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

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1 **Space at home and psychological distress during the COVID-19 lockdown in Italy**

2

3 **Abstract**

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

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

16

17 **Keywords**

18 perceived stress; COVID-19; restricted movement; satisfaction with the space at home; crowding;
19 perceived risk of COVID-19 infection

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21 **Highlights**

- 22 - Data were collected during the first national lockdown in Italy (2020).
23 - The greater the objective crowding, the lower the satisfaction with the space at home.
24 - The lower the satisfaction with the space at home, the higher the perceived stress.
25 - This latter association was stronger when the perceived COVID-19 risk was lower.
26 - All these associations were stronger in younger generations than in older people.

27 **1. Introduction**

28 During a national lockdown imposed by the Italian government from March to May 2020 to combat
29 the first wave of the COVID-19 pandemic, people were obliged to stay at home all day (09.03.2020,
30 DPCM #iorestoacasa – I stay at home). They were only allowed to go out for necessities, such as to
31 purchase food or medicines, or to work if smart working was impossible. The COVID-19 outbreak
32 changed people’s habits, routines and lifestyles, affecting human relationships and work productivity
33 all over the country. Streets remained deserted and the fear of infection a constant companion. The
34 experience of life at home was strongly affected too, especially during periods of enforced quarantine
35 (Rogers & Power, 2020). Home became the place where most of the population conducted most or
36 all of their daily activities. Its occupants worked, studied, socialized, and engaged in physical exercise
37 routines, sharing the available space throughout the day, sometimes not without family conflicts and
38 tensions (Prime, Wade, & Browne, 2020). The arrival of the COVID-19 pandemic led to a 69%
39 increase in the number of people in Italy working remotely (Savic, 2020). Numerous narratives have
40 emerged regarding the meaning of ‘home’ in these pandemic times (Devine-Wright et al., 2020),
41 some positive (home as a safe and healthy place, peaceful and restful, with more time to spend with
42 the family), some negative (home as a place of isolation, loneliness, threat, oppression and
43 imprisonment).

44 The central role of the home was dramatically emphasized during the COVID-19 lockdown,
45 suggesting the need to see it as more than just a physical living space. It is important to its occupants’
46 social and psychological wellbeing (Daniela et al., 2020). This has shifted the focus to the spatial
47 adequacy of people’s homes as a factor to consider in efforts to reduce the psychological distress
48 caused by lockdowns.

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

52

53 ***1.1. Residential satisfaction***

54 The literature describing research on individuals in relation to their residential environments has
55 addressed various spatial levels applicable to the term “residential” (Marans, 2003), from the micro
56 to the macro level (see also Lewicka, 2010; Bonaiuto & Alves, 2012), from the single dwelling (e.g.,
57 Gómez-Jacinto & Hombrados-Mendieta, 2002; Pasca, Aragones, & Poggio, 2016; Anton &
58 Lawrence, 2014) to the residential complex or facility (e.g., Cerina, Fornara, & Manca, 2017), the
59 neighborhood (e.g., Hernandez, Hidalgo, Salazar-Laplace, & Hess, 2007; Fleury-Bahi et al., 2008;
60 Bonaiuto et al., 2015; Fornara, Lai, Bonaiuto, & Pazzaglia, 2019), and the broader urban context (e.g.,
61 Brown & Kytta, 2014; Casakin, Hernandez, & Ruiz, 2015).

62 Housing satisfaction has been examined as one of the facets of residential satisfaction (Francescato,
63 2002; Lu, 1999; Weidemann & Anderson, 1985), which contributes greatly to overall life satisfaction
64 and happiness (Peck & Kay 1985; Hu 2013; Kahlmeier, Schindler, Grize, & Braun- Fahrländer,
65 2001). On the other hand, the spatial features of the home have rarely been the focus of research in
66 the recent literature (Campagna, 2016; Aragones, Amerigo, & Perez Lopez, 2017).

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68 ***1.2. The spatial dimension of the home***

69 There is empirical evidence of housing quality and the spatial adequacy of housing both affecting
70 housing satisfaction (Lu 1999; Levy-Leboyer1993; Elsinga & Hoekstra, 2005; Vera-Toscano &
71 Ateca-Amestoy, 2008). On the role of a home’s size in predicting residential satisfaction (e.g., Iben
72 & Aduwo, 2013; Zhang et al., 2018 and the review on this topic by Aigbavboa & Thwala, 2016), a
73 positive correlation has been reported between the number of bedrooms in a home and its occupants’
74 general satisfaction (Cheshmehzangi, 2020). Crucially, in a study conducted on students during the
75 lockdown in Lombardy (one of Italy’s geographical regions most affected by the pandemic), living
76 in small homes (less than 60 square meters in size) was associated with a higher likelihood of
77 depressive symptoms (Amerio et al., 2020).

78 Besides the size of a home, another important issue concerns its spatial configuration (Campagna,
79 2016). Partitions convey separation and depth, protecting against unwanted stimuli and intrusions
80 (Evans, Lepore, & Schroeder, 1996). This relates to social spacing aspects, such as crowding and
81 privacy, which are closely related (Bell et al. 2001) because they both concern the interface between
82 spatial layouts and people. As Gatersleben and Griffin (2017) reported, crowding and (lack of)
83 privacy have been among the most often studied social-environmental stressors.

84 The stressful impact of crowded conditions has been demonstrated in various settings, such as offices
85 (Veitch, 2012), correctional facilities (Wener, 2012), and students' dormitories (Baum et al., 1981).
86 In a sample of US college students, Evans, Lepore and Schroeder (1996) found smaller spaces at
87 home associated with higher levels of psychological distress. This effect seems to emerge not only in
88 noncontact cultures (as in Northern European and North American societies), but also in contact
89 cultures (in Latin America, for instance), as shown by Evans, Lepore, and Allen (2000). The stressful
90 influence of chronic residential crowding has been judged to be "moderately strong" (Evans &
91 Stecker, 2004), though the evidence mainly concerned dormitories or laboratory studies. To be more
92 specific, research has demonstrated that the degree of psychological distress increases with the
93 number of people per room (Evans, 2003), which has also shown to influence the support to anti-
94 democratic political systems in Italy during the COVID-19 lockdown (Cavazza, Russo, Colloca, &
95 Roccato, 2021).

96 Amongst the indicators of crowding, Torshizian and Grimes (2020) mention the floor area per person
97 used by the United Nations and World Health Organization as a quality of life indicator in judging
98 sustainable human settlements. The people-per-room index, also known as the American Crowding
99 Index (ACI), is another commonly used measure¹. In their literature review on the relationship
100 between crowding in homes and infectious diseases, Baker et al. (2013) found that the people-per-

¹ 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.

101 room index was the most often used measure of crowding, followed by people-per-house and people-
102 per-bedroom indexes. Studies that considered stress as the outcome variable also considered people
103 per room as a measure of crowding (e.g., Evans et al., 1996; Gomez-Jacinto & Hombrados-Mendieta,
104 2002; Campagna, 2016). For instance, Gomez-Jacinto and Hombrados-Mendieta (2002) reported a
105 multiplicative effect of crowding at home and in the community in influencing both psychological
106 distress and residential satisfaction.

107 Crowding at home might be addressed as both an “objective” and a “subjective” condition, as
108 suggested by Bonnes et al. (1991). Thornock et al. (Thornock , Nelson, Porter, & Evans-Stout, 2019)
109 made the point that, despite growing evidence of the prominence of perceived space over actual
110 (objective) space, there have been few studies on the subjective aspect, or perceived crowding, which
111 has to do with “feeling too close to others” and “how distant one feels from others in his or her space”
112 (Thornock et al., 2019, p. 40). For instance, Rodgers (1982) found that the relationship between
113 satisfaction with a community, neighborhood and dwelling related more to perceived crowding than
114 to objective crowding. Torshizian and Grimes (2020) reported instead that perceived crowding and
115 various objective crowding measures carried much the same weight in terms of people’s residential
116 satisfaction. The dichotomy between objective and subjective crowding recalls the broader distinction
117 between objective and subjective assessment of environmental quality of places, e.g. concerning the
118 urban contexts (Gifford, 2002; Bonaiuto & Alves, 2012) and the healthcare settings (Fornara &
119 Andrade, 2012). In this regard, some studies (Andrade e al., 2013; Fornara, 2005) found that users’
120 perceived quality of hospital environmental features (i.e., a kind of subjective assessment) mediate
121 the relationship between expert ratings of the hospital design (i.e., a kind of objective assessment)
1221 and a global response of users’ satisfaction towards their experience.

