Introduction

During the coronavirus-19 (COVID-19) pandemic, the World Health Organization provided official guidelines for limiting the spread of contagion, encompassing individual, and environmental measures (i.e. hygiene practices; social distancing; limiting crowds of people) (WHO, 2021). These guidelines were conceived as an essential complement of pharmacological measures related to treatments and vaccinations (WHO, 2021) and they effectively reduced mortality and slowed the rate of infection in the last 2 years, preventing hospitals’ overcrowding (Bo et al., 2021). Together with the progressive spread of vaccinations, and until vaccinations will be widely available and complied in all countries, the WHO guidelines continue to have a crucial role in contrasting the pandemic.

Keywords
COVID-19 prevention behaviors, health locus of control, fear, young adults
According to international research (Graupensperger et al., 2021; Luo et al., 2021), young adults show less compliance with COVID-19 preventive behaviors in comparison to older adults, a trend that has been confirmed also in Italy (Barari et al., 2020). For example, 92.5% of young adults violated lockdown restrictions (Broodryk and Robinson, 2021). Youths are less likely to suffer negative medical consequences of contagion, and perceive a low personal risk (Franzen and Wöhner, 2021). Thus, at individual level, the adoption of protective measures can be considered a limitation with more costs than benefits. However, at community level, the efficacy of COVID-19 guidelines is widely dependent by the compliance of young adults, since they have the highest probability to get infected and infect others (Abbası, 2020), often being silent spreaders of the virus (Poletti et al., 2020). According to U.S. estimates, in 2020 young adults represented 23% of contagions, but only 1% of deaths (Centers for Disease Control and Prevention [CDC], 2020). Therefore, understanding psychological determinants of young adults’ compliance with COVID-19 preventive behaviors is of primary importance, constituting an emerging research topic (e.g. Christner et al., 2020).

The protection motivation theory (PMT; Rogers, 1975) states that health behaviors are motivated by cognitions about behaviors (beliefs on costs and benefits) and by appraisals on perceived risk (concerns for severity and vulnerability). In line with this paradigm, compliance with COVID-19 preventive behaviors in young people has been studied observing its cognitive (e.g. perceived behavioral efficacy; Zhang and Kou, 2021) and affective correlates (e.g. health-related anxiety and fear; Breakwell et al., 2021). In the present study, we will refer to health locus of control (Steptoe and Wardle, 2001; Wallston, 2005; Wallston et al., 1978) as a possible cognitive predictor of preventive behaviors. This construct indeed predicts compliance with prevention and treatment in different diseases (e.g. Amit Aharon et al., 2018), and there is some initial evidence supporting its adequacy for COVID-19 behaviors (Berg and Lin, 2020).

On the other hand, as emotional predictor of preventive behaviors, we will investigate the role of pandemic fear. In the Rogers’ PMT (1975), fear plays a key role in health-related behaviors. Accordingly, health psychology studies suggest that affective and cognitive components interact in driving health behaviors (review by Ferrer and Klein, 2015), with emotional variables being determinant for action (Hay et al., 2006). In pandemic research, different negative emotions have been investigated, such as anxiety and fear (e.g. Breakwell et al., 2021). However, the interaction effects of cognitive and emotional factors are still relatively understudied, despite some first evidence supporting this hypothesis (Kowalski and Black, 2021). Therefore, the present study aims to investigate the predictors of COVID-19 preventive behaviors in Italian young adults, testing a model of interaction between cognitive (i.e. health locus of control) and emotional variables (i.e. pandemic-related fears). This research has been conducted in Italy from December 2020 to April 2021, when vaccinations were not yet available for Italian young adults and preventive behaviors were the main defense against contagion.

**COVID-19 preventive behaviors in young adults**

Pandemic-related preventive behaviors are those behaviors meeting the public health rules established to stop the spread of contagion (Usher et al., 2020). Reviews of pandemic studies (Bish and Michie, 2010; Usher et al., 2020) distinguished preventive behaviors in hygiene practices and social distancing measures. Hygiene practices include: wearing face masks (reported by 85% of population in different pandemics, Kwok et al., 2020; Yeung et al., 2017), frequently washing hands (from 46% to 89%, Cowling et al., 2010; Kwok et al., 2020), maintaining good indoor ventilation and households disinfection (about 8%, Cowling et al., 2010), and visiting a doctor in presence of flu symptoms (more than 85%, Yeung et al., 2017).
Social distancing includes: avoiding crowded places; avoiding public transports; canceling or postponing travels; isolation and quarantine (Cowling et al., 2010; Kwok et al., 2020; Yeung et al., 2017). Social distancing measures reached rates between 39% and 92% during COVID-19 pandemic (Kwok et al., 2020).

