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Public perceptions and behavioural responses to the first COVID-19 pandemic wave in Italy: results from the iCARE study

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Background: Italy was the first European country to be affected by COVID-19. Considering that many countries are currently battling the second wave of the pandemic, understanding people's perceptions and responses to government policies remain critical for informing on-going mitigation strategies. We assessed attitudes towards COVID-19 policies, levels of adherence to preventive behaviours, and the association between COVID-19 related concerns and adherence levels. **Methods:** We recruited a convenience sample of Italian individuals from an international cross-sectional survey (www.icarestudy.com) from 27 March to 5 May 2020. Multivariate regression models were used to test the association between concerns and the adoption of preventive measures. **Results:** The survey included 1332 participants [female (68%), younger than 25 (57%)] that reported high awareness (over 96%) and perceived importance (88%) of policies. We observed varied levels of adherence to: hand-washing (96%), avoiding social gatherings (96%), self-isolation if suspected or COVID-19 positive (77%). Significantly lower adherence to self-isolation was reported by individuals with current employment. High levels of concerns regarding health of other individuals and country economy were reported. Only health concerns for others were significantly associated with higher adherence to hand-washing behaviour. **Conclusions:** In order to inform current/future government strategies, we provide insights about population's responses to the initial pandemic phase in Italy. Communication approaches should consider addressing people's concerns regarding the health of other individuals to motivate adherence to prevention measures. Provision of social and economic support is warranted to avoid unequal impacts of governmental policies and allow effective adherence to self-isolating measures.

Introduction

Coronavirus disease 2019 (COVID-19), first identified at the end of 2019 in Wuhan, China, has rapidly spread worldwide, causing an international public health emergency. On 11 March 2020, the World Health Organization (WHO) declared a pandemic caused by COVID-19.[1] Despite recent vaccine developments and international rollouts, human behaviours continue to be the target of government COVID-19 prevention policy measures. During different pandemic waves, governmental actions with different levels of restrictions have been adopted worldwide, based on the epidemiological context, economic pressures and political situation, inevitably influencing individuals and communities on multiple levels.[2] Improving health systems' preparedness and optimizing policy responses remain a priority in the context of the current pandemic. Shaping the policies and adapting them to suit different subgroups of the population has to be based on behaviour change principles and a comprehensive understanding of what the populations' behaviours are and what influences them.[3–5]

Insights from behavioural sciences show that factors influencing population adherence to COVID-19 policies can be mapped by two interconnected behaviour prediction models: (i) the Capability, Opportunity, Motivation-Behaviour (COM-B) Model, which predicts that behaviour change depends on the following: awareness of prevention measures (capability), individuals' belief that measures are personally relevant and important (motivation) and having social and environmental structures in place to allow adoption of required behaviour (opportunity); (ii) the Health Beliefs Model, which foresees that adoption of preventive behaviours is predicted by individuals' belief in the personal threat(s) posed by the disease as well as belief around how important and effective the recommended behaviours are.[6,7]

In Europe, Italy was the first country to be affected by COVID-19, with the first confirmed case on 31 January. The organization and implementation of Italian healthcare is mainly a regional jurisdiction. While the country was facing challenges to coordinate the COVID-19 response, initial policies were mainly focussed on northern regions of the country, with a particularly severe outbreak.[8,9] Lockdown and restriction measures were then extended to the entire nation on 9 March and 11 March, respectively. Until 5 May, the policy measures covered the following restrictions: only essential activities were permitted; the mobility of individuals was allowed only for reasons of work or health; schools and universities were closed; and any public gatherings were forbidden.[8,10] Up to that point, the country had registered 213 013 total cases and 29 315 total deaths due to COVID-19.

In order to inform future policies and enable adequate government preparation for the ongoing and forthcoming waves of COVID-19 in Italy, it is necessary to understand population's behavioural responses to the lockdown measures of the country during the initial stages of the pandemic. The present cross-sectional study aimed to understand people's perceptions and attitudes towards COVID-19 policies, adherence to preventive behaviours and COVID-19 related concerns during the initial phase of the COVID-19 pandemic in Italy.

