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A multifaceted analysis of decreasing trust in health institutions in the EU during the COVID-19 pandemic

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Abstract

Background Public trust is crucial during health crises, such as the COVID-19 pandemic, for the effective implementation of scientific and policy interventions. This study investigates factors contributing to the decline in trust in the health sector within the European Union during the pandemic.

Methods Using the publicly available 2020–2022 Standard Eurobarometer dataset, we employed a "geography of trust" approach. We applied equal quantile mapping to visualise high and low trust countries and Local Spatial Autocorrelation (LISA) to identify statistically significant clusters. Using a series of one-way ANOVA, we found associations between socio-economic and other variables available in the same dataset with trust.

Results Trust in health institutions and medical staff declined in 20 of 27 EU countries from 2020 to 2022. Clear geographical clusters of Western and Central Europe as the high-trust countries and Eastern Europe as the low-trust countries emerged through mapping. One-way ANOVA revealed that contrary to several studies, age, gender, and most demographics did not vary with trust, but trust was directly associated with the satisfaction with measures taken to fight the COVID-19 pandemic, and individual perceptions about their life and national affairs ($p < 0.001$).

Conclusion High-trust Western European countries share characteristics in health systems, governance, and pandemic responses. Understanding this interplay could inform trust-building strategies. The persistent low trust in Eastern Europe may stem from slow government responses and requires nuanced approaches considering unique contexts. The decline in traditionally high-trust countries highlights challenges even in established social contexts. This study provides valuable insights for policymakers aiming to foster trust during health crises.

1 Introduction

Trust plays a crucial role during health crises, as emphasized by the World Health Organisation (WHO), which lists building trust as the foremost element in successful communication. The public's trust in their governments and related social institutions greatly influences the capacity of governments and nations to handle such situations and protect citizens' lives [1]. The most recent COVID-19 pandemic, that caused significant human suffering, hospitalisations and fatalities, and had a profound socio-economic impact [2–5], threatened to challenge this very aspect of public trust [2, 3]. The "infodemic"[4] of the spread of misinformation accompanying the rapid spread of infectious diseases poses a significant

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risk to public and global mental health [5, 6], underscoring the importance of trust in countering incorrect information and ensuring transparent and competent government decision-making. Harari's opinion points out that "today humanity faces an acute crisis not only due to COVID-19, but also due to the lack of trust between humans. To defeat an epidemic, people need to trust scientific experts, citizens need to trust public authorities, and countries need to trust each other" [7].

Public trust during the COVID-19 pandemic has been influenced by various socio-economic determinants, as demonstrated in the existing literature on institutional trust and trust in governments [8]. Research from all over the world shows that demographic indicators such as gender, age and income significantly affect trust in governments across different countries [9–11].

Moreover, studies argue that in different countries, different values are prioritized that shape the public policies [3, 12], and we note that trust could be a response to general public perceptions of government policies. Looking at the pandemic in retrospect, a study found that societies with high trust in government and interpersonal trust reacted slower to the pandemic, probably because of the assumption that the government does not need to impose restrictive measures where trust is high, and rather rely on people's compliance with social distancing recommendations [13]. Yet, acceptance of individual measures is heavily dependent on public policies and trusted information for the community [14]. Therefore, it is important to acknowledge the specific pattern of trust—it is affected by major health events and subsequent government responses, while at the same time affecting the impact of responses.