Despite their relatively high prevalence (Berg and Lin, 2020), COVID-19 preventive behaviors were significantly less frequent among young adults in different countries (Graupensperger et al., 2021; Luo et al., 2021), including Italy (Barari et al., 2020). Pandemic research has found recurrent individual differences in young adults, with gender (i.e. women reporting more compliance than men), higher education, and better mental health predicting more adherence to COVID-19 preventive measures (Franzen and Wöhner, 2021; Imtiaz et al., 2021). Beyond individual differences, several psychological variables are associated with COVID-19 preventive behaviors in young adults, including perceived risk for oneself, for loved ones, and for society (Banker and Park, 2020; Jordan et al., 2021); perceived severity of the disease and its consequences (Berg and Lin, 2020; Imbriano et al., 2021); knowledge and information on pandemic (Rayani et al., 2021); subjective evaluation of peer group norms (Graupensperger et al., 2021). Among various models proposed in literature, an interesting line of research shed light on the role of perceived efficacy of health behaviors, suggesting that COVID-19 preventive behaviors might depend on individuals’ beliefs on determinants of health (Zhang and Kou, 2021). First findings in this direction (Berg and Lin, 2020; Zhang and Kou, 2021) indicated that individuals’ beliefs on health may significantly influence COVID-19 preventive behaviors, suggesting the need for a more in-depth investigation.

**The role of health locus of control styles**

The multidimensional health locus of control model (MHLOC; Wallston, 2005; Wallston et al., 1978) described individuals’ beliefs of control over their health, distinguishing internal health locus of control (i.e. believing that health is mainly a consequence of own behavior; IHLC) and external attribution styles (i.e. beliefs regarding external factors influencing individuals’ health). This perceived external control is divided in different dimensions, according to the specific factors supposed to influence health, such as chance, luck, or destiny (chance locus of control; CHLC), or health professionals and other people empowered on health (powerful others health locus of control, PHLC). In this model, people perceiving an internal control are assumed to enact more healthy and to limit risky behaviors, resulting in more positive health outcomes (Wallston et al., 1978).

The role of health locus of control in health behaviors has been broadly studied in research (review by Cheng et al., 2016). Consistently across different studies, IHLC predicted more frequent health-promoting behaviors and reduced risk-taking, while CHLC predicted less health-promoting behaviors and more health-risks (review by Cheng et al., 2016; Mercer et al., 2018). Evidence regarding PHLC is less clear, showing positive associations with only few health behaviors (Cheng et al., 2016). Steptoe and Wardle (2001) suggested that this dimension may exclusively predict behaviors clearly supported by health professionals (e.g. adherence to medical care; review by Náfrádi et al., 2017).

However, Wallston et al. (1978) indicated that the route from health beliefs to health behaviors is influenced by different interacting factors, that should be studied and interpreted in the light of specific contexts. The COVID-19 pandemic may be considered an exceptional social context of study, although research on health beliefs associated with COVID-19 prevention is still in its infancy. There is some evidence for the positive role of internality and powerful others dimensions in fostering compliance with COVID-19 prevention in the general population (Berg and Lin, 2020; Itani and Hollebeek, 2021; Tagini et al., 2021), suggesting a promising research direction. Notwithstanding, no studies so far have focused on the
role of health beliefs in young adults’ COVID-19 prevention behaviors, despite the important role of youths in the spread of contagion.

**The role of pandemic-related fear**

Fear is an innate emotional response to a perceived threat, which results in physical, behavioral (e.g. flight), and cognitive (e.g. worry) activation (Adolphs, 2013). COVID-19 pandemic is a relevant source of fear, threatening physical and mental health, and impacting different areas of life. The wide prevalence of COVID-19 fear is reported in different international and Italian studies, reaching rates of 78% in personal fear and of 63% in fear for others (e.g. Sloan et al., 2021; Zammitti et al., 2021). COVID-19 fear has shown to be very heterogeneous (review by Mertens et al., 2021): The main concerns regard one’s own and others’ health (e.g. Christner et al., 2020; Schimmenti et al., 2020), but many other fears also emerged, among which the most recurrent are fears of financial losses, work failures, and resource scarcity (e.g. Mertens et al., 2020; Taylor et al., 2021). Moreover, while being mostly an adaptive response, fear may also have dysfunctional forms, with abnormal, chronic, or uncontrollable reactions, leading to clinical phobia and anxiety disorders (Brown and Lees-Haley, 1992). Accordingly, also COVID-19 fear has shown adaptive and maladaptive facets, with positive (e.g. flourishing) and negative (e.g. anxiety and depression) consequences on psychological wellbeing (Solymosi et al., 2021; Zammitti et al., 2021).