Methods

Study design and participant recruitment

The present research analyzes the Italian sample of the international assessment of COVID-19-related Attitudes, concerns REsponses and impacts in relation to public health policies (iCARE) Study. Details and methodological background of the iCARE study have been published elsewhere.[11] Briefly, the iCARE study is an international multi-wave cross-sectional study capturing public awareness, attitudes as well as responses to public health measures implemented to contain COVID-19 spread (www.icarestudy.com).

Our analyses focus on the first survey of the iCARE study, which was available in multiple languages from 27 March to 5 May 2020. This timeframe corresponded to the national lockdown in Italy. The data from respondents reporting residency in Italy, regardless of survey language, were included. The iCARE survey (LimeSurvey©) was administered using online snowball sampling globally by engaging study collaborators (distribution occurred via professional associations and societies, university networks, community organizations and groups, social media, and personal contacts).

Ethics approval for the iCARE study was obtained from the Comité d'éthique de recherche du CIUSSS-NIM (Centre intégré universitaire de santé et de services sociaux du Nord-de-l'île-de-Montréal), approval #: 2020-2099/25-03-2020. This article is reported in line with the Strengthening the Reporting of Observational Studies in Epidemiology statement (Supplementary table S1).[12]

iCARE survey

The survey included 54 questions on socio-demographics, health and COVID-19 status, health behaviours, sources of COVID-19 information, public awareness, attitudes and adoption of the local COVID-19 public health policies and perceived COVID-19 related concerns.

For the purposes of the present analysis, we considered following five behaviours: hand-washing; staying at least 1–2 m away from others (physical distancing); self-isolating if having or believing to have the virus; self-quarantining if returning from a trip; and avoiding all social gatherings (social distancing). Adoption of these preventive behaviours was assessed as the frequency with which an individual has adopted different preventive behaviours in the previous 7 days (possible answers: 'Most of the time, Some of the time, Seldom, Never'). COVID-related concerns were measured with 14 different survey items, with possible answers: 'To a Great Extent, Somewhat, Very Little, Not at All'.

The survey was designed to measure constructs related to the COM-B Model[6] and Health Belief Model[13] (more details available in the iCARE protocol study[11]). The survey is available online: https://osf.io/nswcm/.

Statistical analysis

Descriptive statistics [mean (M), standard deviation (SD) and proportions] were calculated to provide an overview of the study sample in terms of demographic characteristics and selected lifestyle habits. Questionnaire items that included an answer 'I don't know/I prefer not to answer/Not applicable' were considered missing values. In order to assess adherence to preventive behaviours and COVID-19 related concerns, we reported proportions of individuals that reported practicing behaviours 'Most of the time' and expressing concerns 'To a great extent', vs. all other response options. Stratified analysis was conducted according to a series of socio-demographic variables, including age, sex, education, current employment and living situation.

In order to classify the Italian regions with different epidemiological scenarios, we used COVID-19 cumulative incidence rates, reported by Istituto Superiore di Sanità (National Health Institute) on 30 April 2020.[14] Specifically, we used the values of the interquartile range (IQR) of the cumulative incidence rates to classify the regions into three different levels of transmission. Regions with rates higher than the upper limit of the IQR, within the values of IQR and lower than the lower limit of IQR were classified as high, intermediate and low transmission areas, respectively (Supplementary table S2).[15]

To cluster COVID-19-related concerns, we performed a principal component analysis (PCA) on polychoric correlation matrix of the 14 variables in the COVID-19 concerns module. An orthogonal (varimax) rotation was done in order to distribute the factor loadings. We identified four concern patterns in the sample that were selected based on the Kaiser criterion (eigenvalue >1.0), scree plot and components interpretability.[16] Items with factor loadings higher than 0.4 were used to interpret each component of COVID-19 concerns. We observed a four-factor structure that included: 'Health concerns (self)', 'Health concerns (others)', 'Personal financial concerns' and 'Social/economic concerns' (Supplementary table S3). Individual items were averaged in order to create four components (M and SD are reported).

Multivariate logistic regression models were applied to test the association between the adoption of preventive measures (dependent variables) and COVID-19 related concerns (independent variables). Additional variables included as an adjustment in the models were age, sex, education and region of COVID-19 transmission. All statistical tests were two-sided, and a P-value <0.05 was considered statistically significant. Statistical analysis was performed in SAS, version 9.4.