In the European Union (EU), the alarming potential of the pandemic became evident by March 2020. However, despite a collective response from EU countries, there were variations in the policy mix and timing, even among relatively similar EU member states [13]. We focus our analysis on these EU countries, to study the dynamics of public trust during the pandemic. During this unique crisis, national responses such as the lockdown schedules for schools and other public spaces and the use of the COVID Pass varied, and research shows that the consequences in terms of life expectancy also differed [15]. First-of-its-kind scientific groups or councils were formed in Western Europe to provide scientific advice to governments and citizens to a large extent, based on the best available evidence at that given point of time. Pooling large databases and combining input from computational fluid dynamics, evolutionary genetics, behavioural science and in some cases, even economics and ethics proved to be a successful endeavour by these councils [16]. These various initiatives and their influence on political decisions could have contributed to differences in trust in governments, policies and health institutions which in turn are at the forefront of executing these policies. This complex setting and interplay make it challenging to uncover how public trust is influenced and via which actions. To move towards a more detailed understanding, the Eurobarometer survey can be a helpful starting point. It can be used to visualise and analyse variations in public trust. Most of the previous public trust studies tried to measure or assess public trust in various institutions and information sources, identify the determinants of trust, or address the impact of trust on health outcomes such as vaccinations, their focus is usually on trust in governments or institutional trust [1, 8, 12, 17, 18]. While that is useful, the Eurobarometer dataset introduced a new subset of these institutions as "trust in health institutions and medical staff", shortly after the declaration of the coronavirus pandemic in Summer 2020, providing an opportunity to delve deeper public trust in health institutions specifically. Moreover, we can compare the general socio-economic determinants of institutional trust—such as age, gender, education, income and region as identified by previous studies as determinants of trust in public authorities [1] or governments [8]—with the determinants of trust in the health sector, thus enabling a richer discussion on public trust during the pandemic.

With this study, we aim to contribute to knowledge in the dynamics of public trust, especially in health institutions, in two parts: first, we bring out a missing dimension of spatio-temporal visualisation in the public trust debate, especially when elaborate country level data is available. While every EU country has its own unique characteristics, it has been successfully argued that shared borders create common values that in turn could be reflected in public trust dynamics, and that these could potentially impact or be impacted by the responses to the COVID-19 pandemic [19]. Hence, we present a spatio-temporal visualisation and analysis of public trust in the health sector in this study.

Second, we aim to understand these cross-country variations in trust through the lens of socio-economic factors within the same dataset. Studies prior to the pandemic identified that older individuals tend to have higher trust levels due to a more collective-oriented perspective [9, 11]. Gender and household composition also impact trust [20], with men generally showing higher trust levels, while women were more often neutral, with regional differences playing a crucial role in trust dynamics [1]. Other studies corroborated these findings on a global scale, showing that better health conditions positively influenced trust, whereas higher education and income had a negative effect [8]. Mixed findings exist regarding income, as higher income is associated with greater trust in some contexts but not others [9, 21]. Education is consistently found to be negatively associated with trust, as higher-educated individuals tend to be more critical of governments [9]. Also, political context matters, with higher levels of democracy and

political rights enhancing trust in governments [22–24]. Lastly, studies show that respondents' perception of the satisfaction in their own life [25, 26] and their life evaluations [27] are also predictors of trust. This body of research informs our hypothesis of socio-economic factors in shaping public trust during crises. Specifically:

H1 (Socio-economic factors and beyond): Socio-economic factors such as age, gender, health conditions, education, and income, as well as factors such as political context and favourable perceptions of their life and national affairs are significantly related to public trust in health institutions during the COVID-19 pandemic.

H2 (Variation between high-trust and low-trust countries): The socio-economic determinants of trust in health institutions differ between high-trust countries and low-trust countries.

H3 (Variation in Increasing (Positively deviant) vs. Decreasing Trust (Negatively deviant) Countries): Countries with increasing trust in health institutions exhibit differences in socio-economic determinants compared to countries with decreasing trust.

We ascertain that these dimensions will contribute to the broader discourse on crisis response in public health and inform targeted health policy and communication strategies, pointing towards a direction for in-depth analysis.

2 Methodology

2.1 Data

Data from the publicly available dataset Standard Eurobarometer 93 (Summer 2020) to 97 (Summer 2022) [28–32] was used in the analysis presented in this paper, with some initial parts of the analysis extending to Standard Eurobarometer 99 (Summer 2023) [33, 34]. The Standard Eurobarometer is a bi-yearly public opinion survey that captures public opinions on various aspects, including trust, and has been doing so even before COVID-19 [35].