In the PMT (Rogers, 1975), fear is the emotional outcome of perceived risk and vulnerability, which motivates health behaviors, therefore it may be important to understand its role in COVID-19 preventive behaviors. However, contrarily to the well-documented psychological outcomes (e.g. Fitzpatrick et al., 2020), there is still limited evidence for the behavioral outcomes of COVID-19 fear. It is confirmed that pandemic fear may lead to maladaptive behaviors, such as avoiding access to health services (Karacin et al., 2020), while there are contrasting findings for preventive behaviors, with some studies reporting fear associated with more compliance to prevention guidelines (Breakwell et al., 2021; Harper et al., 2021), and other studies disconfirming this association (Christner et al., 2020; Solymosi et al., 2021). In this regard, we should note that most international studies assessed pandemic fear with the Fear for Covid-19 scale (FCV-19S, Ahorsu et al., 2020; review by Muller et al., 2021), an instrument which investigates general symptoms of fear, but neglects its specific contents. As noted by Mertens et al. (2021), the very different areas of COVID-19 fear can be better studied using different measures. Therefore, the present study aims to assess the impact of COVID-19 fear on preventive behaviors in young adults, exploring not only general symptoms of fear, but also its most common contents as emerged in recent research (Mertens et al., 2021).

**The current study**

This study aims to investigate the predictors of COVID-19 preventive behaviors in Italian young adults. Controlling for individual differences (i.e. biological sex and age), we explored the roles of cognitive (i.e. health locus of control styles) and emotional variables (i.e. pandemic related fears), as suggested by health psychology studies (Ferrer and Klein, 2015). Since recent research has shed light on different components in pandemic fear (Mertens et al., 2021), we assessed both general fear of contagion (using the FCV-19S, Ahorsu et al., 2020), and various contents of pandemic fear (hereafter named COVID-19 fears). Moreover, in accordance with Ferrer and Klein (2015), we also investigated the presence of interaction effects between cognitive and emotional variables, hypothesizing that only specific profiles of health locus of control and fears would predict preventive behaviors. Specifically, we aim to verify the following hypotheses:

H1. According to previous research on health locus of control (Cheng et al., 2016; Náfrádi et al., 2017), we expect IHLC and PHLC
being positive predictors of COVID-19 prevention behaviors, whilst CHLC is supposed to be a negative predictor.

H2. In line with health psychology studies (Ferrer and Klein, 2015), we hypothesize that the relationship between each health locus of control style and preventive behaviors would be moderated by pandemic fear, which is expected to be a protective factor promoting positive health behaviors (Rogers, 1975). Therefore, in presence of high pandemic fear, the positive effects of IHLC and PHLC on prevention behaviors should be enhanced, while the negative effects of CHLC should be reduced.

Method

Participants and procedure
Data for the present study were gathered from December 2020 to April 2021, when Italy was facing the second and third waves of COVID-19 pandemic. The inclusion criteria of this research were the age range (19–26) and being currently living in Italy. Participants were contacted online with a snowball sampling method, sharing the link of the survey through the University website. Preliminary, they accepted an informed consent ensuring the complete anonymity and voluntariness of their participation. The completion of questionnaires was 15 minutes long on average. Initially, 229 youths were invited to participate in the study, but only 188 accepted the informed consent, matched the inclusion criteria for the study, and correctly completed all questionnaires, resulting in a response rate of 82.1%. Thus, the final sample was composed by 188 young adults aged 19–26 years old (M_age = 22.76, SD_age = 1.95; 85.6% girls). Most of participants (78.7%) lived in central Italy, while 17.6% were from the South, and 3.7% from the North. Regarding their education level, 39.9% completed the secondary school, 54.3% had a bachelor degree, and 5.9% had a master’s degree. An a-priori power analyses was conducted using the software G*Power version 3.1. Setting the power at the conventional level of 80% and alpha significance at 0.05 (Cohen, 1988), the power analysis indicated a required minimum sample size of 64 to detect small effects (Cohen’s d = 0.20). This research and its procedure were approved by the ethic committee of the Department of Developmental and Social Psychology, Sapienza University of Rome.

Measures

Individual information. Participants reported their biological sex (0 = woman, 1 = man), age, living area (northern, central or southern Italy) and education level.

