceived Covid-19 risk [ΔF (1, 1346) = 5.0083, p < .05]		

Notes: \* p < .05, \*\* p < .01, \*\*\* p < .001.

**5. Discussion**

Our findings provide some first evidence of Satisfaction with the space at home mediating the relationship between Objective home crowding and Perceived stress in a sample of respondents largely obliged to stay at home to comply with governmental measures to contain the COVID-19 pandemic. The mediating role of Satisfaction with the space at home was significant for different levels of both Age and Perceived COVID-19 risk, but its effect was stronger for younger people, and for those who perceived a higher risk of catching the infection.

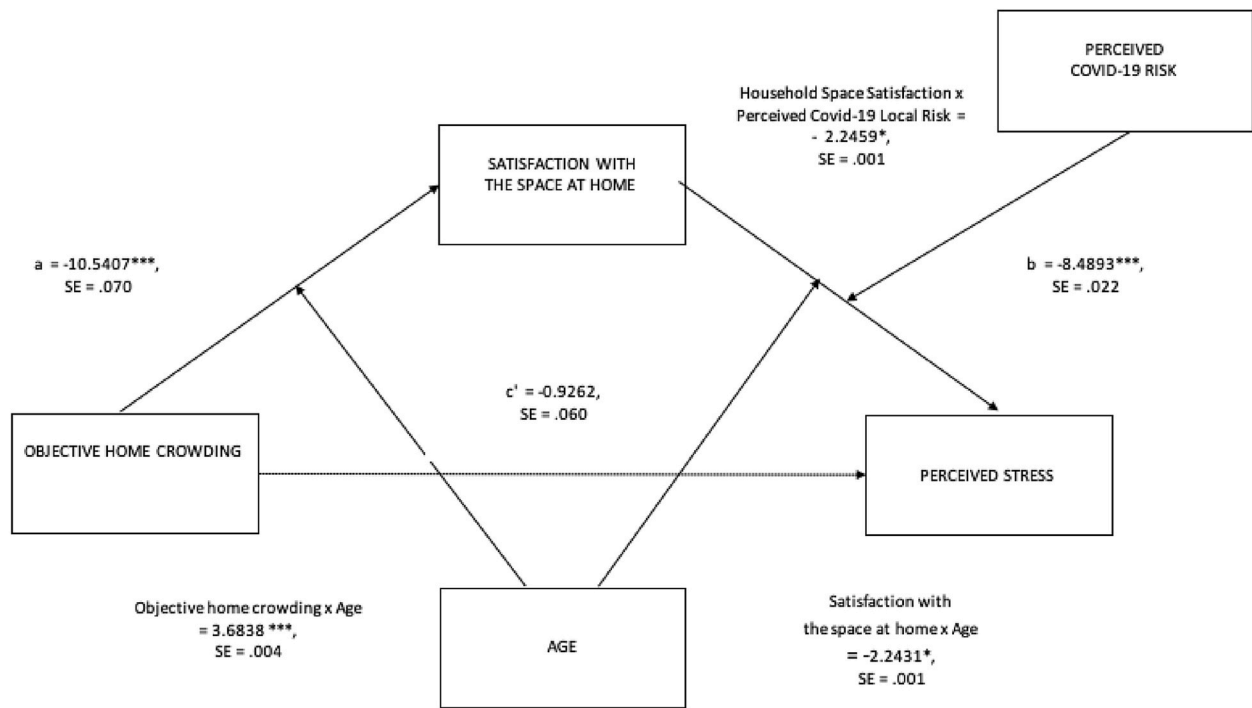
As concerns H1, we confirmed that Satisfaction with the space at home increases when Objective home crowding decreases, consistently with previous findings on the influence of “objective” home crowding on