Results

Study population

A total of 1332 participants were included in our survey in the period from 27 March to 5 May 2020 (table 1). Participants were predominantly younger adults [individuals younger than 25 (57%), female (68%) and without existing health problems (79%)]. About 67% of people reported having an educational attainment equal to or less than high school, 65% were not currently employed, and almost 95% of the sample reported living with at least one individual. In terms of geographical distribution, we observed an equal distribution across northern, central and southern regions of Italy with half of individuals living in urban areas. However, only 4% of participants came from high transmission regions, while almost two-thirds of responses came from regions reporting moderate incidence rates [cumulative incidence rates from 97 to 490 cases per 100 000 (Supplementary table S2).

Awareness and perceptions of government measures

Overall, the vast majority of Italians in our sample reported being aware of the major recommendations during the time of this study, including hand-washing (99.9%), physical distancing (99.8%), social distancing (98.9%), self-isolating if you believe you have the virus (98.2%) and self-quarantine if you are returning from a trip (96.4%).

About 88% of individuals expressed that government measures were 'very important' for preventing and/or reducing the spread of

Table 1 Descriptive characteristics of the Italian sample ($N = 1332$)

Variable	*N*	%
Sex		
Male	422	32.0
Female	899	68.1
Missing values	11	
Age		
≤25 years	749	57.0
26–50 years	438	33.3
51 years or more	127	9.7
Missing values	18	
Education level		
High school or lower	861	66.5
Graduate or postgraduate degree	434	33.5
Missing values	37	
Region		
South	525	40.4
Centre	425	32.7
North	350	26.9
Missing values	32	
Region (transmission)		
Low transmission regions	480	36.92
Moderate transmission regions	769	59.15
High transmission regions	51	3.92
Missing values	32	
Residential area		
Rural or country area	475	36.3
Suburban or regional	175	13.4
Urban or city	657	50.3
Missing values	25	
Current employment status		
No	863	64.8
Yes	332	24.9
Missing values	137	
Living situation		
Alone	69	5.42
With one individual	286	22.45
With 2 or more individuals	919	72.13
Missing values	58	
Health condition at risk[a]		
No	1032	78.7
Yes	280	21.3
Missing values	20	

a: Includes: any heart disease or history of heart attack or stroke, any chronic lung disease (e.g. asthma, chronic obstructive pulmonary disease, emphysema/chronic bronchitis); active/current cancer; hypertension; diabetes; severe obesity; any autoimmune disease (e.g. lupus, multiple sclerosis, rheumatoid arthritis, psoriasis, Crohn's disease and inflammatory bowel disease).

COVID-19. Government measures were perceived as 'appropriate' by the majority ($N = 1071$; 83%), and as 'too lenient' by the minority of the population ($N = 175$; 14%). Stratification by different population characteristics (e.g. age, sex, region or socio-economic status) did not reveal any statistically significant differences in perception of government measures. However, older adults (individuals over 51 years of age) generally reported the highest values for perceived importance of government policies ($N = 117$; 92%), and appropriate strictness of the implemented measures ($N = 109$; 87%) (Supplementary figures S1 and S2).

Adherence and motivation to adhere to preventive behaviours

Frequencies of practicing recommended hygiene measures most of the time were high for hand-washing behaviour ($N = 1257$; 96%), with significantly higher proportions observed among women compared to men. Overall, the adherence to social distancing behaviours was >95% in our sample (for avoiding all social gatherings). In terms of physical distancing behaviours, the proportion of those maintaining 2 m distance from others was 93%, but variations were observed among subsets of the population with different age and educational level. In contrast, a substantial proportion of individuals reported never self-quarantining if returning from a trip (26%) nor self-isolating if they had/believed they had the virus (23%). Individuals with current employment reported lower adherence to both of these behaviours when compared to the unemployed individuals (employed individuals: 68%, and 71%; unemployed individuals: 78%, and 78%; for self-quarantining and self-isolating, respectively) (table 2).