COVID-19 Prevention behaviors. Ten items were adapted from the official guidelines recommended by Italian Ministry of Health to avoid the risk of COVID-19 contagion (Italian Ministry of Health, 2020), as follows: (1) wearing the antivirus mask indoors; (2) wearing the antivirus mask outdoor if interpersonal distance from non-cohabiting people cannot be guaranteed; (3) maintaining an interpersonal safety distance of at least 1 m; (4) washing or sanitizing your hands often; (5) avoiding crowded places and indoor places with poor ventilation; (6) avoiding unnecessary physical contact (e.g. hugs and handshakes); (7) sneezing and coughing into a handkerchief; (8) avoiding to touch your eyes, nose or mouth with your hands; (9) do not take antiviral drugs unless prescribed by your doctor; (10) staying home and contacting a doctor in case of fever, cough, or other symptoms related to COVID-19. During fall and winter 2020, the Italian population was made aware of these health recommendations, with some of them being mandatory in public places. Therefore, following a focus group with expert researchers in developmental psychology, we decided to use the sum of these items to assess the adherence of young adults to official prevention behaviors ("Please, report how often you adopt the following behaviors to prevent COVID-19 contagion"). Participants answered on a 5 point Likert-type scale, from 1 (never or
almost never) to 5 (always or almost always). The principal components analysis (PCA) detected one main factor with eigenvalue >1 (eigenvalue = 4), which explained the 43.04% of variance, suggesting the presence of one-factor structure for this measure (Gorsuch, 1983). A confirmatory factor analysis (CFA) was then run using the LISREL software version 8.80, to test the adequacy of the one-factor model. The maximum-likelihood estimates were computed from the sample correlation matrix. The goodness of fit of the model was estimated by the relative Chi-square test statistic ($\chi^2$/df), whose acceptable values range between 1 and 3 (Carmines and McIver, 1983); by the comparative fit index (CFI), the normative fit index (NFI) and the nonnormative fit index (NNFI), whose values should be >0.95 in a good model fit (Hu and Bentler, 1999); and by the root mean square error of approximation (RMSEA), and the standardized root mean square residual (SRMR), whose values <0.08 are indicative of acceptable fit (Kaplan, 2000). The CFA confirmed the adequacy of the one-factor model: $\chi^2$(26) = 47.09, $p$ = 0.005; $\chi^2$/df = 1.84; CFI = 0.98; NFI = 0.96; NNFI = 0.97; RMSEA = 0.06; SRMR = 0.04. The instrument obtained good values of reliability (Cronbach’s alpha of 0.84), and internal consistency (average inter-item correlation of 0.36; Piedmont, 2014) in our sample.

Health locus of control. The Italian version of the Multidimensional Health Locus of Control Scale—Form A (MHLCS; Wallston et al., 1978; Italian validation of Gala et al., 1995) was used to assess three locus of control styles regarding own health: internal locus of control, describing a perceived control on own health which is considered depending on own behaviors (IHLC; six items, sample item: “if I take care of myself I can avoid disease”); chance locus of control, describing the beliefs that own health is determined by external uncontrollable factors, such as luck, fate and chance (CHLC; six items, sample item: “no matter what I do, if I have to get sick I’ll get sick”); powerful others locus of control, describing the beliefs that own health is under the external control of other people, such as doctors, nurses, family (PHLC; six items, sample item: “with respect to my health, I can only do what my doctor tells me to do”). Participants rated their answers on a 6 point scale from 1 (decidedly disagree) to 6 (decidedly agree). The three dimensions have shown good psychometric properties in previous studies (Wallston, 2005), which were confirmed in Italian samples (Gala et al., 1995). This instrument also obtained acceptable reliability scores in our study (Cronbach’s alpha of 0.70 for IHLC; 0.76 for CHLC; 0.68 for PHLC).

Fear of COVID-19 contagion. The Italian version of the Fear of Covid-19 Scale (FCV-19S; Ahorsu et al., 2020; Italian validation by Soraci et al., 2020) was administered to measure the general level of fear of COVID-19, with associated anxious symptoms (seven items; e.g. “I cannot sleep because I’m worrying about getting coronavirus-19”,”My heart races or palpitates when I think about getting coronavirus-19”). The scale has shown good psychometric properties in different international and Italian studies (review by Muller et al., 2021), and it also reached good reliability in the present study (Cronbach’s alpha of 0.87).