the perception of living in crowded conditions (Evans et al., 2000) and on residential satisfaction (Gomez-Jacinto & Hombrados-Mendieta, 2002). On the other hand, our model revealed no direct influence of Objective home crowding on Perceived stress<sup>4</sup> (H2), in contrast with much of the literature on the relationship between crowding and stress (e.g., Baum et al., 1981; Evans & Stecker, 2004; Veitch, 2012; Wener, 2012), in the home environment too (Evans et al., 1996, 2000). Instead, a significant indirect link emerged between Objective home crowding and Perceived stress through the mediation of Satisfaction with the space at home (H4). The more residents were satisfied with the spatial dimensions of their home, the lower the levels of psychological distress they experienced (H3). This would confirm reports on the effect of residential satisfaction on positive global human psychological responses, such as overall life satisfaction and happiness (Peck & Kay Stewart, 1985; Hu, 2013; Kahlmeier, Schindler, Grize, & Braun-Fahrlander, 2001). Both the direct stress-reducing effect of satisfaction with the space at home and its pivotal role in mediating between crowding and stress take on a special meaning in a situation where people are obliged to stay at home. People who feel that their living space suffices, and meets their need for privacy, are less likely to experience a sense of helplessness, which is often closely related to psychological distress and a perceived lack of control over the situation (Evans & Stecker, 2004; Gatersleben & Griffin, 2017).

As concerns the perceived COVID-19 risk, alongside its predictable significant association with the level of stress (i.e., the higher the perceived risk, the greater the stress), this variable also emerged as a moderator between Satisfaction with the space at home and Perceived stress. As expected (H5), the strength of the association between these two variables is greater the lower the Perceived COVID-19 risk. In other words, appreciating the space available at home is much more important in containing stress levels for people who are less concerned about the COVID-19 risk than for those more worried about the pandemic.

As well as confirming that residential satisfaction increases with aging (Campbell, Converse, & Rodgers, 1976; Lu, 1999; Mridha, 2020; Zhang et al., 2018), older people also seem to be less affected by home crowding than younger people, as hypothesized in (H6). This is consistent with previous reports of older adults being more satisfied with their tiny homes than younger generations (Boeckerman et al., 2019). In our study, older people also felt less stressed than younger people, although it has been amply acknowledged that the harm caused by COVID-19 disease increases with age (Calderón-Larrañaga, Dekhtyar, Vetrano, Bellander, & Fratiglioni, 2020). On the other hand, the restrictions imposed to combat the pandemic are likely to have affected the younger generations more. While older people already tended to organize their daily activities in and around their home (Bonaiuto et al., 2004; Fornara & Manca, 2017), lockdown brought far more dramatic changes for younger adults and children. This situation is also confirmed by the fact that satisfaction with the space at home has a less important role in containing psychological distress for the elderly than for the younger generations (H7).

<sup>4</sup> It is worth mentioning that the zero-order bivariate correlation between Objective home crowding and Perceived stress is 0.14, so - although it is significant (p < .01) - it seems quite low because of the large sample size.



Notes. \*\*\*  $p < 0.001$ , \*  $p < 0.05$ ; SE = standard error

Fig. 2. Path model with parameter estimates for all variables. Notes. \*\*\*  $p < .001$ , \*  $p < .05$ ; SE = standard error.

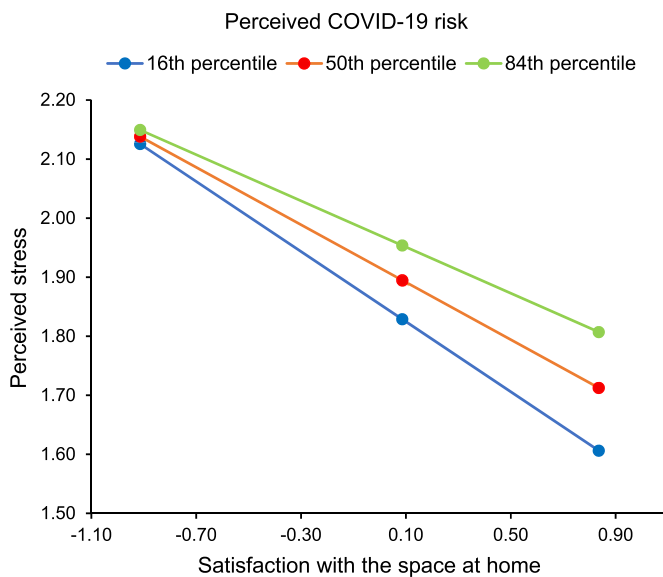


Fig. 3. Conditional indirect effect of Satisfaction with the space at home on Perceived stress through the mediation of the Perceived COVID-19 risk estimates (16th, 50th and 84th percentiles). Ninety-five percent bootstrap confidence intervals for indirect effects involving those in the 16th, 50th and 84th percentiles of Perceived COVID-19 risk did not include 0, indicating meaningful indirect effects.