COVID-19 related concerns

Our PCA analysis revealed that the study sample reported having lower levels of health concerns for oneself ($M \pm SD = 2.73 \pm 0.87$) and personal financial situation ($M \pm SD = 2.56 \pm 0.90$) relative to concerns regarding the health of other individuals and about the economy of the country ($M \pm SD = 3.51 \pm 0.60$, and $M \pm SD = 3.33 \pm 0.58$, respectively) (table 3). Our stratified analyses revealed that women expressed significantly higher levels of concerns across all four factors compared to men. Furthermore, older adults, people with higher education and currently employed reported significantly higher levels of personal health concerns. Lastly, we observed significantly higher levels of personal financial concerns among less educated individuals in comparison to individuals with higher education ($P = 0.003$).

Association between COVID-19 related concerns and practicing preventive behaviours

With the aim of identifying whether COVID-19 concerns might be associated with adherence to preventive measures, a multivariate analysis was performed. After adjustments for sex, age, education and region, our models revealed that only health concerns for others were significantly associated with better adherence to hand-washing ($\beta = 0.871$, $P < 0.001$) (table 4). When evaluating the effects of personal health concerns on other preventive behaviours, results were not statistically significant; however, we noticed effects with similar directions, but with smaller magnitudes ($\beta = 0.432$, $P = 0.077$ for social distancing; $\beta = 0.231$, $P = 0.092$ for self-isolating). Interestingly, COVID-19 related concerns were not significantly associated with adherence to other preventive measures (i.e. physical distancing and self-quarantining).

Discussion

Data from the initial wave of the COVID-19 epidemic in Italy suggested great awareness and broad acknowledgement of the importance and appropriateness of COVID-19 policy measures by the citizens. We observed a high level of adherence to major preventive behaviours, especially for hygiene and social distancing measures (over 95%). Of note, self-isolation in case COVID-19 positive or suspected was a less frequently adopted behaviour (23% of individuals reported non-adherence), especially among currently employed individuals. Surveyed participants, mainly females and young, reported greater level of concerns about the health of other individuals and the economic situation of the country, rather than their own health and personal finances. Higher levels of concerns for others were significantly associated with higher adherence to preventive hygiene measures (mostly hand-washing behaviour).

Our analyses provide insights on how COVID-19 related concerns, which represent vital aspects of society-level reactions and pandemic response, can influence the degree of adherence to preventive behaviours. Interestingly, only adherence to hand-washing behaviour was significantly associated with greater concerns for other individuals after adjusting for age, sex, education and region. When taking a broader look at the government communication around hand-washing behaviour during the initial stages of the pandemic, it seems that major efforts were directed towards educating

Table 2 Frequency of practicing different behaviours in the last 7 days (overall sample and stratified by different population characteristics)

	Behaviours (*N* (%))				
	Hygiene	**Physical distancing**	**Self-quarantining**	**Self-isolating**	**Social distancing**
	Hand-washing	At least 6 feet/1–2 m away from others	If returning from a trip	If COVID-19 positive or suspected	Avoiding all social gatherings
Adoption of preventive behaviours[a]					
Overall	1257 (95.6)	1212 (93.0)	747 (74.3)	811 (76.5)	1260 (96.0)
Sex					
Male	**387 (92.8)**	378 (91.3)	218 (74.2)	246 (77.4)	400 (95.7)
Female	**861 (97.0)**	826 (93.8)	524 (74.4)	560 (76.1)	850 (96.1)
Age					
≤25 years	710 (95.1)	**671 (91.2)**	418 (74.6)	453 (76.0)	713 (95.7)
26–50 years	409 (95.3)	**403 (94.4)**	255 (74.8)	275 (78.1)	413 (96.3)
≥51 years	125 (98.4)	**125 (98.4)**	70 (72.9)	76 (73.8)	121 (96.0)
Region of transmission					
Low	456 (95.0)	436 (91.8)	316 (77.3)	326 (77.3)	465 (96.9)
Moderate	736 (95.8)	708 (93.3)	388 (71.2)	441 (75.3)	734 (95.8)
High	49 (96.1)	51 (100.0)	30 (79.0)	32 (82.1)	47 (94.0)
Education					
Low	821 (95.7)	**778 (91.6)**	488 (74.7)	532 (76.8)	815 (95.2)
High	413 (95.2)	**410 (95.4)**	251 (74.3)	268 (76.4)	423 (97.5)
Current employment					
No	825 (95.6)	791 (92.7)	**527 (77.8)**	**558 (78.3)**	827 (96.2)
Yes	318 (96.1)	312 (94.3)	**169 (67.6)**	**188 (71.2)**	317 (95.5)
Living situation					
Alone	1152 (95.7)	1107 (92.8)	49 (83.1)	51 (83.6)	1153 (96.0)
With others	64 (92.8)	65 (95.6)	680 (73.8)	739 (76.0)	67 (97.1)