The variable representing trust in health institutions and medical staff (hereby, HIMS) is based on the following question from the Standard Eurobarometer:

How much trust do you have in certain institutions? For each of the following institutions, do you tend to trust or tend to not trust it?

A. *Tend to trust*
B. *Tend to not trust*
C. *Don't know*

For our analysis, we chose percentages of respondents who answered with "tend to trust" as the indicator of trust. Initially, we looked into trust in public administration and trust in regional or local public authorities to contextualise trust in HIMS, before we focused our analysis specifically on trust in HIMS. Trust in HIMS was introduced in the Standard Eurobarometer 93 (Summer 2020). Trust in public administration was discontinued after Standard Eurobarometer 97 (Summer 2022).

2.2 Spatial analysis

We applied equal count (quantile) intervals for Summer 2020 data, so that each class will have the same number of elements, and used the same intervals to map percentages of the samples who "tend to trust" in each country, at each time point of the standard Eurobarometer survey: summer 2020, winter 2020/21, spring 2021, winter 2021/22, and summer 2022—classifying countries into high to low trusting countries. To deepen our understanding of the patterns that emerged out of this step, we expanded our analysis to spatial statistics using Local Spatial Autocorrelation (LISA). LISA uses Local Moran's I to measure spatial autocorrelation, identifying areas with similar values that are clustered together or dispersed across the study area, here, the EU region. The formula for calculating Local Moran's I is as follows:

$$I_i = \frac{(x_i - \bar{x})\left(\sum_{j=1}^{n} w_{ij}(x_j - \bar{x})\right)}{\sum_{j=1}^{n}(x_j - \bar{x})^2}$$

where:

- I_i is the local Moran's I value for observation i,
- x_i is the value of the variable of interest for observation i,
- $\bar{x}$ is the mean of the variable of interest for all observations,
- w_{ij} is the spatial weight between observation i and observation j,
- n is the total number of observations.

In this formula, $\sum_{j=1}^{n} w_{ij}(x_j - \bar{x})$ represents the spatial lag, which is the weighted average value of the variable of interest in the neighbouring locations of observation i. The formula essentially compares the value of the variable for a specific location with the average value of its neighbours, considering the spatial weights. The Moran's I value spans from −1 to + 1, where a value approaching + 1.0 indicates clustering, a value of zero indicates randomness, and a value nearing −1.0 suggests dispersion [36]. Local Moran's I is often used to identify clusters of similar values (high-high or low-low) and outliers (high-low or low–high) in a spatial dataset. It provides a local measure of spatial autocorrelation for each observation, allowing for the identification of spatial patterns at a fine scale. Here, we used LISA maps to identify statistically significant clusters (and cluster cores) of high and low trust countries.

2.3 Statistical analysis

A series of one-way ANOVA were performed to compare the effect of socio-demographics on the trust in health institutions and medical staff in the Standard Eurobarometer 97 (Summer 2022) data. Variables were selected based on their theoretical significance and relevance to the research question, as supported by the existing body of literature on public trust and socio-economic factors—"age", "gender", "education", "socio-professional category", "household composition", "marital status" and "use of the internet" as seen in multiple studies [8, 9, 11, 20]; "left–right political scale" was included based on evidence that political orientation influences trust levels [22–24]; "consider belonging to (economic class)", and "difficulty paying bills" were included as proxy indicators of income supported by literature indicating that economic status significantly impacts trust in government, albeit with mixed findings on the direction of this relationship [9, 21]—to use in comparing the means (mean trust represented by % sample who "tend to trust" in HIMS) between groups, to test all three hypotheses H1, H2, and H3.

Additionally, "satisfaction with the life you lead", "things in your life are going in the right/wrong direction", "things in your country are going in the right/wrong direction", and "things in EU are going in the right/wrong direction" were included for their relevance with individual perceptions, happiness, and life evaluations for public trust [25–27]. Lastly, "Satisfaction with measures taken to fight the COVID-19 pandemic by the government" was included as it directly relates to the public's perception of government effectiveness during the crisis; "Satisfaction with measures taken to fight the COVID-19 pandemic by the EU" was included for its relevance to assessing trust in EU-level responses to the pandemic; and "Trust the EU to make right decisions in the future regarding the coronavirus pandemic" was included to capture trust in future actions by the EU, which is crucial for understanding broader institutional trust and its influence on specific trust in HIMS.

