



A quantitative investigation in a territory of Italy on citizens' attitudes towards medicines through the COVID-19 pandemic: the importance of possible indirect effects caused by the pandemic

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ABSTRACT

Background: The COVID-19 pandemic has greatly influenced many aspects of everyday life, particularly that of the general population health. In order to better understand the potential impacts of the COVID-19 pandemic on people's attitudes toward medicines use, a quantitative investigation was conducted in a territory of Sardinia region, Italy.

Methods: Stratification of the random multilevel population sample was based on gender, age range, and territory. The methodological strategy to verify the potential approach changes towards medicines due to the COVID-19 pandemic consisted of oral interviews with adult citizens and unrecognizability preservation. Investigation, also supported by a study completed before the insurgence of the pandemic about taking medicines, interrupting treatments without consulting, and reading the information leaflet, allowed to explore citizens' attitudes before and during pandemic, and changing.

Results: The most relevant findings are the tendency towards a higher occurrence of self-interruption of treatments and an increased interest in the information leaflet (package leaflet), but not an increased self-administration of medicines.

Conclusions: These results indicate new indirect effects of the COVID-19 pandemic that could exert an additional impact on the state of citizens' health and health systems. The study, with reference to prophylactic medical treatments and based on some considerations concerning the pandemic from its insurgence to today, also provides solutions for related problems for the present or future periods of health emergencies.

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Background

On 5 May 2023, the head of the UN World Health Organization (WHO) declared the end of the COVID-19 pandemic, caused by the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), as a public health emergency, reminding, however, that this did not mean the disease was no longer a global threat and that millions of people would likely have lived for the future 'with the debilitating effects' of the disease (World Health Organization [WHO], 2023a). While the shift from the pandemic to the endemic status of COVID-19 is still a debated subject, with many open questions about its management (Contreras et al., 2023), it is, however, clear that SARS-CoV-2 infection is, even today, a major health concern. In fact, the COVID-19 epidemiological update published by the World Health Organization (WHO) on 17 June 2024 reported a further decrease in COVID-19 cases (−11%) and deaths (−36%) worldwide compared to the previous 28 days (1–28 April 2024), with over 129,000 new infections registered, more than 1,800 deaths reported, and a global counter, since the beginning of the pandemic, exceeding 775 million cases and 7 million deaths (World Health Organization [WHO], 2024). Nevertheless, the same report pointed out that, based on data from wastewater surveillance, the real burden of new cases was underestimated from 2 to 19-fold due to reduced testing and slow notification updates in many countries.

The management of the SARS-CoV-2 emergency has not been univocal in different countries but has in, any case, implied the adoption of a wide range of health and social measures (Wang & Mao, 2021). In some cases, a certain unpreparedness in the management of the emergency has also emerged, as shown, for example, by the bureaucratic chaos of the authorities towards masks in some countries (Damiani et al., 2021b). On the other hand, research, reports, and media have dramatically expressed that the COVID-19 pandemic has greatly influenced many aspects of everyday life (Di Renzo et al., 2020; Naveed et al., 2024). Particularly, the general dramatic effects of the global outbreak of SARS-CoV-2 on the medical system, such as indirect impacts, including some aspects of the doctor-patient relationship, negative effects on cardiovascular behaviours and cancer prevention, or the risk of reducing the compliance of patients undergoing essential care for beliefs that were later proven wrong, as in the case of dermatological patients undergoing therapy with biologics, have been reported (Bragazzi et al., 2020; Damiani et al., 2021a; Duffy et al., 2022; Laddu et al., 2023; Zhou et al., 2021).

The importance of information and attention to a correct use of medicines, has been highlighted by multiple sources at the international and national levels for many years (Bahri, 2020; Catalan-Matamoros & Peñafiel-Saiz, 2019; de Vries et al., 2017; Erice Statement, 2009, 2010; Stevenson et al., 2004; Tesfaye et al., 2023), and self-medication has been recently considered an important public health problem in many countries over the last few years (Brandão et al., 2020; Chautrakarn et al., 2021; Kassie et al., 2018; Lei et al., 2018). The COVID-19 pandemic, with a combination of several aspects (fear, isolation, difficulty in a face-to-face consultation with doctors, long and often symptomatic convalescence after infection, and organisational issues), could have affected citizens' approach to medicines with a potential additional impact on citizens' health and health systems. Nevertheless, to the best of our knowledge, no study has analysed this specific issue. Interestingly, Waheed et al., in a recent study focused on psychotropic prescribing, reported how in England the prescription of different classes of medicines was impacted by the COVID-19 pandemic, observing modifications in anxiolytic/hypnotic and antidepressant prescription, but leaving to a next step the evaluation of the pandemic influence on the individual experience to general practice access to the same medicines (Waheed et al., 2023). Moreover, a recent pilot study performed before the insurgence of SARS-CoV-2 pandemic showed how a tool based on a dedicated software platform and oral interviews can be useful to emphasise critical issues and needs regarding the use of medicines (Pittau et al., 2021).