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124 1.3. Age-related differences in home satisfaction

125 Age needs to be borne in mind when addressing the influence of the spatial dimensions of homes.

126 Zhang et al. (Zhang et al., 2018) found that several features of a home - such as ownership, type, size,

127 number of bedrooms, and the presence of living rooms or bathrooms - predicted older adults' level
128 of satisfaction with their homes, whereas only the size of the home and the number of bedrooms were
129 significant predictors for younger people.

130 The Tiny House Community Survey conducted by Boeckerman and colleagues (Boeckerman,
131 Kaczynski, & King, 2019) identified age as a significant sociodemographic predictor of respondents'
132 satisfaction with their tiny homes: people from 40 to 66 years old were more satisfied than younger
133 residents (from 19 to 39 years old). Other studies found that residential satisfaction tends to increase
134 with age (Lu, 1999; Mridha, 2020). The home probably tends to have a more central role in the lives
135 of older adults, who are more likely to organize their daily activities around their place of residence
136 than younger adults (Bonaiuto, Bonnes, & Continisio, 2004; Fornara & Manca, 2017; Fornara, Lai,
137 Bonaiuto, & Pazzaglia, 2019). The spatial adequacy of a home is therefore more crucial to the
138 satisfaction of older people's personal needs (Mridha, 2020). The home may also be more important
139 to older people because it gives them a sense of continuity with the past (Korpela, 2012), helps them
140 retain a positive self-image (Rubinstein & Parmelee, 1992), and sustains their sense of identity,
141 independence and wellbeing (Eyles & Williams, 2008).

142 Both the above-mentioned research findings and the lifestyle changes prompted by the pandemic
143 suggest that age could play a significant part in both residential satisfaction (in relation to the actual
144 space available) and stress responses (in relation to satisfaction with the space at home). This is
145 because during lockdown the home would presumably be the place where older people already
146 conducted most of their activities, whereas younger people would have generally been obliged to
1471 change their habits and rearrange their daily routines.

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149 **2. Study objectives and hypotheses**

150 The present study aimed to explore the relationship between home crowding, residential satisfaction,
151 and perceived stress during a period of lockdown, when people were obliged to stay at home and
152 environmental variables were likely to be more influential than usual. A first aim was to assess the

153 impact of home crowding on perceived stress because very few studies have analyzed this specific
154 issue (Evans et al., 1996, 2000). Our study drew theoretical and applicative support from the strong
155 interest in the psychology of home environments (e.g., Graham, Gosling, & Travis, 2015) prompted
156 by the COVID-19 emergency and the associated restrictions on people's movements (e.g.,
157 <https://www.covidfamilystudy.org/>). A second aim was to examine the link between home crowding
158 and residential satisfaction. Various studies (e.g., Ibem & Aduwo, 2013; Zhang et al., 2018) found an
159 influence of a home's size and level of crowding on the prediction of residential satisfaction. The
160 novelty of our work lies in that it analyzed the three variables - home crowding, perceived stress, and
161 residential satisfaction, and the associations between them - in the same study. We focused on the
162 spatial dimension of residential satisfaction, since it represents the "subjective" side of home
163 crowding. In particular, we tested the hypothesis that the relationship between crowding and
164 perceived stress could be mediated by satisfaction with the space at home. We also considered the
165 moderating role of the perceived risk of COVID-19 and age, based on the relationships between
166 perception of safety, age, and satisfaction with the space at home (Ahn & Hedge, 2011). To achieve
167 our aims, we estimated a moderated mediation model (see Figure 1) where perceived stress during
168 lockdown was expected to be influenced by objective home crowding (an "objective" measure of the
169 actual space available), both directly and also indirectly through the mediation of satisfaction with
170 the space at home (i.e., a "subjective" measure of environmental satisfaction, including aspects related
171 to perceived crowding, privacy, lighting conditions, and more generally of satisfaction with one's
172 home). We also considered the role of perceived risk of COVID-19 and age as moderators in the
173 model.

174 We tested the following hypotheses.

175 H1: The lesser the degree of Objective home crowding, the greater the Satisfaction with the space at
176 home.

177 H2: The greater the degree of Objective home crowding, the higher the Perceived stress.

178 H3: The greater the Satisfaction with the space at home, the lower the Perceived stress.

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

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

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

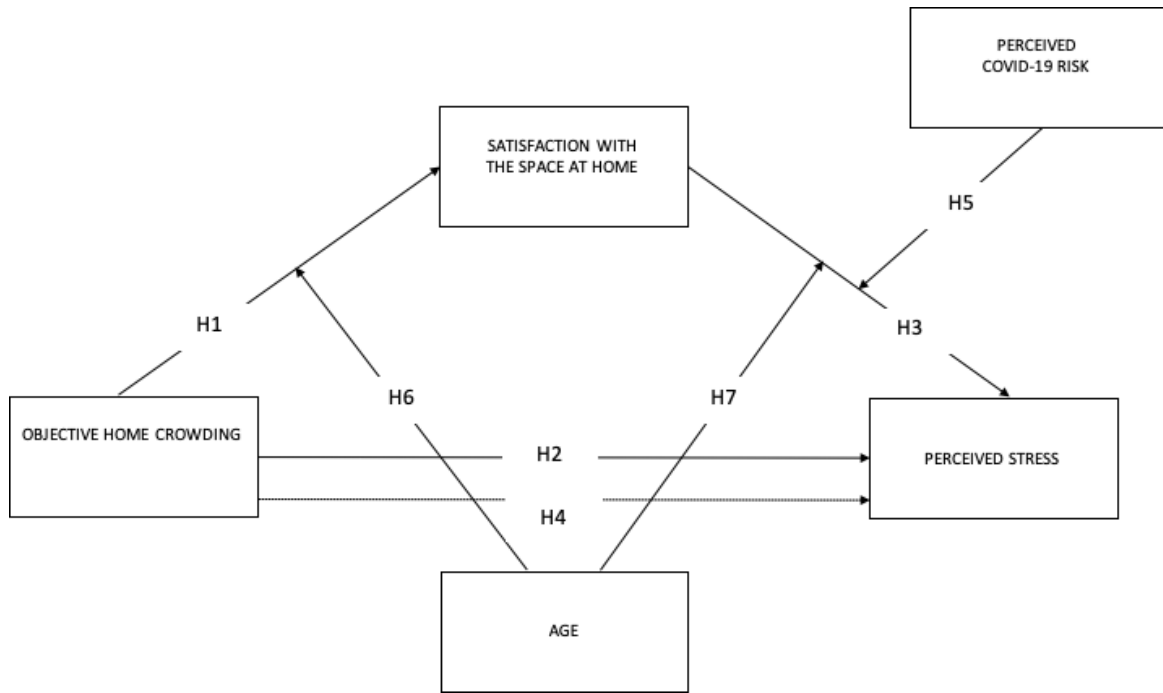
187 H7: Age has a moderating role in the relationship between Satisfaction with the space at home and
188 Perceived stress. In particular, we expected the influence of any dissatisfaction with the space at home
189 on perceived stress to be weaker for older adults.