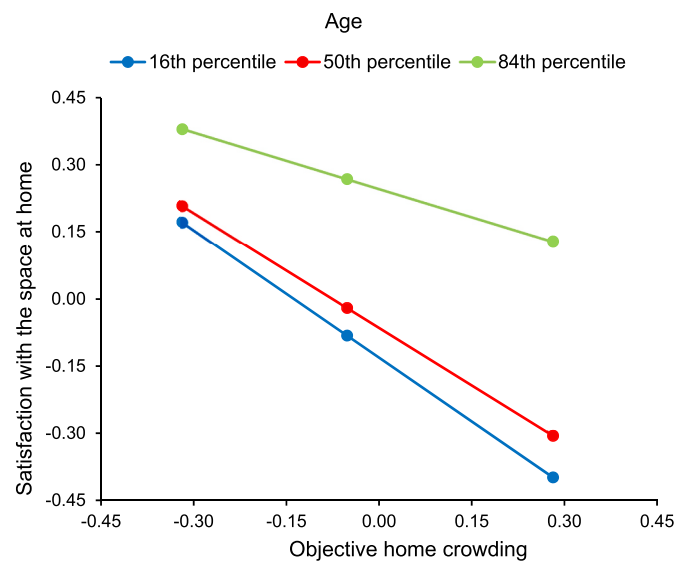


Fig. 4. Conditional indirect effect of Objective home crowding on Satisfaction with the space at home through the mediation of the Age estimates (16th, 50th, and 84th percentiles). Ninety-five percent bootstrap confidence intervals for indirect effects involving those in the 16th, 50th and 84th percentiles of Age did not include 0, indicating meaningful indirect effects.



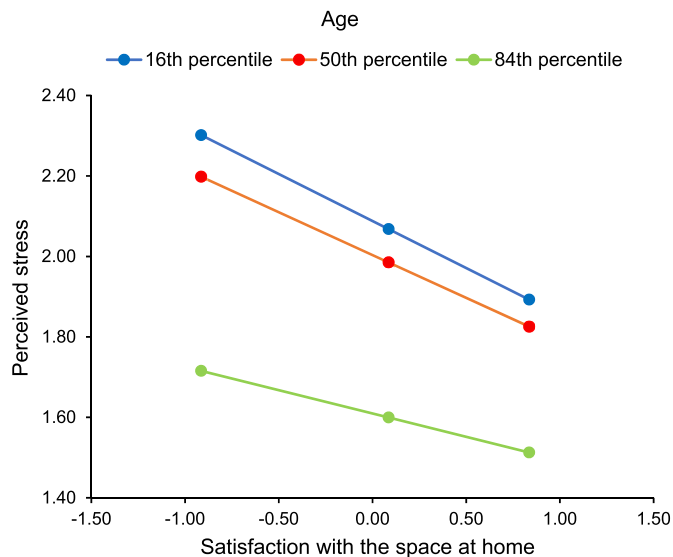


Fig. 5. Conditional indirect effect of Satisfaction with the space at home on Perceived stress through the mediation of the Age estimates (16th, 50th and 84th percentiles). Ninety-five percent bootstrap confidence intervals for indirect effects involving those in the 16th, 50th and 84th percentiles of Age did not include 0, indicating meaningful indirect effects.

Finally, regarding gender-related differences, our results show that women perceived more stress than men under lockdown, in line with previous findings (for a review, see Ahuja, Syal, & Kaur, 2020). In fact, even if men and women tended to cope differently with stress, women seemed to be more severely stressed by lockdown and COVID-related restrictive measures than men (e.g., Song et al., 2020; Qiu et al., 2020, Mazza et al., 2020). This may be because of women's front-line role in caring for the family in Italian society as a whole, and thus they might have reached the peak of psychological distress during the first period lockdown (Salfi et al., 2020).