Considering these concerns and taking advantage of previous information (Pittau et al., 2021), a quantitative investigation was performed on a sample population in a territory of Italy. The specific aim of this study was to disclose the potential impact of the COVID-19 pandemic on citizens' attitudes towards the use of medicines and related implications, and to suggest possible intervention measures able to support a correct use and management of medicines.

Methods

Study design

This is a non-clinical quantitative, study, which does not involve the processing of personal data and therefore does not require authorization opinions and does not fall under regulations on the protection of natural persons; participation in the study was on a voluntary basis, no written consent was requested, no recordings were made, responses were collected anonymously.

The study does not fall within the scope of Italian regulations on clinical trials and biomedical research, which require the opinion of the Ethics Committee, nor within the scope of data protection regulations because it does

not deal with personal data and it does not pose any risk to the safety, well-being, and fundamental rights. Therefore Committee approval was deemed unnecessary in accordance with Italian law (Law No. 3 01/11/2018 'Delegation to the Government for the reorganization and reform of clinical trial regulations'; Decree of the Ministry of Health 01/26/2023 'Art. 1, 1'; Decree of the Ministry of Health 02/01/2022 'Art. 1, paragraph 2'; Decree of the Ministry of Health 01/30/2023 'Art.1, paragraph 1, 2, 3').

Anonymous oral interview approach was selected to combine the strengths of face-to-face interview (the gold standard method) and anonymous condition (to diminish hesitancy to communicate true views). Due to pandemic limitation oral interviews were also conducted by phone maintaining anonymity. The oral interview choice was to improve interaction with the interviewees, to prevent misunderstandings and facilitating the establishment of a trusting interaction, important also to reassure the interviewee about data protection and anonymity.

Study context

This study was conducted in a southern territory of the Sardinia region of Italy, which includes two administrative provinces (approximately 782,000 inhabitants, 679,000 adults). Data were collected by oral interviews with adult citizens (≥ 18 years), by phone or face-to-face, conducted with unrecognizability preservation. The study was conducted between the end of May 2021 and August 2021. A picture of the epidemiological situation of the SARS-CoV-2 pandemic in Sardinia at the time of the study is summarised in the [Supplemental Material Table S1](#).

To obtain data representative of the territory's total population under investigation, the sample size to be interviewed was selected by stratified random sampling of the total number of adults based on demographic statistics. In particular, the process consisted of two phases: (i) a preliminary phase in which the adult population of the territory was stratified into subgroups with the same attributes, and (ii) a second phase in which the interviews were performed unbiasedly and randomly in order to obtain a number of adult people for provinces and subgroups that respected the proportions of the attributes of the entire territory under investigation. The attributes considered were: (i) gender (ii) age range, and (iii) geographic area. No other characteristics, such as cultural, social, clinical, including SARS-CoV-2 infection/vaccination situation, etc., were considered or collected during the interview. The sample size for interviews for the territory under investigation was calculated based on Lwanga and Lemeshow's suggestions (Lwanga & Lemeshow, 1991). According to Lwanga and Lemeshow the minimum estimated sample size required to obtain a 5% error was $n = 384$. Stratification was important at the beginning of the study for planning the

sampling, and it was not intended for later stage application during data analysis. Subsequently, during interviews, the exclusion criteria for gender and age range already represented according to the performed stratification were applied to achieve the composition of the sample size. Data collection, as part of the unrecognizability preservation, was organised according to the stratification by aggregating the data concerning subgroups and gender separately from the answers to the proposed questions.

The participants were contacted by one of the researchers by phone (random blind extraction from public phone books followed by random blind contact) or by random, anonymous face-to-face interviews (in open spaces and public access) when the pandemic condition allowed it. Public phone books used for random blind extraction had been previously amended by hiding personal data, i.e. names and addresses. The same preliminary subdivision of sample size into subgroups was also applied to anonymous face-to-face interviews.

Some strategies were adopted to further preserve the unrecognizability of the participants. First, the age range of the interviewees was sampled from a larger area (province). Second, gender was sampled by merging subareas when the subarea was small and then referring to the province to complete the stratification. Moreover, interviews were completed but not collected at a higher number than required from the stratification. The final sample size of the interviewees was 386, including 198 females and 188 males. Collected samples were distributed into six age ranges, resulting in a population distribution that looked qualitatively and quantitatively representative of the entire territory under investigation based on demographic statistics. All data collected are based on the combined results of phone interviews and face-to-face interviews, with no way of distinguishing between the two.