190 We also considered the possibility of gender-related differences in people's satisfaction with the space
191 at home and psychological distress under lockdown, as a few studies found females more satisfied
192 with their homes than males (Hu, 2013; Huang et al. 2015; Mridha, 2020; Vera-Toscano & Ateca-
193 Amestoy, 2008). Recognizing the extent to which disease outbreaks affect women and men
194 differently is a fundamental step towards understanding the primary and secondary effects of a health
195 emergency on different individuals and communities, and devising effective, equitable policies and
196 interventions (Wenham, Smith, & Morgan, 2020). Wang et al. (2020) found that gender influenced
197 symptoms of stress, anxiety and depression in a Chinese sample during the initial stage of the COVID-
198 19 outbreak, though only a minority of the participants reported having been obliged to stay at home.
199 In another study on Italian healthcare workers during the COVID-19 outbreak, women expressed
200 higher levels of anxiety (but not of stress) than men (Mazza et al., 2021). Gender was consequently

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207 **3. Method**

208 **3.1. Participants and procedure**

209 Data were collected between April 23rd and May 2nd 2020, during “Phase 1” of the Italian lockdown
 210 to mitigate the spread of COVID-19. The sample size required was estimated with G*Power 3.1 (Faul,
 211 Erdfelder, Buchner, & Lang, 2009). The α was set to .05 and the power to 0.95. Analysis indicated
 212 that a total of 1145 participants was needed to detect a small effect size (.02), 160 for a medium effect
 213 size (.15), and 74 for a large effect size (.35). A convenience sample of 1354 participants (F= 896,
 214 M= 458) aged 18 to 82 years (M= 35.44, SD= 15.95) took part in the study. Informed consent was
 215 obtained from all participants. Recruitment and testing were done in accordance with the ethical
 216 standards of the Institutional Review Board at the Department of Psychology (University of

217 Campania L. Vanvitelli, Caserta, Italy; N. 8 prot. #16.20) and with the Declaration of Helsinki.
218 Participants answered an online questionnaire using the PsyToolkit, a free online platform for
219 demonstrating, programming and performing psycho-cognitive experiments and investigations. A

220 link to the electronic survey was distributed worldwide by consortium colleagues (i.e., the
221 Universities of Bologna, Bari, Cagliari, Campania, Milano-Bicocca, and Padova) using various
222 methods: e-mail invitations, the official pages of the consortium's faculties, and other social media
223 platforms such as Facebook™, WhatsApp™, and Twitter™. Participants were also involved in the
224 plans to disseminate the research through the promotion of the survey in their networks. The
225 questionnaire included an introductory page containing the background and aims of the survey. All
226 participants completed the questionnaire, answering all the items, after reading the instructions and
2272 digitally signing the informed consent form.

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229 **3.2. Measures**

230 The study tools inserted in the online questionnaire included the following measures, among others².
231 *Perceived stress* - assessed with the Italian version of the Perceived Stress Scale (PSS: Cohen,
232 Kamarck, & Mermelstein, 1983), the most widely-used psychological tool for measuring the degree
233 to which situations in one's life are perceived as stressful. Psychological stress can be defined as the
234 extent to which people perceive that demands placed on them exceed their ability to cope. The PSS
235 consists of 10 items (e.g. "In the last month, how often have you been upset because of something
236 that happened unexpectedly?", "In the last month, how often have you found that you could not cope
237 with all the things that you had to do?") rated on a 5-point Likert scale, ranging from 0 = "never" to
238 4 = "very frequently". These items relate to feelings and thoughts during the previous month (i.e.
239 during lockdown in our case), and participants indicated how often they had felt or thought a certain
240 way ($\alpha = .87$).

241 *Satisfaction with the space at home* - four questions investigated respondents' satisfaction regarding
242 the spatial aspects of their homes: 1) "How satisfied are you generally with your home?", 2) "How

243 satisfied are you with the space, or square footage, of your home?"; 3) "How satisfied are you with

² This study was part of a wider research project, and the questionnaire included a set of other measures that are not the focus of the present report. See XXX (2021), blinded for review.

244 your privacy at home?"; and 4) "How satisfied are you with the natural light in your home?". These
245 items were rated on a Likert scale ranging from 1 = not at all satisfied to 5= completely satisfied (α
246 = .78).

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

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

259 Sociodemographic information was also collected, including age, gender, education level, marital
2602 status, having children or not, and place of residence (see Table 1).

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Variables	N	Frequency (%)
1. Sex		
Males	458	33.8
Females	896	66.2
Total	1.354	100.0
2. Education level		
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
3. Marital status		
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
4. Region of residence		
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
5. Having children		
Yes	960	70.9
No	394	29.1
Total	1.354	100.0

265 **3.3. Statistical analysis**

266 Data analyses were performed with SPSS version 25, including the PROCESS model macro (Hayes,
267 2013). PROCESS is a modelling tool that calculates the direct and indirect effects of mediation
268 models, as well as the interactions and conditional indirect effects in moderation and moderated
269 mediation models (see <http://www.processmacro.org/index.html> for more details). It generates not
270 only an ordinary least squares regression-based path analysis similar to structural equation modeling
271 (SEM), but also additional useful statistics and safeguards against irregular sampling distributions
272 (Hayes et al., 2017). Continuous measures involved in the interaction term (Age, Satisfaction with
273 the space at home, Objective home crowding, and Perceived COVID-19 risk) were mean-centered
274 prior to the analysis (Aiken & West, 1991). We calculated descriptive statistics and zero-order
275 correlations, which are given in Table 1. Then, we conducted dual moderated mediation regression
276 analyses (Hayes, 2017, Model 64), assuming that the indirect effects of the independent variable
277 (Objective home crowding) on the dependent variable (Perceived stress during lockdown), through
278 the mediator (Satisfaction with the space at home) depends on two moderators, namely Age and
279 Perceived COVID-19 risk. As reported in the Hypotheses section, we assumed that age would have
280 an effect at both the first- and the second-stage mediation, and that Perceived COVID-19 risk would
281 have an effect only in the second stage of the dual moderated mediation analysis. Gender was input
2822 as a covariate in the model.

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284 **3.3.1. Test of mediation**

285 Recent methodological approaches suggest that mediation analysis should be conducted on a formal
286 significance test of the indirect effect “ab”, obtained from the product of the regression coefficients
287 between the predictor and mediator variables (“a”) and the mediator and outcome variables (“b”).

288 Bootstrap confidence intervals afford a superior test of the significance of indirect effects in mediation
289 models, however (Hayes, 2013; MacKinnon et al., 2002). We thus tested our mediation hypothesis
290 using the PROCESS program made available by Hayes (Hayes, 2013). Table 2 shows the regression

291 coefficients for the model with Objective home crowding (Y), Satisfaction with the space at home
292 (M) and Perceived stress during lockdown (Y), controlling for Gender, based on the PROCESS output
2932 reported in the Appendix.

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295 3.3.2. *Test of moderated mediation*

296 Assuming that the mediation hypothesis is supported by the data (i.e., that the relationship between
297 Objective home crowding and Perceived stress is indirectly mediated by Satisfaction with the space
298 at home), the strength of the indirect effect (mediation) may be influenced by the value of the
299 moderators, Age and Perceived COVID-19 risk. This is termed a conditional indirect effect, or
300 moderated mediation (Hayes, 2013; Preacher, Rucker, & Hayes, 2007). As recommended by Preacher
301 et al. (2007), we estimated the conditional indirect effects using ordinary least squares regression, and
302 tested these effects with bootstrap confidence intervals, assessing whether the indirect effects differ
303 from zero for various values of the moderator. We used 5000 bootstrap estimates to generate 95%
304 bias-corrected confidence intervals for the conditional indirect effects observed. The conditional
305 indirect effects of Objective home crowding on Perceived stress were assessed for three different
306 levels of Age (16th, 50th and 86th percentiles³) and Perceived COVID-19 risk (16th, 50th and 86th
307 percentiles).

308

309 **4. Results**

310 Table 2 shows the descriptive statistics concerning the model measures and zero-order correlations
311 between variables, and Table 3 shows the results of the moderated mediation analysis.

312

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

313 Table 2. Means \pm standard deviations, skewness, kurtosis, and zero-order correlations (Pearson's
 314 *r*) for variables included in the model.

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

3153 Notes. * $p < .05$, ** $p < .01$, *** $p < .001$

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318 Perceived stress is negatively associated with Satisfaction with the space at home ($r = -.25, p < .001$)
 319 and Age ($r = -.38, p < .001$), and positively associated with Objective home crowding ($r = .14, p < .001$) and Perceived COVID-19 risk ($r = .12, p < .001$).

321 Central to the mediation hypothesis, the effect of Objective home crowding on Satisfaction with the
 322 space at home (H1) is significant ($B = -.7405, t = -10.5570, p < .001$), as is the effect of Satisfaction
 323 with the space at home on Perceived stress (H3) ($B = -.1917, t = -8.5399, p < .001$). On the other
 324 hand, there is no significant direct effect of Objective home crowding on Perceived stress (H2) ($B =$
 325 $-0.0570, t = -0.9546, p = .339$). These results confirm H4, showing an indirect effect of Objective
 3263 home crowding on Perceived stress through the mediation of Satisfaction with the space at home.