COVID-19-related fears. Five items were created ad hoc to investigate the content of fears that young adults may have about consequences of COVID-19 contagion, as follows: (1) fear of being infected and getting sick with COVID-19; (2) fear of being positive for COVID-19 and infecting other people; (3) fear of people dear to me getting sick with COVID-19; (4) fear of losing loved ones due to COVID-19; (5) fear of losing my job or having serious financial damage due to pandemic. Participants were asked to rate how much they felt described by each item, on a 5 point Likert-type scale from 1 (not at all) to 5 (very much). The items were conceived in a focus group among expert researchers in developmental psychology, after reviewing the very recent literature on pandemic fear, and covered both personal and altruistic fears (Sloan et al., 2021), and concerns for health and socio-economic risks (Mertens et al., 2021). The PCA analysis identified one single factor solution.
with eigenvalue higher than 1, explaining the 59.63% of variance. The subsequent CFA confirmed the adequacy of one-factor structure for the scale, $\chi^2(2) = 3.85$, $p = 0.15$; $\chi^2/df = 1.92$; CFI = 1.00; NFI = 0.99; NNFI = 0.98; RMSEA = 0.07; SRMR = 0.02. In our study, this measure showed good values of reliability (Cronbach’s alpha of 0.80), and concurrent validity (correlation with FCV-19S scale: Pearson $r$ correlation coefficient of 0.61).

### Data analysis

Data analyses were performed using the statistical software SPSS version 27.0. Descriptive statistics, biological sex differences, and bivariate correlations were computed on study variables. Two moderation regression analyses were performed, entering prevention behaviors as criterion variable. Independent predictors were preliminary centered on their grand-mean (except biological sex which was dummy coded), as suggested by Cohen et al. (2002). Then, six interaction terms were computed according with our hypotheses: IHLC * COVID-19 fears; CHLC * COVID-19 fears; PHLC * COVID-19 fears; IHLC * FCV-19S; CHLC * FCV-19S; PHLC * FCV-19S. Finally, two moderation models were tested in different steps: in Step 1 of each model, biological sex and age were controlled as covariates; in Step 2, the three health locus of control styles were regressed on the criterion; in Step 3, pandemic-related fears—i.e. COVID-19 fears and FCV-19S—were added to the regression equation. Finally, Step 4 was conceived in line with our hypotheses, testing the interaction effects between health locus of control styles and COVID-19 fears in the first regression model (Model 1), and the interaction effects between health locus of control styles and FCV-19S in the second model (Model 2). Afterward, simple slope analyses were conducted in order to interpret the direction of each significant interaction. As suggested by Aiken and West (1991), the predicted values of COVID-19 prevention behaviors were plotted as a function of each predictor, for high (1 SD above the mean) versus low (1 SD below the mean) levels of the moderator.

### Results

Preliminary analyses of skewness and kurtosis ascertained the normal distribution of variables in our study ($\pm 2$; Tabachnick and Fidell, 2013). See Table 1 for descriptive statistics and biological sex differences, and Table 2 for bivariate Pearson’s correlations on study variables.

### Assumptions of multiple regression analyses were preliminarily verified, confirming the absence of multicollinearity problems (variance inflation factors between 1.02–1.72). In Model 1, the 24.1% of variance in COVID-19 prevention behaviors was explained. Step 1 accounted for the 4.2% of variance, with only biological sex emerging as significant covariate (women scored higher than men). Step 2 added a significant 10.2% to the explained variance, detecting a significant negative effect for CHLC and a

### Table 1. Descriptive statistics and differences by biological sex.

|                      | Range | Women | Men | F(df)         | Total |
|----------------------|-------|-------|-----|---------------|-------|
|                      | M (SD)| M (SD)|     |               | M (SD)|
| IHLC                 | 1–6   | 3.86  | 4.05| $F(187) = 1.19$, $\eta^2 = 0.006$ | 3.89  |
| CHLC                 | 1–6   | 2.42  | 2.59| $F(187) = 0.85$, $\eta^2 = 0.005$ | 2.45  |
| PHLC                 | 1–6   | 3.47  | 3.54| $F(187) = 0.20$, $\eta^2 = 0.001$ | 3.48  |
| COVID-19 fears       | 1–5   | 3.72  | 3.29| $F(187) = 7.33^*$, $\eta^2 = 0.04$ | 3.66  |
| FCV-19S              | 1–5   | 2.56  | 2.33| $F(187) = 2.07$, $\eta^2 = 0.01$ | 2.53  |
| COVID-10 prevention behaviors | 1–5 | 4.39  | 4.09| $F(187) = 7.16^*$, $\eta^2 = 0.04$ | 4.35  |

Notes: ***$p < 0.001$; **$p < 0.01$; *$p < 0.05$. $F$=Fisher $F$ values. Biological sex differences were computed by univariate analyses of variance.
significant positive effect for PHLC—while biological sex remained significant. Step 3 explained another significant 4.5% of variance. Only biological sex and CHLC remained significant and, controlling for their effects, also COVID-19 fears turned out to be significant and positive predictor of prevention behaviors. Finally, the Step 4 of Model 1 added a significant 5.3% to the explained variance, detecting significant effects for the three tested interaction terms: IHLC * COVID-19 fears; CHLC * COVID-19 fears; PHLC * COVID-19 fears (see Table 3). Conversely Model 2 explained the 21.2% of variance in COVID-19 prevention behaviors. The Step 4 in this model did not contribute to the explained variance, and no significant interaction terms were found. Full statistics of the two models are reported in Table 3.