Answers to the proposed questions were collected and analysed using a dedicated software platform, named 'COLLABORA' to recall the importance of collaborating. It was an empty version of an informatics tool previously released, which was adapted according to the specific purpose of the present study, and whose adequacy had been tested for a previous study (Pittau et al., 2021). This dedicated informatics tool is a relational database-backed web application that can collect, store, and analyse information, and allows for anonymous collection and analysis of people's answers in aggregate form, which were collected and directly aggregated during the interviews. Some specific aspects concerning the implementation of unrecognizability preservation were as follows: no code was assigned to any specific interview; participants' answers were collected during interviews, and data directly generated aggregate data charts; to conduct oral interviews by phone, random blind extraction and random blind contact were conducted by two separate researchers; all related materials were destroyed at the end of the study.

In addition to a preliminary phase concerning the set of questions/possible answers proposed through interviewed citizens, to evaluate meaningful information from a pharmaceuticals and pharmacological/virological point of view and on the intelligibility of questions/answers, scientists with proven experience in the field were asked to give their opinions. The scientists expressed a positive opinion about the potential contribution of the study to the debate.

Data collection and analysis

Citizens were asked by one of the researchers to provide information to evaluate their approach concerning medicines during the pandemic using questions 1–4 reported in [Table 1](#). These questions were evaluated using a binary yes-no scale. Then, three more questions were asked to evaluate the potential changes in the citizens' approach to medicines due to the pandemic, as reported in [Table 1](#), numbers 5–7. In this case, the evaluation was performed on a ternary more-less-equal scale.

Original questions in Italian are reported as [Supplemental Material Table S1](#).

The inclusion criteria were as follows: (i) age ≥ 18 years and (ii) living in Sardinia. The exclusion criteria were as follows: (i) age under 18 years, (ii) living not in Sardinia, (iii) giving inconsistent/confused answers, (iv) gender already represented according to the performed stratification, and (v) age range already represented according to the performed stratification. In particular, the interview of one respondent who gave inconsistent or confused answers was completed but excluded, that is, it was not collected. At the

Table 1. Set of questions.

Question	Possible answers
1. Did you take medicines without consulting the doctor or pharmacist during the pandemic?	yes/no
2. Did you interrupt a treatment (including also not having done it) without consulting the doctor during the pandemic?	yes/no
3. If you answered 'no', is this because you started a treatment during the pandemic?	yes/no
4. Did you read the information leaflet of drugs during the pandemic?	yes/no
5. Did you take medicines without consulting the doctor or pharmacist during the pandemic more than before the pandemic, equal to before the pandemic, or less than before the pandemic?	more than / equal to /less than before the pandemic
6. Did you interrupt a treatment without consulting the doctor during the pandemic more than before the pandemic, equal to before the pandemic, or less than before the pandemic?	more than / equal to /less than before the pandemic
7. Did you read the information leaflet during the pandemic more than before the pandemic, equal to before the pandemic, or less than before the pandemic?	more than / equal to /less than before the pandemic

end of the interview process, after a summary of the answers, the software platform had the option to collect or exit the interview. Examples of inconsistent/confused answers resulting in exclusion were: (i) recalling a given answer and changing it, during the interview, repeatedly without explanation or request for an explanation, (ii) expressing difficulty in understanding the question and providing an answer even when the question was repeated and explained multiple times, and (iii) inconsistent responses between the groups of questions 1–4 and 5–7. The same approach (i.e. interviews completed but not collected) was also applied for interviews given by respondents whose gender or age range characteristics were already represented according to the performed stratification. During the proposition of questions 5–7, the order of the ternary options changed continuously and randomly. Each randomly sampled citizen could respond to only one interview.

Statistical analysis

Differences in the proportions computed before and during the pandemic were tested using a normal approximation of the binomial distribution. This approximation is reasonable because of the large number of samples considered in the study. The statistical test is implemented by testing whether two normal means are equal or not by using the z-statistics reported in Equation (1).

$$z = \frac{\hat{p}_1 - \hat{p}_2}{\sqrt{\hat{p}(1 - \hat{p})(1/n_1 + 1/n_2)}} \quad (1)$$

In Equation (1), \hat{p}_1 and \hat{p}_2 represent the proportions estimated before and during the pandemic, respectively, n_1 and n_2 indicate the sizes of the corresponding samples. The value $\hat{p} = (n_1 \hat{p}_1 + n_2 \hat{p}_2)/(n_1 + n_2)$ is the pooled proportion of the two samples. A two-tailed test was implemented. Differences were considered significant when the p -value was less than 0.05. A Clopper–Pearson method (Johnson et al., 2005), was used to compute the 95% confidence interval for the estimated percentage for questions 1–4 (with the software MATLAB release R2020a).