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328 Table 3. Moderated mediation analysis. Estimated coefficients, *t*-values and 95% confidence
 329 intervals (CI) for each effect, R^2 and ΔR^2 for mediator and dependent variable.

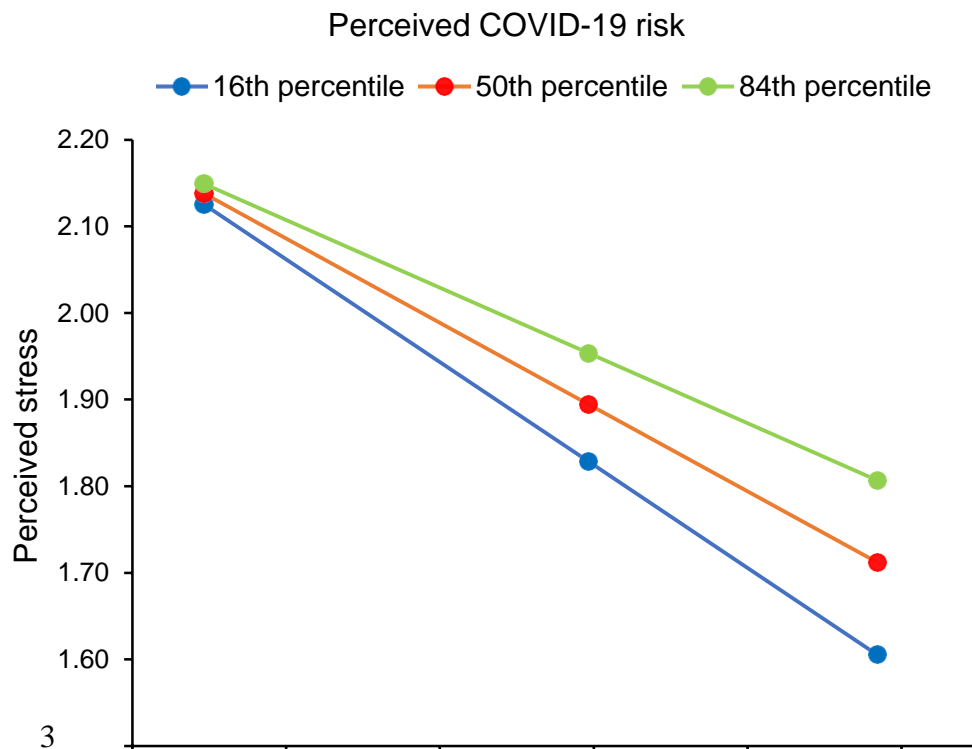
Mediator variable model			
Satisfaction with the space at home			
	<i>B</i>	<i>t</i>	<i>CI</i>
Objective home crowding	- 0.7405	-10.5570***	[-.8781, -.6029]
Age	0.011	8.1500***	[.0084, -.0138]
Objective home crowding*Age	0.0157	3.7202***	[.0074, .0239]
R^2		0.1441	
ΔR^2		.0081	
		[$\Delta F(1, 1349) = 13.5704, p < 0.001$]	
Dependent variable model			
Perceived stress			
	<i>B</i>	<i>t</i>	<i>CI</i>
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^2		.2560	
ΔR^2_1		.0027	
		Satisfaction with the space at home*Age [$\Delta F(1, 1346) = 5.2604, p < .05$]	
ΔR^2_2		.0025	
		Satisfaction with the space at home*Perceived Covid-19 risk [$\Delta F(1, 1346) = 5.0083, p < .05$]	

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332 Regarding the moderator Perceived COVID-19 risk, the effect of Satisfaction with the space at home
 333 on Perceived stress is significant for both high and low levels of Perceived COVID-19 risk. As
 334 concerns the direction of this moderating effect, the ‘Satisfaction with the space at home x Perceived
 335 COVID-19 risk’ interaction reveals a significant effect in the expected direction (H5) on Perceived
 336 stress ($B = 0.020$, $t = 2.24$, $p < .001$), since the moderated relationship is stronger the lower the
 337 Perceived COVID-19 risk (see Figure 2).



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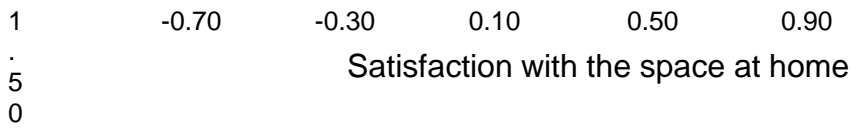
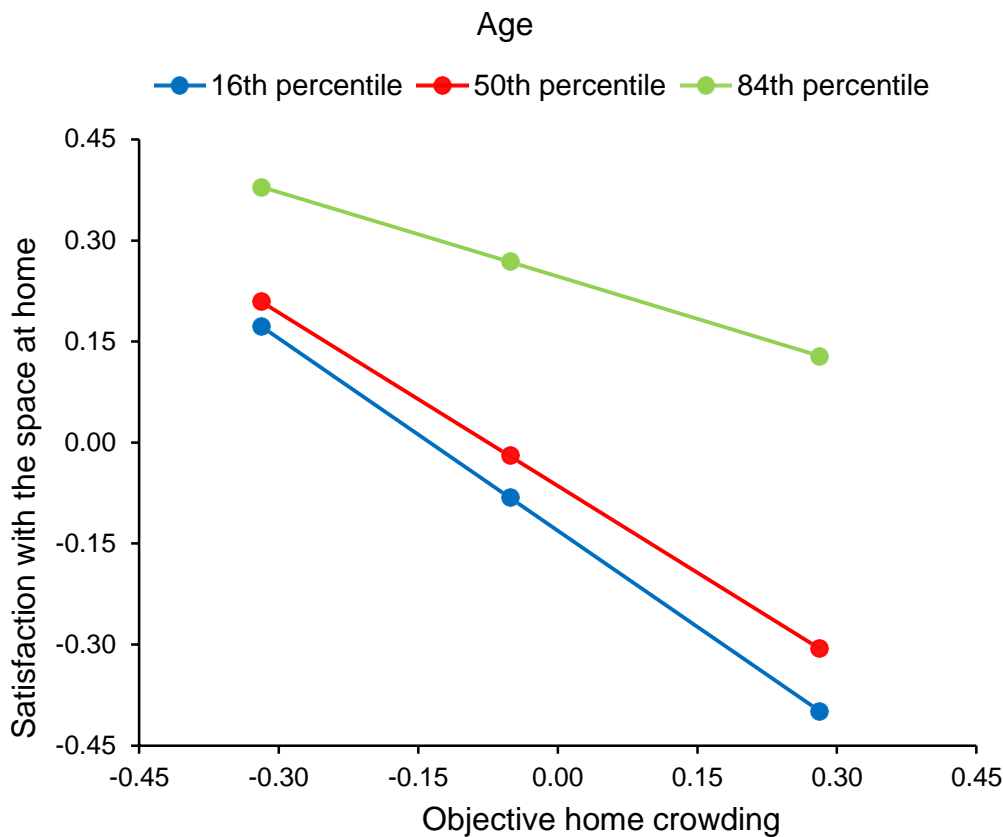


Figure 2. Conditional indirect effect of Satisfaction with the space at home on Perceived stress through the mediation of the Perceived COVID-19 risk estimates (16th, 50th and 84th percentiles). Ninety-five percent bootstrap confidence intervals for indirect effects involving those in the 16th, 50th and 84th percentiles of Perceived COVID-19 risk did not include 0, indicating meaningful indirect effects.

346 As concerns Age, the conditional effect of this moderator is verified in both stages of the model. In
 347 the first stage, the effect of Objective home crowding on Satisfaction with the space at home is
 348 significant for both younger and older respondents. Regarding the direction of this moderating effect,
 349 the ‘Objective home crowding × Age’ interaction has a significant effect in the expected direction

350 (H6) on Satisfaction with the space at home ($B = .0157, t = 3.72, p < .001$), as the moderated
 351 relationship is weaker for older respondents (see Figure 3).