In the first slope analysis, the relationship between IHLC and COVID-19 prevention behaviors was plotted at high versus low levels of the moderator (COVID-19 fears), controlling for all variables in the model. At low levels of fears, IHLC was not related to prevention behaviors, \(\beta = -0.11, p = 0.28\). Conversely at high levels of fears, IHLC positively and significantly predicted prevention behaviors, \(\beta = 0.28, p = 0.01\) (see Figure 1). As regards the second slope analysis, the relationship between CHLC and COVID-19 prevention behaviors was plotted at two levels of COVID-19 fears, while controlling for the other variables in the model. In this case, at low levels of fears CHLC was a negative and significant predictor of COVID-19 prevention behaviors, \(\beta = -0.43, p < 0.001\), whereas at high levels of fears, the same relationship vanished in a nonsignificant effect, \(\beta = -0.16, p = 0.07\) (see Figure 2). Finally in the third slope analysis, the relationship between PHLC and COVID-19 prevention behaviors was plotted at the two levels of the moderator, still controlling for the other variables in the model. When fears were low, PHLC positively predicted prevention behaviors, \(\beta = 0.29, p = 0.003\), conversely when fears were high the same relationship became not significant, \(\beta = -0.16, p = 0.19\) (see Figure 3).

Therefore, when COVID-19 fears were low, CHLC was a risk factor which reduced the adoption of prevention behaviors whereas PHLC was a protective factor which promoted the adoption of prevention behaviors. However, in presence of high COVID-19 fears, the negative effects of CHLC, as well as the positive effects of PHLC, became nonsignificant, and conversely the adherence to COVID-19 prevention behaviors was a function of IHLC, which became a protective factor.

**Discussion**

This study proposed a model of understanding for COVID-19 preventive behaviors in Italian young adults, taking into account cognitive (i.e. health locus of control styles) and affective variables (i.e. pandemic-related fear). Our findings detected relevant contributes of both cognitive

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**Table 2. Bivariate Pearson’s correlations on study variables.**

|                  | 1   | 2    | 3    | 4    | 5    | 6    | 7    | 8    |
|------------------|-----|------|------|------|------|------|------|------|
| 1. Biological sex (0 = women; 1 = men) |      |      |      |      |      |      |      |      |
| 2. Age           |     | 0.24*|      |      |      |      |      |      |
| 3. IHLC          |     |      | 0.08 |      |      |      |      |      |
| 4. CHLC          |     |      |      | 0.07 |      |      |      |      |
| 5. PHLC          |     |      |      |      | 0.03 |      |      |      |
| 6. COVID-19 fears |     |      |      |      |      | -0.19*|      |      |
| 7. FCV-19S       |     |      |      |      |      |      | 0.11 |      |
| 8. COVID-10 prevention behaviors |     |      |      |      |      |      |      | -0.19*|

Notes: ***p < 0.001; **p < 0.01; *p < 0.05.
### Table 3. Moderation regression models predicting COVID-19 Prevention Behaviors.

| Predictors | Model 1 | | | | | | Model 2 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Step 1 | Step 2 | Step 3 | Step 4 | | | Step 1 | Step 2 | Step 3 | Step 4 | | | |
| $R^2$ | $\Delta R^2$ | $\beta$ | $\Delta R^2$ | $\beta$ | | | $R^2$ | $\Delta R^2$ | $\beta$ | | | $R^2$ | $\Delta R^2$ | $\beta$ | | |
| Biological sex (0 = women; 1 = men) | -0.21*** | -0.20*** | -0.15* | -0.13* | -0.21*** | -0.20*** | -0.15* | -0.15* |
| Age | 0.07 | 0.05 | 0.05 | 0.08 | 0.07 | 0.05 | 0.05 | 0.07 |
| IHLC | 0.09 | 0.05 | 0.05 | 0.08 | 0.09 | 0.05 | 0.05 | 0.09 |
| CHLC | -0.26*** | -0.24*** | -0.30*** | -0.26*** | -0.26*** | -0.24*** | -0.24*** | -0.24*** |
| PHLC | 0.16* | 0.12* | 0.06* | 0.16* | 0.12* | 0.12 | 0.07 | 0.07 |
| COVID-19 fears | 0.22* | 0.19 | 0.22 | 0.22 | 0.22 | 0.24 | 0.24 | 0.24 |
| FCV-19S | 0.004 | 0.05 | 0.004 | 0.008 | 0.004 | 0.008 | 0.008 | 0.008 |
| IHLC * COVID-19 fears | | | | | | | | |
| CHLC * COVID-19 fears | | | | | | | | |
| PHLC * COVID-19 fears | | | | | | | | |
| IHLC * FCV-19S | | | | | | | | |
| CHLC * FCV-19S | | | | | | | | |
| PHLC * FCV-19S | | | | | | | | |
| Total $R^2$ | 0.24*** | | | | | | 0.21*** | | | | | |