Results

Investigation on citizens' approach to medicines, treatments and information leaflet during the pandemic and perceived changes

Figure 1 shows the chart obtained by the software platform, which summarises the number of people interviewed and categorises them by age range (as stated by the interviewee). The first aspect investigated was the respondents' approach to medicines during the SARS-CoV-2 pandemic. Analysis of the

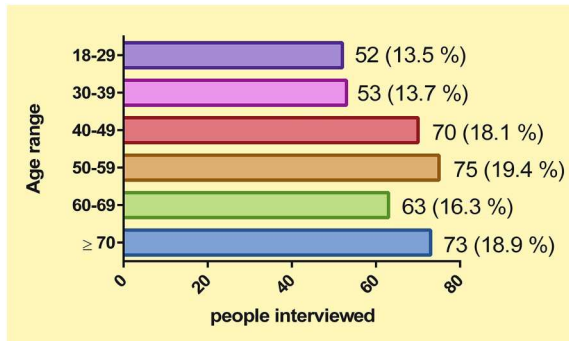


Figure 1. Chart of the people interviewed distinguished by age range, expressed as absolute numbers and percentages.

results showed that about 35% of interviewees (with a confidence interval for the percentage estimate equal to $30.5 \div 40.2$) answered ‘yes’ for having taken medicines without consulting health providers during the pandemic; about 32% of interviewees (with a confidence interval equal to $27.7 \div 37.3$) professed treatment interruption during the pandemic without consulting the doctor (12.4% answered ‘no’ for interruption because started a treatment); and about 55% of interviewees (confidence interval equal to $50.1 \div 60.2$) asserted that they had read the information leaflet (package leaflet) during the pandemic. Percentages of ‘yes’ and ‘no’ answers are reported as pie charts showing the parts-to-a-whole relationships in [Figure 2](#).

The second aspect investigated, concerning the potential changes in citizens’ approach to medicines as a consequence of pandemic condition, can be evaluated by the answers given by respondents to questions 5–7, as reported in [Figure 3](#). About 94% of respondents said that they had taken medicines without consulting ‘equal to before the pandemic’; about 29% said that they had interrupted a treatment without consulting ‘more than before the pandemic’; and about 30% of interviewees reported that they had read the information leaflet (package leaflet) ‘more than before the pandemic’. It is important to clarify that the meaning of the questions was explained to the respondents each time, to prevent misunderstanding/misinterpretation. All interviewees were invited to answer questions 5–7. The aim was to better address these questions in an actual auto-evaluation of the potential difference in respondents’ attitudes towards the proper use of medicines, whether it was the case (i.e. during the pandemic more or less than before the pandemic) or not (i.e. during the pandemic equal to before the pandemic).

As emerged from the analysis of citizens’ answers, the results indicated that some critical changes seem to have occurred with respect to citizens’ attitudes towards medicines and treatments as a consequence of the pandemic.