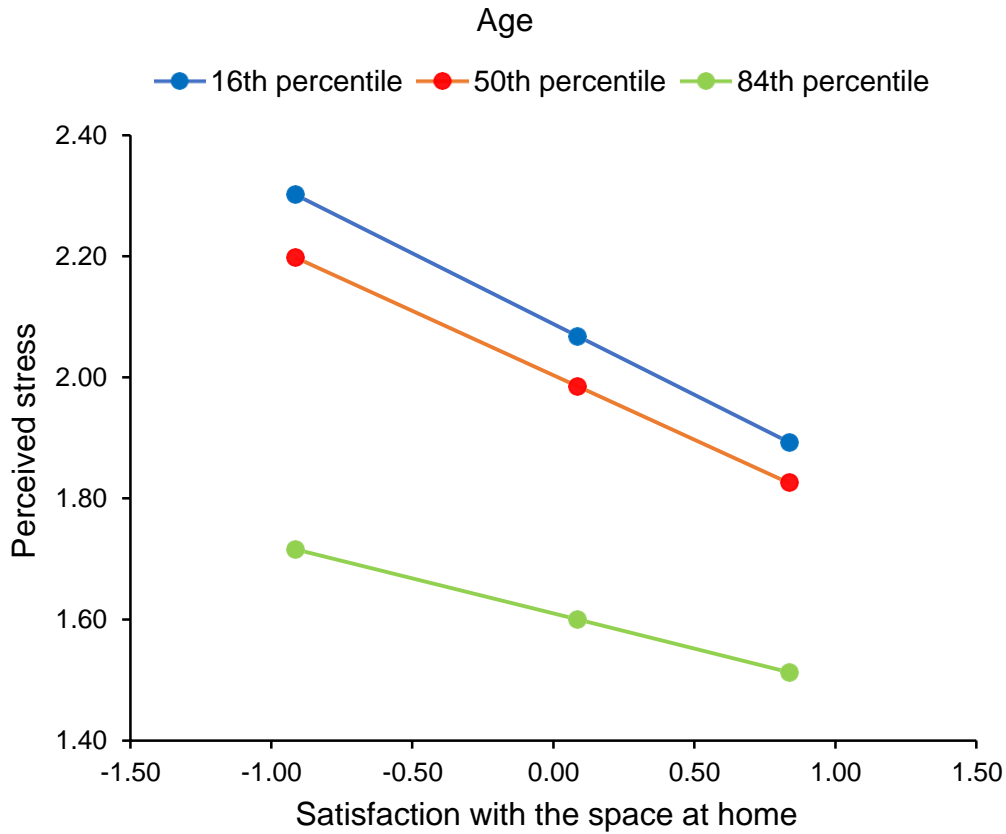
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 5 *Figure 3. Conditional indirect effect of Objective home crowding on Satisfaction with the space at*
 2 *home through the mediation of the Age estimates (16th, 50th, and 84th percentiles). Ninety-five percent*
 3533 *bootstrap confidence intervals for indirect effects involving those in the 16th, 50th and 84th percentiles*
 5 *of Age did not include 0, indicating meaningful indirect effects.*
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358 In the second stage of the model, the effect of Satisfaction with the space at home on Perceived stress
 359 is significant for both younger and older respondents. As for the direction of this moderating effect,
 360 the ‘Satisfaction with the space at home × Age’ interaction has a significant effect (H7) on Perceived

361 stress ($B = 0.0032$, $t = 2.29$, $p < .01$), and the moderated relationship is stronger for younger
3623 respondents (see Figure 4).
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 6 *Figure 4. Conditional indirect effect of Satisfaction with the space at home on Perceived stress*
 4 *through the mediation of the Age estimates (16th, 50th and 84th percentiles). Ninety-five percent*
 3653 *bootstrap confidence intervals for indirect effects involving those in the 16th, 50th and 84th percentiles*
 6 *of Age did not include 0, indicating meaningful indirect effects.*
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370 The conditional effects postulated (moderated mediation) were significant for both Perceived
 371 COVID-19 risk (B=-0.002, CI = -0.0037, -0.006) and Age (B=-0.002, CI = -0.0055, -0.006).
 372 Finally, when the covariate Gender was inserted in the model, there was no significant effect on the
 373 relationship between Objective home crowding and Satisfaction with the space at home (B = .0311,
 374 $t = .6733, p = .500$), whereas its effect on Perceived stress was significant (B = .339, $t = 8.97, p <$

3753 .001), with women feeling more stressed under lockdown than men.

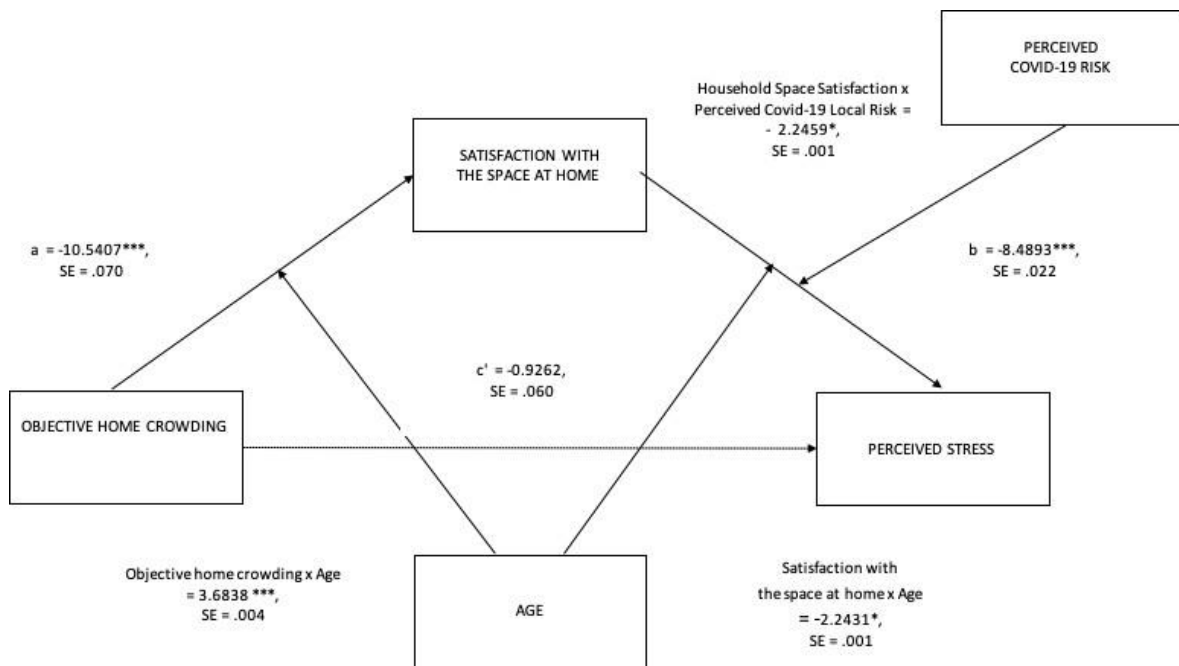
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7 Notes. *** $p < 0.001$, * $p < 0.05$; SE = standard error

3783 *Figure 5. Path model with parameter estimates for all variables.*

382 **5. Discussion**

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

389 As concerns H1, we confirmed that Satisfaction with the space at home increases when Objective
390 home crowding decreases, consistently with previous findings on the influence of “objective” home
391 crowding on the perception of living in crowded conditions (Evans et al., 2000) and on residential
392 satisfaction (Gomez-Jacinto & Hombrados-Mendieta, 2002). On the other hand, our model revealed

393 no direct influence of Objective home crowding on Perceived stress⁴ (H2), in contrast with much of
394 the literature on the relationship between crowding and stress (e.g., Baum et al., 1981; Evans &
395 Stecker, 2004; Veitch, 2012; Wener, 2012), in the home environment too (Evans et al., 1996, 2000).
396 Instead, a significant indirect link emerged between Objective home crowding and Perceived stress
397 through the mediation of Satisfaction with the space at home (H4). The more residents were satisfied
398 with the spatial dimensions of their home, the lower the levels of psychological distress they
399 experienced (H3). This would confirm reports on the effect of residential satisfaction on positive
400 global human psychological responses, such as overall life satisfaction and happiness (Peck & Kay
401 1985; Hu 2013; Kahlmeier, Schindler, Grize, & Braun-Fahrländer, 2001). Both the direct stress-
402 reducing effect of satisfaction with the space at home and its pivotal role in mediating between
403 crowding and stress take on a special meaning in a situation where people are obliged to stay at home.
404 People who feel that their living space suffices, and meets their need for privacy, are less likely to
405 experience a sense of helplessness, which is often closely related to psychological distress and a
406 perceived lack of control over the situation (Evans & Stecker, 2004; Gatersleben & Griffin, 2017).
407 As concerns the perceived COVID-19 risk, alongside its predictable significant association with the
408 level of stress (i.e., the higher the perceived risk, the greater the stress), this variable also emerged as
409 a moderator between Satisfaction with the space at home and Perceived stress. As expected (H5), the
410 strength of the association between these two variables is greater the lower the Perceived COVID-19
411 risk. In other words, appreciating the space available at home is much more important in containing
412 stress levels for people who are less concerned about the COVID-19 risk than for those more worried
413 about the pandemic.
414 As well as confirming that residential satisfaction increases with aging (Campbell, Converse, &
415 Rodgers, 1976; Lu, 1999; Mridha, 2020; Zhang et al. 2018), older people also seem to be less affected
416 by home crowding than younger people, as hypothesized in (H6). This is consistent with previous

⁴ It is worth mentioning that the zero-order bivariate correlation between Objective home crowding and Perceived stress is .14, so - although it is significant ($p < .01$) - it seems quite low because of the large sample size.