Notes: ***$p \leq 0.001$; **$p \leq 0.01$; *$p \leq 0.05$. Standardized regression coefficients are reported.
and emotional variables and also revealed significant interaction effects, indicating that COVID-19 preventive behaviors can be predicted by specific profiles of health beliefs and pandemic fear. This study is a contribute to the emerging literature on compliance with COVID-19 preventive behaviors in young adults and provides, to the best of our knowledge, the first scientific evidence for interaction effects between health locus of control and pandemic fear.

Regarding individual differences on COVID-19 preventive behaviors, only biological sex emerged as significant covariate, with women reporting more frequent prevention behaviors than men, confirming recent studies (Franzen and Wöhner, 2021; Imtiaz et al., 2021). As suggested by Mahalik et al. (2021), some prevention behaviors, such as wearing face mask, can be considered in contrast with an ideal of masculinity according to gender-related social norms, which thus discourage their use in young men. Age showed instead null associations, indicating that prevention behaviors did not vary by age across early adulthood.

About pandemic related fear, our regression models detected two different effects for general fear of COVID-19 contagion and for specific concerns about possible negative consequences of pandemic (COVID-19 fears). The fear of COVID-19 contagion, measured by FCV-19S (Ahorsu et al., 2020) and including psychosomatic symptoms, was not related to preventive behaviors, while conversely the specific COVID-19 fears showed a significant and positive association. Most studies using the FCV-19S have found this dimension related to negative mental health outcomes, such as anxiety, depression, and clinical phobia (review by Muller et al., 2021), but some links also emerged with preventive behaviors (Harper et al., 2021). However our findings indicate that, when both generalized fear of contagion and realistic concerns for consequences are tested simultaneously, it is only the latter dimension that explains the variance in preventive behaviors. Therefore, in line with recent evidence on functional and dysfunctional pandemic fears (Solymosi et al., 2021), our findings suggest the need of distinguishing generalized fear for

Figure 1. Moderation role of COVID-19 fears in the relationship between IHLC and COVID-19 prevention behaviors.
Notes: Dashed line represents a nonsignificant relationship.
Figure 2. Moderation role of COVID-19 fears in the relationship between CHLC and COVID-19 prevention behaviors.
Notes: Dashed line represents a nonsignificant relationship.

Figure 3. Moderation role of COVID-19 fears in the relationship between PHLC and COVID-19 prevention behaviors.
Notes: Dashed line represents a nonsignificant relationship.
contagion (with maladaptive outcomes, see Muller et al., 2021) from realistic concerns for consequences (which conversely show positive behavioral outcomes in our model). Moreover, only COVID-19 fears—but not generalized fear for contagion—resulted to be a significant moderator in the relationships between health locus of control styles and prevention behaviors (see Model 1 vs Model 2), representing an important protective factor.

As regard the effects of health locus of control styles, our findings only partially confirmed research hypotheses. IHLC, as independent predictor, was not related with COVID-19 preventing behaviors, disconfirming initial expectation. Previous studies suggested that perceiving more internal control on health would favor health-promoting behaviors (Cheng et al., 2016; Mercer et al., 2018); however, the few researches that applied this construct to COVID-19 prevention are quite contrasting (Berg and Lin, 2020; Itani and Hollebeek, 2021). In this regard, our findings indicated that the positive role of IHLC is not obvious for young adults during COVID-19 pandemic, but rather it may be observed only in individuals presenting high COVID-19 fears (interaction effect depicted in Figure 1). COVID-19 contagion has shown so far limited consequences for health in young adults, who often were asymptomatic. Therefore internal health beliefs could not be the key to motive youths in following prevention guidelines, since an eventual contagion could not endanger their health. However, for young people who are also concerned about different negative consequences of contagion in their lives (including risks of infecting beloved people and socioeconomic damages), then internal health beliefs become important to predict their preventive behaviors. Thus, COVID-19 fears appear to be a factor triggering the positive effect of IHLC on COVID-19 preventive behaviors in young adults.