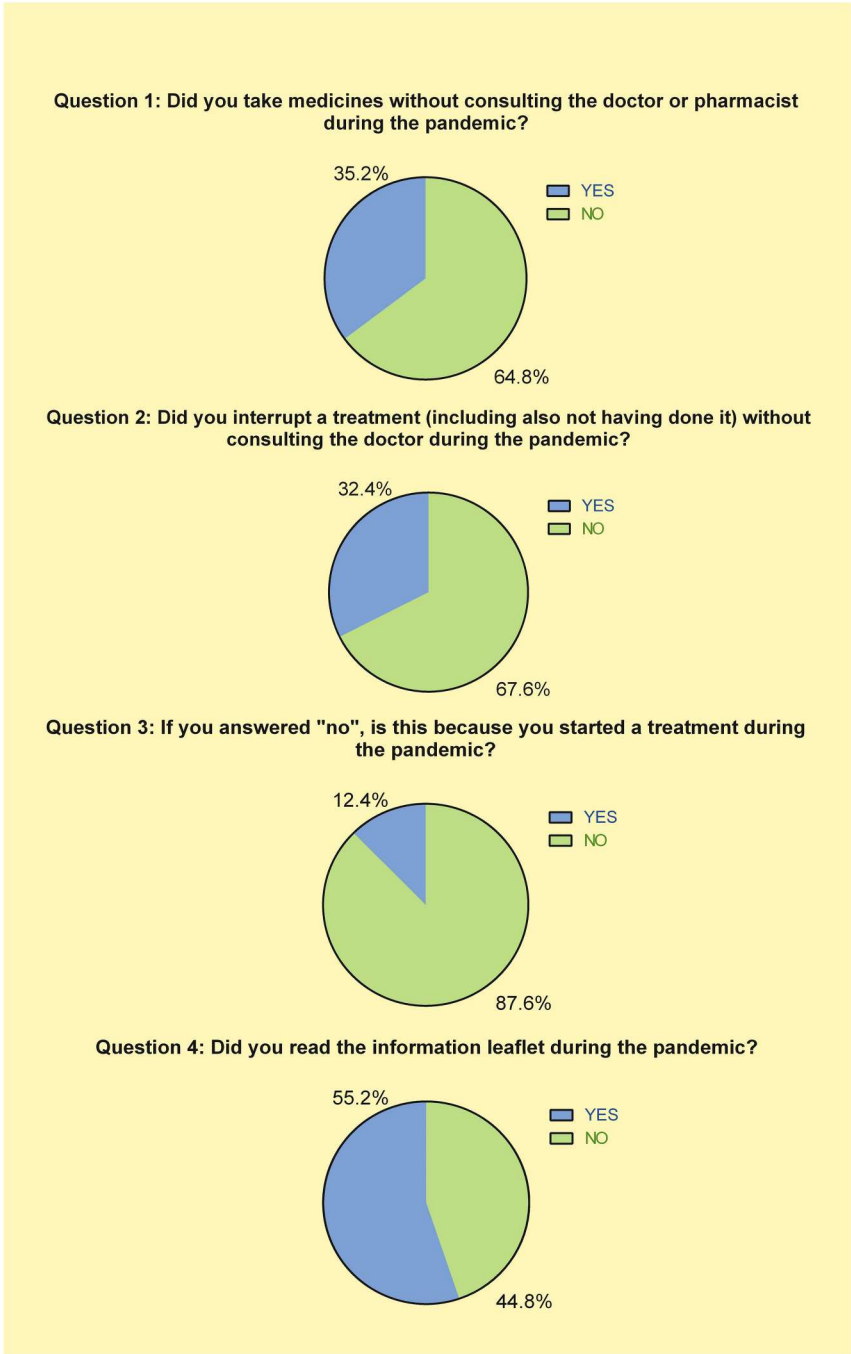


Figure 2. Answer charts for questions 1, 2, 3, and 4.

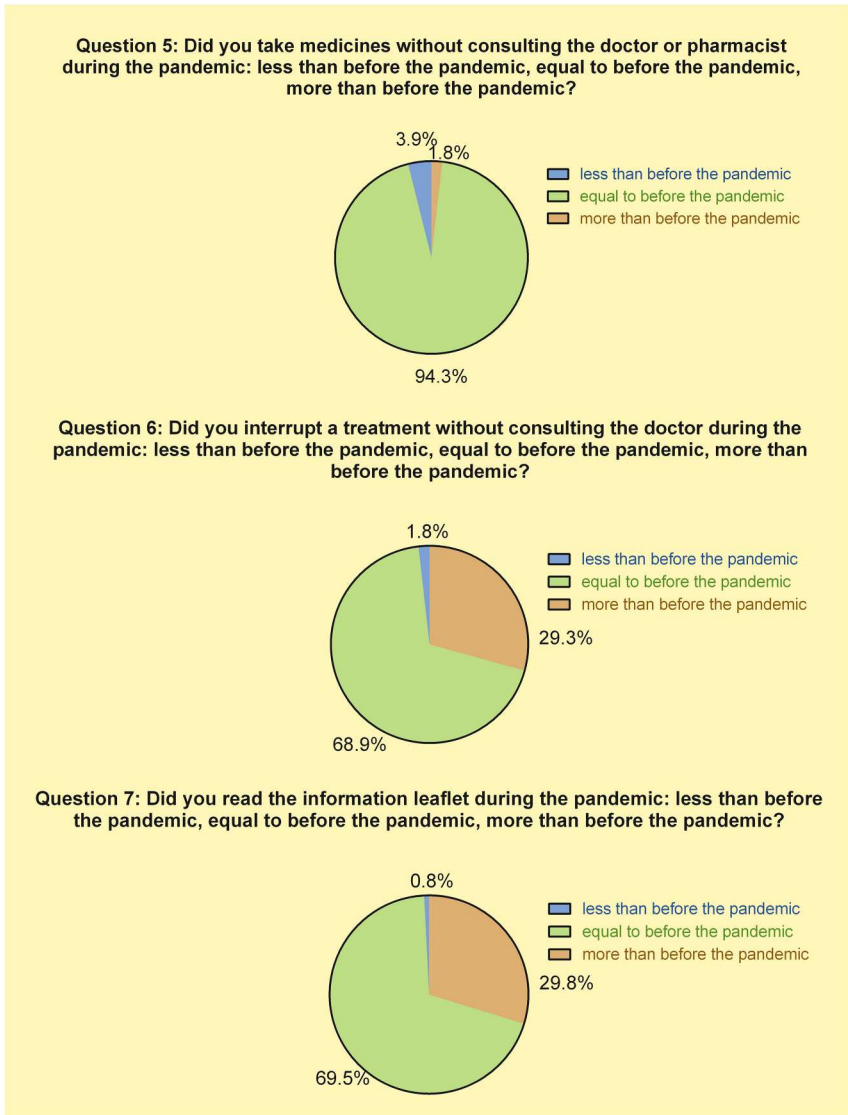


Figure 3. Answer charts for questions 5, 6, and 7.

Investigation on citizens' approach changing before and during the pandemic by comparison to a pre-pandemic period study

To further support this evidence, we performed a direct comparison between answers given by citizens in the present study and those given to the same topics in a previous study performed in an area in the southern territory of the same region before the insurgence of the SARS-

CoV-2 outbreak (Pittau et al., 2021). The results of this comparative analysis are reported in Table 2.