417 reports of older adults being more satisfied with their tiny homes than younger generations
418 (Boeckerman et al., 2019). In our study, older people also felt less stressed than younger people,
419 although it has been amply acknowledged that the harm caused by COVID-19 disease increases with
420 age (Calderón-Larrañaga, Dekhtyar, Vetrano, Bellander, & Fratiglioni, 2020). On the other hand, the
421 restrictions imposed to combat the pandemic are likely to have affected the younger generations more.
422 While older people already tended to organize their daily activities in and around their home
423 (Bonaiuto, Bonnes, & Continisio, 2004; Fornara & Manca, 2017), lockdown brought far more
424 dramatic changes for younger adults and children. This situation is also confirmed by the fact that
425 satisfaction with the space at home has a less important role in containing psychological distress for
426 the elderly than for the younger generations (H7).

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

434 Our findings support an indirect link between objective conditions of crowding at home and
435 psychological distress, mediated by (dis)satisfaction with the spatial dimensions of the home, but the
436 correlational and cross-sectional nature of our study prevents us from inferring any causal chain
437 connecting the variables considered. Future, preferably longitudinal studies should address this
438 limitation, to lend further strength to these findings. A further dimension that could be considered in
439 future research on this topic is the resident's Socio-Economic Status (SES), since it is supposed to
440 impact on objective home crowding, assuming that high SES people have averagely more home space
441 than low SES people, at least in urban contexts. Given that SES is a highly sensitive and confidential
442 piece of data (e.g., see Schwartz & Paulin, 2000; Andreenkova & Javeline, 2019), we decided to not

443 include this measure in our survey, also because we did not have a clear hypothesis on how SES
444 would have influenced our model's paths. In other words, we did not find grounds in literature about
445 variations of the association between objective and subjective crowding at home - or between the
4464 latter and stress - at different SES levels.

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448 **6. Conclusion**

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

454 The study outcomes point to the crucial importance of carefully assessing the influence of satisfaction
455 with the space at home on the association between objective home crowding and perceived stress.
456 Age reveals an important role in these relationships, with younger people's satisfaction with the space
457 at home being more affected by objective home crowding, and their consequent perceived stress is
458 more severe than in older people. The mitigating effect of satisfaction with the space at home on
459 perceived stress was also found weaker when the perceived COVID-19 risk was greater.

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

466 aspects with a view to designing adequate, flexible living spaces in the homes of today and tomorrow.
467 In conclusion, it is to mention that the same notion of pandemic has been questioned, and a syndemic
468 approach was recently proposed (Horton, 2020), in order to demonstrate how an integrated

469 perspective to understanding and coping with diseases can be far more successful than simply
470 controlling epidemics or treating individual patients. Such an approach advocates the inclusion of the
471 economic, social, and environmental factors that could amplify (or buffer) the effect of diseases
472 (Singer, Bulled, Ostrach, & Mendenhall, 2017), as in the case of the COVID-19 pandemic. Given
473 that poor-quality housing is associated with various negative health outcomes, including chronic
474 diseases (Hu, Roberts, Azevedo, & Milner, 2021), it is essential that policy makers and other public
475 health stakeholders take into account the pivotal role of house conditions for individual's wellbeing,
476 considering that, even when hopefully the pandemic will be over, many people will continue to work
4774 from home, either entirely or partially (Guyot & Sawhill, 2020).

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480 Declarations of interest

4814 None.

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483 Data availability

4844 The data examined in this study will be made available upon reasonable request.

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488 **References**

- 489 Ahn, M., & Hedge, A.L. (2011). Perceived aspects of home environment and home modifications by
490 older people living in rural areas. *Journal of Housing for the Elderly*, 25(1), 18-30.
- 491 Ahuja, P., Syal, G., & Kaur, A. Psychological stress: Repercussions of COVID- 19 on gender.
492 *Journal of Public Affairs*, e2533. <https://doi.org/10.1002/pa.2533>
- 493 Aigbavboa, C., & Thwala, W. (2016). A notional appraisal of the bases of housing satisfaction.
494 *International Journal for Housing Science*, 20(2), 133-145.
- 495 Aiken, L. S., West, S. G., & Reno, R. R. (1991). *Multiple Regression: Testing and Interpreting*
496 *Interactions*. Sage Publications.
- 497 Amerio, A., Brambilla, A., Morganti, A., Aguglia, A., Bianchi, D., Santi, F., ... & Capolongo, S.
498 (2020). Covid-19 lockdown: Housing built environment's effects on mental health. *International*
499 *Journal of Environmental Research and Public Health*, 17(16), 5973.
- 500 Andrade, C., Lima, M. L., Fornara, F., & Bonaiuto, M. (2012). Users' views of hospital
501 environmental quality: Validation of the perceived hospital environment quality indicators
502 (PHEQIs). *Journal of Environmental Psychology*, 32(2), 97-111.
- 503 Andrade, C.C., Lima, L., Pereira, C.R., Fornara F., & Bonaiuto, M. (2013). Inpatients' and
504 Outpatients' satisfaction: The mediating role of perceived quality of physical and social
505 environment. *Health & Place*, 21, 122-132.
- 506 Andreenkova, A. V., & Javeline, D. (2019). Sensitive questions in comparative surveys. In T. P.
507 Johnson, B.-E. Pennell, I. A. L. Stoop, & B. Dorer (Eds.), *Advances in comparative survey*
508 *methods: Multinational, multiregional, and multicultural contexts (3MC)* (pp. 139–160). John
509 Wiley & Sons, Inc..
- 510 Anton, C. E., & Lawrence, C. (2014). Home is where the heart is: The effect of place of residence on
511 place attachment and community participation. *Journal of Environmental Psychology*, 40, 451-461.

512 Aragonés, J. I., Américo, M., & Pérez-López, R. (2017). Residential satisfaction and quality of life.
513 In *Handbook of Environmental Psychology and Quality of Life Research* (pp. 311-328). Springer,
514 Cham.

515 Baker, M. G., McDonald, A., Zhang, J., & Howden-Chapman, P. (2013). *Infectious diseases*
516 *attributable to household crowding in New Zealand: A systematic review and burden of disease*
517 *estimate* (Vol. 1, No. 1.26, p. 33). Wellington: He Kainga Oranga/Housing and Health Research.

518 Baum, A., Singer, J. E., & Baum, C. S. (1981). Stress and the environment. *Journal of Social Issues*,
519 37(1), 4-35.

520 Bell, P. A., Greene, T. C., Fisher, J. D., & Baum, A. (1996). *Environmental Psychology (4th ed.)*.
521 Harcourt.

522 Boeckermann, L. M., Kaczynski, A. T., & King, S. B. (2019). Dreaming big and living small:
523 examining motivations and satisfaction in tiny house living. *Journal of Housing and the Built*
524 *Environment*, 34(1), 61-71.

525 Bonaiuto, M., Fornara, F., Ariccio, S., Cancellieri, U. G., & Rahimi, L. (2015). Perceived residential
526 environment quality indicators (PREQIs) relevance for UN-HABITAT city prosperity index (CPI).
527 *Habitat International*, 45, 53-63.