P-values <0.05 are marked in bold text.
a: Presenting frequencies and proportions of individuals engaging in the behaviour most of the time.

the public around proper hand-washing, and promoting engagement in this behaviours through social media campaigns in support to the WHO-launched initiative (#SafeHandsChallenge).[17,18] Besides that, provision of disinfectant materials in the community was warranted through legal entactment.[19] Our data on generally high levels of engagement may testify to the successfulness of the government initiatives, even though some sections of the population reported lower adherence, notably male individuals, which is in line with the current Italian literature.[20] With the arrival of winter months, government messages included benefits of avoiding dual threats (COVID-19 and influenza) when practicing this behaviour.[21] If we consider that global estimates show worrying decreases in hand-washing behaviour over time (94% vs. 65% adherence levels in March and August 2020, respectively),[22] our findings shed interesting light about the potential of leveraging the importance of protecting close individuals in order to maintain motivation in the Italian public to practice hygiene measures continuously.

Even though our models did not yield significant associations for other behaviours, we observed high levels of non-adherence to self-isolation behaviour in the entire Italian sample. Current evidence suggests that isolation for individuals when symptomatic or with potential contact with a COVID-19 case is crucial for reducing incidence (from 44% to 96% of incidence cases potentially prevented) and mortality (from 31% to 76% of deaths potentially prevented).[23] Uniformly, 23% of the individuals in our young sample reported non-adherence to self-isolating when symptomatic or COVID-19 positive. Moreover, our stratified analyses suggested that current employment and living with others might be important drivers of this non-adherence. Young adults might have lacked the physical capacity to isolate in their living environment and those who were employed at the time of our survey were most likely engaged in employments that were not possible to perform from home. Our estimates are aligned with the figures from the national census data (2019), which suggested that a staggering 64% of individuals aged from 18 to 34 in Italy lives with their parents, and 60% is either studying or without occupation.[24]

Nevertheless, our finding suggests that the adherence to this critical behaviour might depend on upstream factors, such as socioeconomic and living situation. It further emphasizes the core concept of behaviour change models rooted in the iCARE study, highlighting that all model components (capability, opportunity and motivation) need to be present in order for the behaviour to be enacted.[5,6] Despite the Italian lockdown scenario at the beginning of the pandemic, where awareness of the policies (capability),[25–27] perceptions of policy importance and concerns (motivation) were high, opportunity to enact the self-isolation behaviour was likely missing. Our findings highlight the need of decision makers to address these barriers by providing physical infrastructures and economic support incentives in order to guarantee that younger portions of the population do not remain negatively impacted by government interventions.[28,29]

There is growing literature demonstrating sex-specific differences not only in the epidemiology of COVID-19,[30] but also in responses to and consequences of the pandemic. In our sample, women expressed higher levels of concerns and better adherence to COVID-19 policies, which is in line with surveys conducted in a similar timeframe in Italy.[26,31,32] Our results might be linked to higher health literacy[33] and better adherence to preventive behaviours that have been traditionally reported in women during epidemics.[34–36] Secondly, women and men experience psychologically and biologically diverse reactions to stress, leading to higher vulnerability and striking differences in the epidemiology of psychiatric disorders that are more prevalent in women.[37,38] Thirdly, risk perception is an important factor that can shape social reactions to the pandemic and is usually reported to be lower among men, regardless of setting.[20,39,40] Ultimately, women traditionally have different societal roles and pressures that might have led to differential responses to the pandemic compared to men. For instance, women's

Table 3 COVID-19 related concerns stratified by socio-demographic characteristics of the sample (presenting mean values of the different factor structures)