Regarding to the self-use of pharmaceuticals without health care professional consultation, the percentage of interviewees who answered ‘yes’ for self-use (about 35%) during the pandemic period can be analysed in association with the high percentage (>94%) of answers that this self-use was ‘equal to before the pandemic’. This result is consistent with the previous study performed before the insurgence of the SARS-CoV-2 outbreak. The antecedent study, applying random sampling and a high number of interviewees, indicated a percentage value of 33% for self-use of pharmaceuticals. Therefore, it could be concluded that the pandemic does not seem to have changed citizens’ attitudes towards the self-use of medicines. This picture is also confirmed by comparing the confidence intervals obtained for the percentage values estimated for Question 1 posed before and during the pandemic, showing an important overlap between them, which implies no statistically significant difference. Incidentally, the z-test on the proportions corroborates this conclusion, showing a z-statistics equal to $z = 0.906$, corresponding to a $p = 0.365$.

Findings relative to the self-interruption of treatment showed that 32% of the respondents professed the self-interruption of treatment during the pandemic. Interestingly, moreover, about 29% said that they had interrupted it ‘more than before the pandemic’. The previous study performed in the pre-pandemic period reported 22% self-interruption (Table 2). Thus, we could obtain the indication that about 10% more citizens (i.e. 32 minus 22%) interrupted a treatment during the pandemic compared to the pre-pandemic period. Furthermore, the confidence interval estimations concerning the questions posed before and during the pandemic do not overlap, confirming

Table 2. Comparison between the answers given before the pandemic and during the pandemic.

Question	Answer				Statistical analysis
	Before the pandemic*		During the pandemic		
	Yes (%)	Confidence interval	Yes (%)	Confidence interval	
Did you take medicines without consulting the doctor or pharmacist?	32.9	31.3÷34.2	35.2	30.5÷40.2	z value = 0.906 p -value = 0.365
Did you interrupt a treatment without consulting the doctor?	22.2	20.6÷23.5	32.4	27.7÷37.3	z value = 4.47 p -value = $7.82 \cdot 10^{-6}$ **
Did you read the information leaflet of drugs?	30.2	26.0÷34.2	55.2	50.1÷60.2	z value = 7.40 p -value = $1.36 \cdot 10^{-13}$ **

* Results of the previous study performed before the SARS-CoV-2 pandemic

** $p < 0.05$.

an evident and significant increase in self-interruption. Additionally, a significant difference emerges between the data collected before and during the pandemic. The z-statistics is equal to $z = 4.47$, corresponding to a p -value $p = 7.82 \times 10^{-6}$. Thus, it could be concluded that the pandemic condition seems to have changed the attitude towards the self-interruption of a treatment increasing the tendency towards discontinuation without consulting health professionals, even for those who used self-interruption before the pandemic.

Concerning the reading of the information leaflet, the study findings showed that about 55% of the interviewees had read it during the pandemic and about 30% had read it more than before the pandemic. Again, compared to the previous study, reporting at the pre-pandemic time that about 30% of citizens professed to read information leaflets, we could obtain the indication that about 25% more citizens (i.e. 55% minus 30%) had read the information leaflet during the pandemic. Again, a comparison of the confidence interval estimations related to question posed before and during the pandemic shows that they do not overlap, confirming that the pandemic condition seems to have changed the attitude towards reading the information leaflet, increasing the approach to reading. There is a significant difference between the pre-pandemic and pandemic period, with a z-value of 7.40 corresponding to a practically nil p -value.

Answers to question 2 refer not only to household medicine management alone, as for treatment interruption connected with the conditioned activity of local health services during the pandemic, as emerged during the interviews. In fact, many respondents' answers were 'no' regarding self-interruption because the suspension of the treatment was not their choice, but it was due to external factors related to the pandemic. Therefore, the treatment interruption that occurred during the pandemic seems to be underestimated by the percentage of 'yes' answers from citizens in the interviews given during the pandemic. Moreover, it is noteworthy that the results derived from the territory of each of the two distinct administrative provinces included in the sample area showed very similar answers to the seven questions, with only a few percentage points of difference.

Discussion

The COVID-19 pandemic exerted global implications on adults' lifestyle behaviour as collateral and long-term effects (Musa et al., 2023). Particularly, an inappropriate approach to medicines by citizens as a consequence of the pandemic could be a potential additional impact on citizens' health and health services. Our study's findings provide new data on the unexpected consequences of the COVID-19 pandemic on citizens' attitudes towards medicines and treatments and confirm or disregard some suspected

consequences concerning the same issue. In fact, our results indicate that the pandemic condition seems to have increased the tendency towards discontinuation of treatment without consulting a health professional, even for those who used self-interruption before the insurgence of the SARS-CoV-2 outbreak. The increasing tendency towards self-interruption of treatment could be a potential additional injury caused by COVID-19 to the people. This is a crucial aspect to consider whether it is due to the general fear factor, whether it depends on an increased, specific distrust towards medical treatments, whether it is linked to the suspension of part of the activity of the health systems, or whether it depends on concomitant factors. The specific issue of self-interruption of treatment during the COVID-19 pandemic has not, to our knowledge, been addressed by other studies. However, our data seems to be in line with the preliminary results obtained in a study carried out in Italy as part of a project dedicated to assessing patients' non-adherence to chronic therapies, based on the monitoring of administrative flows concerning patients who had to refill prescriptions for chronic therapy registered by the adherent Local Health Authorities (Degli Esposti et al., 2020). This study showed a tendency of increased failed prescription refill after the first months of COVID-19 outbreak.