528 Bonaiuto, M., & Alves, S. (2012). Residential places and neighborhoods: Toward healthy life, social
529 integration, and reputable residence. In S. D. Clayton (Ed.), *Oxford Library of Psychology. The*
530 *Oxford Handbook of Environmental and Conservation Psychology* (p. 221–247). Oxford University
531 Press.

532 Bonaiuto, M., Bonnes, M., & Continisio, M. (2004). Neighborhood evaluation within a multiplace
533 perspective on urban activities. *Environment and Behavior*, 36(1), 41-69.

534 Bonnes, M., Bonaiuto, M., & Ercolani, A. P. (1991). Crowding and residential satisfaction in the
535 urban environment: A contextual approach. *Environment and Behavior*, 23(5), 531-552.

536 Brown, G., & Kyttä, M. (2014). Key issues and research priorities for public participation GIS
537 (PPGIS): A synthesis based on empirical research. *Applied Geography*, 46, 122-136.

538 Calderón-Larrañaga, A., Dekhtyar, S., Vetrano, D. L., Bellander, T., & Fratiglioni, L. (2020).
539 COVID-19: Risk accumulation among biologically and socially vulnerable older populations. *Ageing*
540 *Research Reviews*, 101149.

541 Campbell, A., Converse, P. E., & Rodgers, W. L. (1976). *The Quality of American Life: Perceptions,*
542 *Evaluations, and Satisfactions*. Russell Sage Foundation.

543 Campagna, G. (2016). Linking crowding, housing inadequacy, and perceived housing stress. *Journal*
544 *of Environmental Psychology*, 45, 252-266.

545 Casakin, H., Hernández, B., & Ruiz, C. (2015). Place attachment and place identity in Israeli cities:
546 The influence of city size. *Cities*, 42, 224-230.

547 Cavazza, N., Russo, S., Colloca, P. Roccato, M. (2021). Household crowding can have political
548 effects: An empirical study on support for anti-democratic political systems during the COVID-19
549 lockdown in Italy. *Journal of Environmental Psychology*, 76, 101628.

550 Cerina, V., Fornara, F., & Manca, S. (2017). Architectural style and green spaces predict older adults'
551 evaluations of residential facilities. *European Journal of Ageing*, 14(3), 207-217.

552 Cheshmehzangi, A. (2020). Housing and health evaluation related to general comfort and indoor
553 thermal comfort satisfaction during the COVID-19 lockdown. *Journal of Human Behavior in the*
554 *Social Environment*, 1-26.

555 Cohen, S., Kamarck, T., & Mermelstein, R. (1983). A global measure of perceived stress. *Journal of*
556 *Health and Social Behavior*, 385-396.715 39.

557 Cohen, S. (1988). Perceived stress in a probability sample of the United States. In S. Spacapan & S.
558 Oskamp (Eds.), *The Claremont Symposium on Applied Social Psychology. The Social Psychology of*
559 *Health* (p. 31–67). Sage Publications.

560 Daniela, D. A., Gola, M., Letizia, A., Marco, D., Fara, G. M., Rebecchi, A., ... & Capolongo, S.
561 (2020). COVID-19 and living spaces challenge. Well-being and public health recommendations for
562 a healthy, safe, and sustainable housing. *Acta Biomedica*, 91(9).

563 Devine-Wright, P., de Carvalho, L. P., Di Masso, A., Lewicka, M., Manzo, L., & Williams, D. R.
564 (2020). "Re-placed" - Reconsidering relationships with place and lessons from a pandemic. *Journal*
565 *of Environmental Psychology*, 72, 101514.

566 Dietz, L., Horve, P.F., Coil, D.A., Fretz, M., Eisen, J.A., & Van Den Wymelenberg, K. (2020). 2019
567 novel coronavirus (COVID-19) pandemic: built environment considerations to reduce transmission.
568 *mSystems*, 5, e00245-20.

569 Elsbach, K. D., & Pratt, M. G. (2007). The physical environment in organizations. *Academy of*
570 *Management Annals*, 1(1), 181-224.

571 Elsinga, M., & Hoekstra, J. (2005). Home ownership and housing satisfaction. *Journal of Housing*
572 *and the Built Environment*, 20(4), 401-424.

573 Evans, G. W., & Stecker, R. (2004). Motivational consequences of environmental stress. *Journal of*
574 *Environmental Psychology*, 24(2), 143-165.

575 Evans, G. W. (2003). The built environment and mental health. *Journal of Urban Health*, 80(4), 536-
576 555.

577 Evans, G. W., Lepore, S. J., & Allen, K. M. (2000). Cross-cultural differences in tolerance for
578 crowding: fact or fiction? *Journal of Personality and Social Psychology*, 79(2), 204.

579 Evans, G. W., Lepore, S. J., & Schroeder, A. (1996). The role of interior design elements in human
580 responses to crowding. *Journal of Personality and Social Psychology*, 70(1), 41.

581 Eyles, J., & Williams, A. (Eds.). (2008). *Sense of Place, Health and Quality of Life*. Ashgate
582 Publishing, Ltd.

583 Faul, F., Erdfelder, E., Buchner, A., & Lang, A. G. (2009). Statistical power analyses using G* Power
584 3.1: Tests for correlation and regression analyses. *Behavior Research Methods*, 41(4), 1149-1160.

585 Fleury-Bahi, G., Félonneau, M. L., & Marchand, D. (2008). Processes of place identification and
586 residential satisfaction. *Environment and Behavior*, 40(5), 669-682.

587 Fornara, F. (2005). Users' Evaluative Responses to Spatio-Physical Humanization: The Case of Hospital
588 Environments. In B. Martens, A. G. Keul (Eds.), *Designing Social Innovation: Planning, Building, Evaluating*
589 (pp. 231-240). Gottingen (Germany): Hogrefe & Huber.

590 Fornara, F., & Andrade, C. (2012). Healthcare environments. In S. Clayton (Ed.), *The Oxford Handbook of*
591 *Environmental and Conservation Psychology* (pp.295-315). New York: Oxford University Press.

592 Fornara, F., Lai, A. E., Bonaiuto, M., & Pazzaglia, F. (2019). Residential place attachment as an
593 adaptive strategy for coping with the reduction of spatial abilities in old age. *Frontiers in Psychology*,
594 *10*, 856.

595 Fornara, F., & Manca, S. (2017). Healthy residential environments for the elderly. In *Handbook of*
596 *Environmental Psychology and Quality of Life Research* (pp. 441-465). Springer, Cham.

597 Gatersleben, B., & Griffin, I. (2017). Environmental stress. In *Handbook of Environmental*
598 *Psychology and Quality of Life Research* (pp. 469-485). Springer, Cham.

599 Gifford, R. (2002). *Environmental psychology: Principles and practice*. Boston: Allyn & Bacon.

600 Gomez-Jacinto, L., & Hombrados-Mendieta, I. (2002). Multiple effects of community and household
601 crowding. *Journal of Environmental Psychology*, *22*(3), 233-246.

602 Graham, L. T., Gosling, S. D., & Travis, C. K. (2015). The psychology of home environments: A call
603 for research on residential space. *Perspectives on Psychological Science*, *10*(3), 346–356.

604 Guyot, K., & Sawhill, I. V. (2020). Telecommuting will likely continue long after the pandemic.
605 [online] Available at: [https://www.brookings.edu/blog/up-front/2020/04/06/telecommuting-will-](https://www.brookings.edu/blog/up-front/2020/04/06/telecommuting-will-likely-continue-long-after-the-pandemic)
606 [likely-continue-long-after-the-pandemic](https://www.brookings.edu/blog/up-front/2020/04/06/telecommuting-will-likely-continue-long-after-the-pandemic) [Accessed 1st December 2021].

607 Hayes, A. F. (2017). *Introduction to Mediation, Moderation, and Conditional Process Analysis: A*
608 *regression-based approach*. Guilford publications.

609 Hernández, B., Hidalgo, M. C., Salazar-Laplace, M. E., & Hess, S. (2007). Place attachment and
610 place identity in natives and non-natives. *Journal of Environmental Psychology*, *27*(4), 310-319.

611 Horton, R. (2020). Offline: COVID-19 is not a pandemic. *The Lancet*, *396*(10255), 874.

612 Hu, F. (2013). Home ownership and subjective wellbeing in urban China: Does owning a house make
613 you happier? *Social Indicators Research*, *110*(3), 951-971.