		COVID-19 related concerns			
		Health concerns (self)	**Health concerns (others)**	**Personal financial concerns**	**Social/economic concerns**
Overall					
	M ± SD[a]	2.73 ± 0.87	3.51 ± 0.60	2.56 ± 0.90	3.33 ± 0.58
	N	1309	1313	1314	1315
Sex					
Male	M ± SD	2.66 ± 0.85	3.34 ± 0.67	2.36 ± 0.90	3.23 ± 0.62
	N	417	417	418	418
Female	M ± SD	2.77 ± 0.88	3.59 ± 0.54	2.65 ± 0.89	3.38 ± 0.56
	N	883	887	886	887
	P-value	**0.0141**	**<0.0001**	**<0.0001**	**<0.0001**
Age					
≤25 years	M ± SD	2.63 ± 0.86	3.5 ± 0.57	2.58 ± 0.92	3.34 ± 0.57
	N	743	745	745	746
26–50 years	M ± SD	2.78 ± 0.85	3.52 ± 0.62	2.56 ± 0.89	3.31 ± 0.60
	N	429	429	430	430
≥51 years	M ± SD	3.19 ± 0.81	3.52 ± 0.68	2.46 ± 0.88	3.38 ± 0.61
	N	124	126	126	126
	P-value	**<0.0001**	0.09	0.37	0.41
Education					
High school or lower	M ± SD	2.67 ± 0.87	3.52 ± 0.58	2.61 ± 0.91	3.33 ± 0.58
	N	855	858	858	859
Graduate or postgraduate	M ± SD	2.86 ± 0.86	3.49 ± 0.62	2.45 ± 0.89	3.32 ± 0.60
	N	433	433	434	434
	P-value	**0.0004**	0.94	**0.003**	0.74
Region of transmission					
Low	M ± SD	2.78 ± 0.87	3.6 ± 0.52	2.68 ± 0.90	3.36 ± 0.56
	N	478	480	480	480
Intermediate	M ± SD	2.69 ± 0.87	3.46 ± 0.63	2.48 ± 0.89	3.32 ± 0.59
	N	766	767	767	768
High	M ± SD	2.87 ± 0.83	3.41 ± 0.61	2.6 ± 1.03	3.24 ± 0.67
	N	49	50	51	51
	P-value	0.14	**0.0008**	**0.0013**	0.39
Current employment					
No	M ± SD	2.66 ± 0.87	3.52 ± 0.58	2.58 ± 0.91	3.34 ± 0.57
	N	861	861	861	862
Yes	M ± SD	2.94 ± 0.85	3.51 ± 0.65	2.49 ± 0.88	3.32 ± 0.63
	N	330	331	332	332
	P-value	**0.0001**	0.4949	0.1286	0.8955
Living situation					
Alone	M ± SD	2.83 ± 0.87	3.33 ± 0.75	2.55 ± 0.97	3.38 ± 0.55
	N	69	68	69	69
With others	M ± SD	2.72 ± 0.87	3.52 ± 0.58	2.56 ± 0.90	3.33 ± 0.59
	N	1198	1203	1203	1204
	P-value	0.3516	0.1118	0.9691	0.4864

a: M, mean; SD, standard deviation.
Note: Elements in bold are significantly different for the group of variable ($P < 0.05$).

socially prescribed role as caregivers within the healthcare sector and beyond might have placed them in a position of higher susceptibility to experience increased levels of stress and concerns.[41] Considering that our sample largely consisted of female individuals, higher concerns for the health of others may indeed be explained by above-mentioned factors, highlighting the great necessity to further explore gender-related aspects of the pandemic responses.

Beyond sex-specific differences, we observed differential responses to the pandemic in Italy across diverse age groups. Even though younger adults reported high levels of perceived importance of policy measures, they were significantly less compliant to maintain physical distance from other individuals.[20,36] It is important to note that, similar to previous studies conducted in Italy, the younger adults in our sample were also less concerned about personal health compared to their older counterparts.[20] Considering that the younger population is currently driving the increases in transmission in Italy and across the globe,[42,43] our findings might suggest that they are likely underestimate the risks of acquiring the infection as well as their role of being carriers of the infection. Consistent with the previous surveys findings,[44–47] our data indicate that messages sensitive to the demographic target (i.e. younger adults), might benefit from an approach that would allow maintaining realistic perceptions of the risks throughout each stage of the pandemic. These implications remain a priority for reducing community transmission and protecting vulnerable populations in Italy.