Interesting to note, our results did not indicate an increase in self-administration during the pandemic. Nevertheless, even if the percentage of citizens self-administering medicines does not seem to have worsened during the pandemic, our findings confirm the high attitude of citizens toward this practice. Previous studies reporting data collected before the SARS-CoV-2 outbreak have shown a wide range of self-administration prevalence (between 11.2% and 93.7% in function of target population and country) (Chautrakarn et al., 2021). According to a study, among older adults, across Europe, the prevalence of self-medication was around 25% (between 49.4% in Poland and 7.8% in Spain) (Brandão et al., 2020). Our finding (about 35%), although with the necessary differences in the study samples, seems also consistent with the European context and far from, for example, the self-medication rate around 88% detected in metropolitan areas in Thailand (Chautrakarn et al., 2021). In this context, it is also important to consider that differences in the rules of the different countries concerning medications available without prescription and prescription medications may affect the habits. Moreover, the same differences are an additional obstacle to comparing our results with those of similar studies. In fact, some studies have addressed the topic of self-medication practices during the COVID-19 pandemic, indicating that such practices were widespread and diversified across countries and populations, as recently reviewed (Zheng et al., 2023). However, the same review concluded that similar high prevalence rates had been reported in studies carried out in pre-pandemic periods, but the heterogeneity found in the studies carried out in distinct territories precluded

real direct comparisons on the specific topic of changes in self-administration in the pre-endemic and endemic periods.

Another interesting finding of our study is the increase in reading the information leaflet (package leaflet) during the COVID-19 pandemic. This finding is also original. In fact, we couldn't find any published article that paid attention to this point. This result could be explained by the greater need for information or increased sensitivity towards the importance of health information. During the pandemic, citizens' needs for official information, such as that reported in the patient information leaflet, might have been more marked with respect to possible unofficial alternatives, such as those offered by social media. In contrast, this finding could reflect more suspicion about medical treatments. Studies have shown that misinformation on social media and unprecedented quarantine measures exacerbate panic (Bendau et al., 2021; Dong & Bouey, 2020). Moreover, increased reading of the information leaflet could have been the result of the not irrelevant number of individuals who experienced long-term sequelae after acute SARS-CoV-2 infection (Scharf & Anaya, 2023). An explanation such as an increased need for information about medicines could be also supported by pre-pandemic findings (Pittau et al., 2021).

In Italy, which was seriously affected during the first two pandemic waves accounting for approximately 4.4 million total cases in the summer of 2021, Sardinia counted for approximately 66 thousand cases (Supplemental Material Table S2). Even if successively refuted by a dedicated study (Rocchigiani et al., 2023), after the summer of 2020 Sardinia was supposed to give rise to the second Italian wave due to intense tourist flow. In this context, our findings could have also some relationship with approach to vaccines. Results of a study indicate a positive link between the willingness of individuals to be vaccinated against COVID-19 and trust in health institution (Jennings et al., 2023). Data on COVID-19 vaccination dated on May 2023 show percentages of 84.6% fully vaccinated and of 86.0% with at least one dose in Sardinia, in comparison with 84.1% and 85.6%, respectively, throughout Italy (Supplemental Material Table S3). Thus, also considering the relative impact of SARS-CoV-2 infection cases in Sardinia at the time of our investigation, our results concerning approaches to medicines and treatments do not seem to deal with distrust toward medical treatments. Looking to more recent data, i.e. those referring to the COVID-19 2023/2024 vaccination campaign, particularly in the population aged 60 years and above, i.e. the most at risk age group, it can be noticed that the % vaccination coverage in Sardinia is about half of that in the whole Italy (Supplementary Material Table S4). Based on the above reported considerations therefore, although we cannot completely rule out an increased distrust toward medical treatments, the low adherence in the recent vaccination campaign in Sardinia can be connected to a general finding of a lower number of new SARS-CoV-2-positive cases in

Sardinia with respect to the rest of Italy, not counteracted by a robust vaccination information campaign in the recent period. Nevertheless, it should also be noted a general low adherence to the 2023/2024 COVID-19 vaccination campaign in Italy ([Supplementary Material Table S4](#)). We think that it will be significant primarily to target information/communication actions during current time and for the future.