Conversely, CHLC was a significant and negative predictor of COVID-19 prevention behaviors, as hypothesized according with previous studies on MHLC model (Steptoe and Wardle, 2001). Young adults who believe their health being mostly determined by chance also reported lower prevention behaviors, suggesting that they undervalue the effectiveness of pandemic guidelines and neglect them, exposing themselves and others to more risk for contagion. In this perspective, CHLC should be considered a risk factor at individual and community level, contributing to the general spread of COVID-19 contagion. However, the significant interaction with COVID-19 fears (depicted in Figure 2) indicates that the negative role of CHLC can be nullified by high pandemic fear: CHLC is a risk factor for more exposure to contagion only in individuals who are unaware or unconcerned about the possible consequences of contagion in their lives. Conversely, when youths are highly concerned for consequences of COVID-19 contagion, they tend to adopt more preventive behaviors regardless of their beliefs on uncontrollability of health.

Results on PHLC also confirmed our expectation, showing a positive significant association with COVID-19 preventive behaviors. In previous research (Cheng et al., 2016), this dimension has inconsistent associations with health behaviors because, according to Steptoe and Wardle (2001), PHLC can predict only behaviors clearly sponsored by healthcare authorities (Náfrádi et al., 2017). In the context of COVID-19 pandemic, it is well-understandable that young adults high in PHLC are also more compliant with prevention guidelines provided by the Ministry of Health, due to their trust in health professionals’ indications. Accordingly, the few extant research on health locus of control during pandemic has found very similar results (Berg and Lin, 2020; Tagini et al., 2021). Furthermore, the interaction effect emerged with COVID-19 fear (see Figure 3) indicates that PHLC is a positive predictor of preventive behaviors exclusively for young adults with low COVID-19 fears. Conversely their peers with high COVID-19 fears reported higher rates of compliance to prevention guidelines regardless of their PHLC beliefs. Therefore, PHLC appears to be a specific protective factor in presence of low pandemic fear, because even the youths more unconcerned
about negative consequences of contagion, may be moved to adopt preventive behaviors in reason of their trust in the importance of following medical suggestions for preserving their health.

Limitations and implications

To the best of our knowledge, this is the first evidence of interaction effects between health beliefs and pandemic fear in predicting compliance with COVID-19 preventive behaviors in young adults. Nevertheless, some limitations should be taken into account: First, the study sample is not large, but however it is adequate for detecting significant effects as indicated by power analysis. Second, men are underrepresented in our study, so the effect of biological sex—although significant and controlled for in our models—might have been underestimated. Future studies should therefore replicate our findings in larger samples with equal prevalence of men and women. Third, the adoption of exclusively self-report instruments may have increased the risk of social desirability bias, so that undesirable behaviors (such as low compliance with official guidelines) might have been underreported. Notwithstanding, significant and interesting results emerged by our models. Fourth, results of this study exclusively describe the sociocultural context of Italy during COVID-19 pandemic, and cannot be generalized to different cultural contexts.

In conclusion, this study shed a new light on the predictors of compliance with COVID-19 prevention guidelines in young adults, suggesting that a key role is played by interactions of health beliefs with a specific functional type of pandemic fear (i.e. concerns for possible negative consequences of contagion on different areas). Overall, these findings may have implications for social policies and future research. Our results can be useful during pandemic, as well as in post-pandemic period, for targeting health promoting interventions on specific risk groups, such as youths with external attributional styles on health, and/or lack of awareness for the possible negative consequences of pandemic on their lives. Moreover, our results can support implementation of public health messages targeted to young people, hopefully extendable to other health-risk conditions. These findings may also suggest different directions for future research: First, the role of health beliefs and pandemic fear should be studied in other health behaviors related to pandemic, such as compliance with vaccination in next years. Moreover, it would be desirable to test our model in other healthy and risky behaviors beyond pandemic, in order to understand its usefulness in different health conditions. Finally, future research should also deeply understand the different roles of contextualized versus generalized fear, observing their outcomes on health in a longitudinal perspective, and across different genders and sociocultural backgrounds.

Data sharing statement

The current article includes the complete raw dataset collected in the study including the participants’ data set, syntax file and log files for analysis. These files are all available in the Figshare repository and as Supplemental Material on the SAGE Journals platform.

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Compliance with ethical standards

This study and its procedure were approved by the Ethics Committee of the Department of Developmental and Social Psychology, Sapienza University of Rome.

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