Our study has some limitations that need to be acknowledged. The study design is cross-sectional in nature, which restricts our ability to make causal inference. Our sample is a convenience sample, not representative of the whole Italian population, that was recruited using internet survey methodology. Lastly, even though the iCARE questionnaire did not implement validated scales, we used robust statistical methods to determine the psychometric properties of our concerns variables. We performed sensitivity analysis and observed similar factor structures in the global convenience sample and representative sample in Canada, which further strengthens the validity of our results linking concern types to

Table 4 Logistic regression model estimating adherence to various preventive behaviours and COVID-19 related concerns

	Estimate	SE[b]	95% CIc		*P*-value[d]
			Lower	Upper	
Hand-washing with soap and water[a]					
Intercept	−0.485	1.129	−2.697	1.727	0.667
Health concerns (self) (continuous)	−0.333	0.189	−0.703	0.036	0.077
Health concerns (others) (continuous)	0.831	0.232	0.376	1.286	**<0.001**
Personal financial concerns (continuous)	−0.094	0.168	−0.422	0.235	0.576
Social/economic concerns (continuous)	0.115	0.235	−0.346	0.575	0.626
Sex (Male vs. Female)	−0.796	0.289	−1.362	−0.231	**0.006**
Age (continuous)	0.055	0.020	0.015	0.095	**0.007**
Education (high vs. low)	0.395	0.313	−0.219	1.009	0.207
Transmission region (high vs. low)	−0.020	0.777	−1.543	1.503	0.979
Transmission region (medium vs. low)	0.144	0.292	−0.429	0.717	0.622
Goodness-of-fit test[e] (*P* =0.528)					
Staying at least 6 feet or 1–2 m away from other people[a]					
Intercept	1.026	1.021	−0.974	3.027	0.315
Health concerns (self) (continuous)	0.036	0.141	−0.240	0.312	0.800
Health concerns (others) (continuous)	−0.169	0.213	−0.586	0.248	0.427
Personal financial concerns (continuous)	0.122	0.131	−0.136	0.379	0.354
Social/economic concerns (continuous)	0.074	0.195	−0.309	0.456	0.706
Sex (Male vs. Female)	−0.494	0.232	−0.948	−0.040	**0.033**
Age (continuous)	0.063	0.019	0.026	0.101	**0.001**
Education (high vs. low)	−0.141	0.273	−0.676	0.394	0.606
Transmission region (high vs. low)	1.711	1.431	−1.094	4.515	0.232
Transmission region (medium vs. low)	−0.002	0.226	−0.445	0.442	0.994
Goodness-of-fit test (*P*=0.279)					
Self-isolating if COVID-19 positive or suspected[a]					
Intercept	0.336	0.622	−0.882	1.555	0.589
Health concerns (self) (continuous)	0.014	0.097	−0.175	0.204	0.883
Health concerns (others) (continuous)	0.231	0.137	−0.038	0.500	0.092
Personal financial concerns (continuous)	0.089	0.091	−0.088	0.267	0.324
Social/economic concerns (continuous)	−0.044	0.136	−0.310	0.223	0.747
Sex (Male vs. Female)	0.168	0.167	−0.159	0.494	0.313
Age (continuous)	−0.005	0.007	−0.018	0.008	0.444
Education (high vs. low)	−0.003	0.167	−0.330	0.324	0.986
Transmission region (high vs. low)	0.293	0.447	−0.584	1.170	0.513
Transmission region (medium vs. low)	−0.018	0.160	−0.332	0.296	0.910
Goodness-of-fit test (*P*=0.651)					
Self-quarantining if returning from a trip[a]					
Intercept	0.685	0.623	−0.537	1.907	0.272
Health concerns (self) (continuous)	0.074	0.096	−0.115	0.263	0.441
Health concerns (others) (continuous)	0.062	0.138	−0.210	0.333	0.656
Personal financial concerns (continuous)	0.084	0.091	−0.094	0.263	0.355
Social/economic concerns (continuous)	0.008	0.135	−0.256	0.271	0.955
Sex (Male vs. Female)	0.014	0.165	−0.310	0.338	0.932
Age (continuous)	−0.005	0.007	−0.018	0.008	0.455
Education (high vs. low)	−0.035	0.167	−0.362	0.292	0.834
Transmission region (high vs. low)	0.038	0.423	−0.792	0.867	0.929
Transmission region (medium vs. low)	−0.225	0.161	−0.541	0.091	0.163
Goodness-of-fit test (*P*=0.940)					
Avoiding all social gatherings (large and small)[a]					
Intercept	1.638	1.256	−0.825	4.101	0.192
Health concerns (self) (continuous)	0.220	0.196	−0.164	0.604	0.261
Health concerns (others) (continuous)	0.432	0.244	−0.047	0.910	0.077
Personal financial concerns (continuous)	0.160	0.176	−0.186	0.505	0.365
Social/economic concerns (continuous)	−0.254	0.267	−0.776	0.269	0.342
Sex (Male vs. Female)	0.091	0.325	−0.546	0.728	0.780
Age (continuous)	0.020	0.018	−0.015	0.056	0.258
Education (high vs. low)	−0.534	0.389	−1.297	0.229	0.170
Transmission region (high vs. low)	−0.650	0.794	−2.205	0.905	0.413
Transmission region (medium vs. low)	−0.308	0.329	−0.953	0.337	0.349
Goodness-of-fit test (*P*=0.854)					