It is worthy of note that this study provides data on *modus operandi* of citizens during the SARS-CoV-2 emergency, giving the opportunity to make a direct comparison with the pre-pandemic period, thanks to a previous and extensive investigation on the same object completed in an area of the same region shortly before this one. Moreover, with reference to the present situation, our study draws attention to the importance of monitoring the changing in attitudes to verify if it will persist or even worsen after the end of the pandemic emergency. The awareness of the changing could help health services and involved professionals in their interaction with citizens concerning the management of medicines and treatments, and hopefully lead to reducing potential health problems and costs. Future studies will address related issues. Finally, we would like to underline that, to the best of our knowledge, this study is the first that addresses the specific issue of the indirect effect of COVID-19 pandemic on citizens' attitudes towards medicines and treatments, collecting relevant information by directly involving people. Another feature that outlines the uniqueness of this study is represented by the fact that it was possible both to explore changes due to the pandemic perceived by citizens on their habits, in a kind of self-evaluation, and changing by comparison to an immediate pre-pandemic period study, in a homogeneous territory. All this can offer health providers and stakeholders the opportunity to draw considerations related to the main new information, taking into account changing that have occurred due to the pandemic from its onset until today. The practical implications of the study are therefore that health providers and stakeholders could, also by further investigation about possible causes of people's behaviour towards medicines and treatments, face with it proposing appropriate solutions immediately and in perspective over time.

Limitations

This study has some limitations. First, due to pandemic restriction, interviews were performed by phone and face-to-face in open-space public areas, where possible. Our experience, presumably also connected to the pandemic condition, was that interviews by phone showed a lower response rate. The difference between the way interviews are carried out, only face-to-face in the pre-pandemic period study, and combined in the pandemic period, can still represent a potential bias in the comparison. In addition, another

potential bias affecting the study could be the impact that the COVID-19 pandemic has had on citizens, considering that it is possible that the emergency condition may have enhanced scepticism and habit to distance compared to pre-pandemic period. Nevertheless, interviews by phone coupled with face-to-face interviews allowed us to increase random sample variability and reach the calculated sample size in a reasonable time, thus avoiding lack of homogeneity during the investigation period. Moreover, the choice to address questions 5, 6, and 7 to all the respondents was to collect an overall auto-evaluation of the potential difference in their attitudes. However, because of this choice, an appropriate explanation of these questions was necessary during the interviews. In some cases, where interviewee answered 'no' for a treatment interruption but with consulting an health professional other than a doctor, it was included as a not self-interruption, and this could be another potential bias. Another limitation of our study could be the choice not to take into account and not to collect additional characteristics of the participants as it does not support a further data analysis. However, stratified random sampling was also applied to prevent confounding bias. In fact, our main intent was to preserve the participants' unrecognizability. Finally, another limit may be derived from memory bias during the COVID-19 pandemic due to time lost or different perceptions.

Conclusions

In conclusion, the findings of the present study, offering considerations through the COVID-19 pandemic from the emergency until today, provide simple and clear information for the current time and next future as well as for possible future emergencies. In particular, new information is provided about indirect effects of the COVID-19 pandemic on citizens' attitudes such as the tendency to self-interrupt treatment or read the information leaflet. It is also interesting that the prevalence of self-administration observed does not seem to have increased during the pandemic; rather, it confirms the high percentage of citizens who self-administer medicines.

This study carries, therefore, two key messages for the health systems and personnel involved in management of medicines and treatments. The first is taking actions to identify and discourage behaviours with possible dangerous consequences, such as self-interruption and self-administration, could be very important. The second is encouraging actions to enhance information/communication about medicines and treatments toward citizens, such as a capillary health care support, might be a solution to organise especially during emergencies. These messages represent critical aspects for citizens' health and health services due to their implications for a proper use of pharmaceuticals tools and an optimal use of related services and resources. In particular, moreover, it seems important that such actions should be carried out without any

interruption whatsoever. Overall, from one side our conclusions are perfectly in line with recent position statements of WHO/Europe that recommends applying the lessons of SARS-CoV-2 pandemic to accordingly strengthen the resilience and the functioning of the healthcare systems (World Health Organization – European Region, 2023b). On the other side, our findings highlight how important it is to control the indirect effects of pandemic emergencies and how critical could be persisting with the control even after they have been declared over. In conclusion, the simple but clear results of our study support the need for future research and actions to keep attention high on possible indirect effects of the pandemic, and monitoring whether these effects persist, reoccur or even worsen.

Ethics approval and consent to participate

Not applicable.

Consent for publication

Not applicable.

Availability of data and materials

All data generated or analysed during this study are included in this published article and its [Supplemental Material](#).

Authors' contributions

Conceptualisation: BP; methodology: BP, GO, MG, FP, and AM; software: PP; formal analysis: BP, and MG; writing-original draft preparation BP, and AM; writing-review and editing: BP, MG, and AM; supervision: BP, and AM; funding acquisition: BP. All authors have read and approved the final version of the manuscript.

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Disclosure statement

No potential conflict of interest was reported by the author(s).

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