614 Hu, M., Roberts, J. D., Azevedo, G. P., & Milner, D. (2021). The role of built and social
615 environmental factors in Covid-19 transmission: A look at America's capital city. *Sustainable Cities
616 and Society*, *65*, 102580.

617 Huang, Z., Du, X., & Yu, X. (2015). Home ownership and residential satisfaction: Evidence from
618 Hangzhou, China. *Habitat International*, *49*, 74-83

619 Ibem, E. O., & Aduwo, E. B. (2013). Assessment of residential satisfaction in public housing in Ogun
620 State, Nigeria. *Habitat International*, *40*, 163-175.

621 Kahlmeier, S., Schindler, C., Grize, L., & Braun-Fahrlander, C. (2001). Perceived environmental
622 housing quality and wellbeing of movers. *Journal of Epidemiology & Community Health*, *55*(10),
623 708-715.

624 Korpela, K. M. (2012). Place attachment. In S. D. Clayton (Ed.), *The Oxford Handbook of
625 Environmental and Conservation Psychology* (pp. 148-163). Oxford University Press.

626 Leiringer, R., & Cardellino, P. (2011). Schools for the twenty-first century: School design and
627 educational transformation. *British Educational Research Journal*, *37*(6), 915-934.

628 Levy-Leboyer, C., & Ratiu, E. (1993). The need for space and residential satisfaction. *Architecture
629 & Comportement/Architecture & Behaviour*, *9*(4), 475-490.

630 Lewicka, M. (2010). What makes neighborhood different from home and city? Effects of place scale
631 on place attachment. *Journal of Environmental Psychology*, *30*(1), 35-51.

632 Lu, M. (1999). Determinants of residential satisfaction: Ordered logit vs. regression models. *Growth
633 and Change*, *30*(2), 264-287.

634 MacKinnon, D. P., Lockwood, C. M., Hoffman, J. M., West, S. G., & Sheets, V. (2002). A
635 comparison of methods to test mediation and other intervening variable effects. *Psychological
636 Methods*, *7*(1), 83.

637 Marans, R. W. (2003). Understanding environmental quality through quality of life studies: The 2001
638 DAS and its use of subjective and objective indicators. *Landscape and Urban Planning*, 65(1-2), 73-
639 83.

640 Mazza, C., Ricci, E., Biondi, S., Colasanti, M., Ferracuti, S., Napoli, C., & Roma, P. (2020). A
641 nationwide survey of psychological distress among Italian people during the COVID-19 pandemic:
642 Immediate psychological responses and associated factors. *International Journal of Environmental
643 Research and Public Health*, 17(9), 3165.

644 Mazza, C., Colasanti, M., Ricci, E., Di Giandomenico, S., Marchetti, D., et al. (2021). The COVID-
645 19 outbreak and psychological distress in healthcare workers: The role of personality traits,
646 attachment styles, and sociodemographic factors. *Sustainability*, 13(9), 4992.

647 Mridha, M. (2020). The effect of age, gender and marital status on residential satisfaction. *Local
648 Environment*, 25(8), 540-558.

649 Pasca, L., Aragonés, J. I., & Poggio, L. (2016). Dimensions that explain attachment to the
650 home/Dimensiones que explican el apego a la vivienda. *Psychology*, 7(2), 113-129.

651 Peck, C., & Kay Stewart, K. (1985). Satisfaction with housing and quality of life. *Home Economics
652 Research Journal*, 13(4), 363-372.

653 Preacher, K. J., Rucker, D. D., & Hayes, A. F. (2007). Addressing moderated mediation hypotheses:
654 Theory, methods, and prescriptions. *Multivariate Behavioral Research*, 42(1), 185-227.

655 Prime, H., Wade, M., & Browne, D. T. (2020). Risk and resilience in family well-being during the
656 COVID-19 pandemic. *American Psychologist*, 75(5), 631-643.

657 Qiu, J., Shen, B., Zhao, M., Wang, Z., Xie, B., & Xu, Y. (2020). A nationwide survey of psychological
658 distress among Chinese people in the COVID-19 epidemic: Implications and policy
659 recommendations. *General Psychiatry*, 33(2).

660 Rodgers, W. L. (1982). Density, crowding, and satisfaction with the residential environment. *Social
661 Indicators Research*, 10(1), 75-102.

662 Rogers, D., & Power, E. (2020). Housing policy and the COVID-19 pandemic: The importance of
663 housing research during this health emergency. *International Journal of Housing Policy*, 20(2), 177-
664 183.

665 Rubinstein, R. I., & Parmelee, P. A. (1992). Attachment to place and the representation of the life
666 course by the elderly. In I. Altman & S.M. Low (Eds.), *Place Attachment* (pp. 139-163). Boston, MA:
667 Springer.

668 Salfi, F., Lauriola, M., Amicucci, G., Corigliano, D., Viselli, L., Tempesta, D., & Ferrara, M. (2020).
669 Gender-related time course of sleep disturbances and psychological symptoms during the COVID-19
670 lockdown: A longitudinal study on the Italian population. *Neurobiology of Stress*, 13, 100259.

671 Savić, D. (2020). COVID-19 and work from home: Digital transformation of the workforce. *Grey*
672 *Journal (TGJ)*, 16(2), 101-104.

673 Schwartz, L. K., & Paulin, G. D. (2000). Improving response rates to income questions. *American*
674 *Statistical Association (ASA), Section on Survey Research Methods, Proceedings*, 965-970.

675 Singer, M., Bulled, N., Ostrach, B., & Mendenhall, E. (2017). Syndemics and the biosocial
676 conception of health. *The Lancet*, 389(10072), 941-950.

677 Song, K., Li, T., Luo, D., Hou, F., Bi, F., Stratton, T. D., ... & Jiang, Y. (2020). Psychological stress
678 and gender differences during COVID-19 pandemic in Chinese population. *MedRxiv*.

679 Thornock, C. M., Nelson, L. J., Porter, C. L., & Evans-Stout, C. A. (2019). There's no place like
680 home: The associations between residential attributes and family functioning. *Journal of*
681 *Environmental Psychology*, 64, 39-47.

682 Torshizian, E., & Grimes, A. (2020). Household crowding measures: A comparison and external test
683 of validity. *Journal of Happiness Studies*, 1-27.

684 Veitch, J. A. (2012). Work environments. In S. D. Clayton (Ed.), *The Oxford Handbook of*
685 *Environmental and Conservation Psychology* (p. 248–275). Oxford University Press.

686 Vera-Toscano, E., & Ateca-Amestoy, V. (2008). The relevance of social interactions on housing
687 satisfaction. *Social Indicators Research*, 86(2), 257-274.

- 688 Wang, C., Pan, R., Wan, X., Tan, Y., Xu, L., Ho, C. S., & Ho, R. C. (2020). Immediate psychological
689 responses and associated factors during the initial stage of the 2019 coronavirus disease (COVID-19)
690 epidemic among the general population in China. *International Journal of Environmental Research
691 and Public Health*, 17(5), 1729.
- 692 Weidemann, S., & Anderson, J. R. (1985). A conceptual framework for residential satisfaction. In
693 *Home Environments* (pp. 153-182). Springer, Boston, MA.
- 694 Wener, R. (2012). *The Environmental Psychology of Prisons and Jails: Creating humane spaces in
695 secure settings*. Cambridge University Press.
- 696 Wenham, C., Smith, J., & Morgan, R. (2020). COVID-19: The gendered impacts of the outbreak. *The
697 Lancet*, 395(10227), 846-848.
- 698 Zhang, F., Zhang, C., & Hudson, J. (2018). Housing conditions and life satisfaction in urban China.
699 *Cities*, 81, 35-44.

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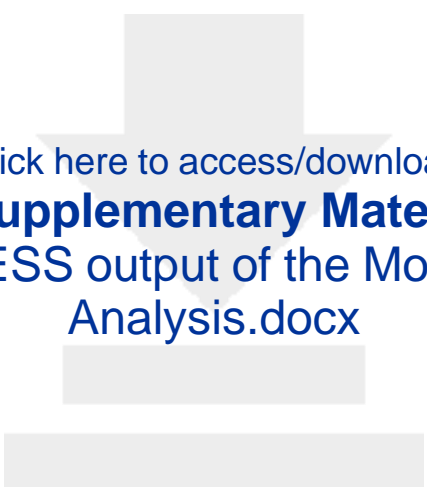
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Supplementary Material

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