a: Probability of adhering to a particular behaviour most of the time was modelled.
b: SE, standard error; *N*, study sample.
c: 95% confidence interval for the regression parameters.
d: *P*-values for the chi-square test, testing the null hypothesis that the individual predictor's regression coefficient equals to zero, given the other predictor variables are in the model. Statistically significant *P*-values (<0.05) are bolded.
e: Hosmer and Lemeshow goodness-of-fit test.

behavioural adherence. Additional strengths of our research include theoretical background—the survey was designed in line with important theories of behaviour change (such as COM-B and Health Beliefs Model). This of particular importance in the context of the unprecedented pandemic, as it has become apparent that human behaviour represents a key to the success of any public health measure, from testing and contact tracing, to isolation, adoption of personal preventive behaviours and vaccine acceptance.[5] In order to implement successful policies and communication strategies leading to large scale behaviour change, it is crucial to have methodologically-sound and theory-driven scientific understanding of the complex processes that influence human behaviour. Hence, insights and feedback from behavioural and psychological scientists should be embedded in cross-disciplinary collaborations and placed at the forefront of national and international pandemic responses. The timing and the substantial sample size of the survey represents a further strength of the current analyses, allowing us to capture population responses in one of the hardest hit nations in the world and during the critical lockdown period.

In conclusion, the findings of the current study offer valuable insights about the population behavioural responses and concerns in regards to the initial pandemic phase of COVID-19 in Italy. We observed high level of awareness and adherence to recommended behaviours, mainly hygiene and social distancing measures. Adherence to self-isolation and quarantine behaviours was substantially lower, with almost a quarter of the population not adhering to these behaviours most of the time. Our sample reported elevated concerns about the health of other individuals and the economic situation of the country, notably among women and older individuals. Notwithstanding certain limitations, our findings suggest that COVID-19 public information campaigns might leverage health concerns for others to promote messages focussing on solidarity and the advantages of helping each other in order to allow large scale adherence to preventive behaviours. We believe that targeting risk-communication efforts at younger individuals as well as men, could potentially lead to higher compliance rates in future pandemic waves. On the other hand, adherence to certain measures, such as quarantining after travelling or isolating if COVID-19 positive or suspected, might fall outside complete individuals' control, and governments should provide social and economic infrastructures to ensure that sections of the population do not remain disproportionately disadvantaged by the implemented policies. Our early-pandemic results offer important implications for informing current government policies and strategies that are tackling the second pandemic wave in Italy.

Supplementary data

Supplementary data are available at *EURPUB* online.

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Conflicts of interest: None declared.

Disclaimer

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Key points

- This cross-sectional survey recruited 1332 participants in Italy and observed high levels of adherence to hygiene and social distancing measures (96%), and lower levels of adherence to self-isolation if suspected or COVID-19 positive (77%).
- Italians reported high levels of concerns regarding health of other individuals and economy of the country.
- Multivariate models showed that individuals with higher health concerns for others were more likely to adhere to hand-washing behaviour.
- Communication of COVID-19 mitigation policies should consider addressing people's concerns regarding the health of other individuals to motivate adherence to prevention measures.
- In order to avoid unequal impacts of policies and allow adherence to self-isolating measures (especially among young working adults), governments should establish social and economic support for individuals.

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