Our findings support an indirect link between objective conditions of crowding at home and psychological distress, mediated by (dis)satisfaction with the spatial dimensions of the home, but the correlational and cross-sectional nature of our study prevents us from inferring any causal chain connecting the variables considered. Future, preferably longitudinal studies should address this limitation, to lend further strength to these findings. A further dimension that could be considered in future research on this topic is the resident's Socio-Economic Status (SES), since it is supposed to impact on objective home crowding, assuming that high SES people have averagely more home space than low SES people, at least in urban contexts. Given that SES is a highly sensitive and confidential piece of data (e.g., see Schwartz & Paulin, 2000; Andreenkova & Javeline, 2019), we decided to not include this measure in our survey, also because we did not have a clear hypothesis on how SES would have influenced our model's paths. In other words, we did not find grounds in literature about variations of the association between objective and subjective crowding at home - or between the latter and stress - at different SES levels.

## 6. Conclusion

The present study, based on a large sample recruited in different Italian regions, sheds some light on the sense of wellbeing associated with the objective and subjective characteristics of our homes. The data examined were collected about six weeks after the start of a national lockdown imposed by the central government in Italy, as in many other European countries, at the start of the COVID-19 pandemic.

The study outcomes point to the crucial importance of carefully assessing the influence of satisfaction with the space at home on the

association between objective home crowding and perceived stress. Age reveals an important role in these relationships, with younger people's satisfaction with the space at home being more affected by objective home crowding, and their consequent perceived stress is more severe than in older people. The mitigating effect of satisfaction with the space at home on perceived stress was also found weaker when the perceived COVID-19 risk was greater.

Overall, a coherent picture emerges from our results: home means a safe haven, especially for the elderly, but for the younger generations its objective and subjectively-perceived spatial features have a key role in mitigating the stressful effects of having to stay at home under lockdown. Taken together, these findings show that issues relating to the space available at home - in terms of residential satisfaction and crowding - are fundamental to people's wellbeing and perceived stress in response to the restrictions imposed by the COVID-19 emergency. It is therefore important to consider these aspects with a view to designing adequate, flexible living spaces in the homes of today and tomorrow.

In conclusion, it is to mention that the same notion of pandemic has been questioned, and a syndemic approach was recently proposed (Horton, 2020), in order to demonstrate how an integrated perspective to understanding and coping with diseases can be far more successful than simply controlling epidemics or treating individual patients. Such an approach advocates the inclusion of the economic, social, and environmental factors that could amplify (or buffer) the effect of diseases (Singer, Bulled, Ostrach, & Mendenhall, 2017), as in the case of the COVID-19 pandemic. Given that poor-quality housing is associated with various negative health outcomes, including chronic diseases (Hu, Roberts, Azevedo, & Milner, 2021), it is essential that policy makers and other public health stakeholders take into account the pivotal role of house conditions for individual's wellbeing, considering that, even when hopefully the pandemic will be over, many people will continue to work from home, either entirely or partially (Guyot & Sawhill, 2020).

## Declarations of interest

None.

## Data availability

The data examined in this study will be made available upon reasonable request.

## CRedit authorship contribution statement

**Ferdinando Fornara:** Conceptualization, Methodology, Investigation, Formal analysis, Writing – original draft, Writing – review & editing. **Oriana Mosca:** Conceptualization, Methodology, Formal analysis, Writing – original draft, Writing – review & editing. **Andrea Bosco:** Methodology, Investigation, Formal analysis, Writing – review & editing. **Alessandro O. Caffò:** Methodology, Investigation, Formal analysis, Writing – review & editing. **Antonella Lopez:** Methodology, Investigation, Formal analysis, Writing – review & editing. **Tina Iachini:** Project administration, Investigation, Writing – review & editing. **Genaro Ruggiero:** Investigation, Writing – review & editing. **Francesco Ruotolo:** Investigation, Writing – review & editing. **Filomena Leonela Sbordone:** Investigation, Software, Writing – review & editing. **Antonella Ferrara:** Investigation, Software, Writing – review & editing. **Zaira Cattaneo:** Investigation, Writing – review & editing. **Maria Arioli:** Investigation, Writing – review & editing. **Francesca Frassinetti:** Investigation, Writing – review & editing. **Michela Candini:** Investigation, Writing – review & editing. **Laura Miola:** Investigation, Methodology, Writing – review & editing. **Francesca Pazzaglia:** Conceptualization, Methodology, Investigation, Writing – review & editing.

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## Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.jenvp.2021.101747>.

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