For the analysis, the countries were grouped as given in Table 1.

EU countries: All of the 27 European Union countries which were surveyed by the Standard Eurobarometer were included in this group at this stage of the analysis.

Higher and Lower trust countries: Our initial mapping exercise classified countries into 5 categories using equal count (quantile) intervals in the Standard Eurobarometer 93 data. Using the same intervals, we then classified Standard Eurobarometer 94, 95, 96 and 97 data, and then used the Eurobarometer 97 categories for this part of the grouping. To ensure a balanced distribution between high and low trust countries, we grouped countries greater than 78% who "tend to trust" (as per the cut-off of the yellow category in Eurobarometer 97 map from Fig. 2) as high trust countries (Dark green, light green and yellow from Fig. 2), and countries less than that as low trust ones (Red and orange from Fig. 2).

Table 1 Grouping of countries for statistical analysis

	Category (No. of countries)	Countries included
a	EU countries (27)	Austria, Belgium, Bulgaria, Croatia, Cyprus, Czechia, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden
b	Higher trust countries (14)	Belgium, Czechia, Denmark, Estonia, Finland, France, Germany, Ireland, Luxembourg, Malta, Netherlands, Portugal, Spain, Sweden
c	Lower trust countries (13)	Austria, Bulgaria, Croatia, Cyprus, Greece, Hungary, Italy, Latvia, Lithuania, Poland, Romania, Slovakia, Slovenia
d	Positively deviant countries (7)	Bulgaria, Hungary, Lithuania, Luxembourg, Latvia, Malta, Slovakia
e	Negatively deviant countries (20)	Austria, Belgium, Croatia, Cyprus, Czechia, *Denmark (no deviance),* Estonia, Finland, France, Germany, Greece, Ireland, Italy, Netherlands, Poland, Portugal, Romania, Slovenia, Spain, Sweden

Positively and negatively deviant countries: We calculated positive or negative deviance in the % sample who "tend to trust" in HIMS by calculating the difference between Eurobarometer 93 (Summer 2020) and Eurobarometer 97 (Summer 2022) data for each country. A negative difference indicates an increase in trust, while a positive difference indicates a decrease in trust – categorised as positively deviant and negatively deviant countries respectively. In this way, we found that there were seven positively deviant countries, 1 country with no deviance and 19 negatively deviant countries (Supplementary Table 1). For this analysis, we included the no deviance country, Denmark, into the negatively deviant group so as to focus on positive deviance.

In cases where the assumption of homogeneity of variance was violated (tested by Levene's statistic), one-way ANOVA was replaced with a non-parametric Kruskal–Wallis test and those results are reported in the table. Here, it is important to note that the Kruskal–Wallis one-way ANOVA / test does not make assumptions about the population such as normality and homogeneity of variance, and therefore, may have lower statistical power because it is a non-parametric test.

One-way ANOVA was followed by Tukey's HSD, and Kruskal–Wallis test was followed by pairwise comparison as post-hoc tests to identify where the differences between the groups lie. For those variables where there are less than three groups, we interpret the differences between groups by looking at the mean in the descriptive tables.

3 Results

The graph (Fig. 1) presents trust percentages across various institutions based on data from the Standard Eurobarometer 93–99 at the European Union (EU) level. It features clustered bars depicting trust percentages in 'public administration' and 'regional or local public authorities', alongside a trend line representing trust percentages in 'health institutions and medical staff'. From the figure, it is evident that the mean trust in the health sector is much higher than the mean trust in the other two authorities. The bars for trust in 'public administration' and 'regional or local public authorities' exhibit a stable pattern, with marginal fluctuations indicating both increases and decreases. This haphazard trend suggests a relatively consistent level of trust in these institutions over the measured period.

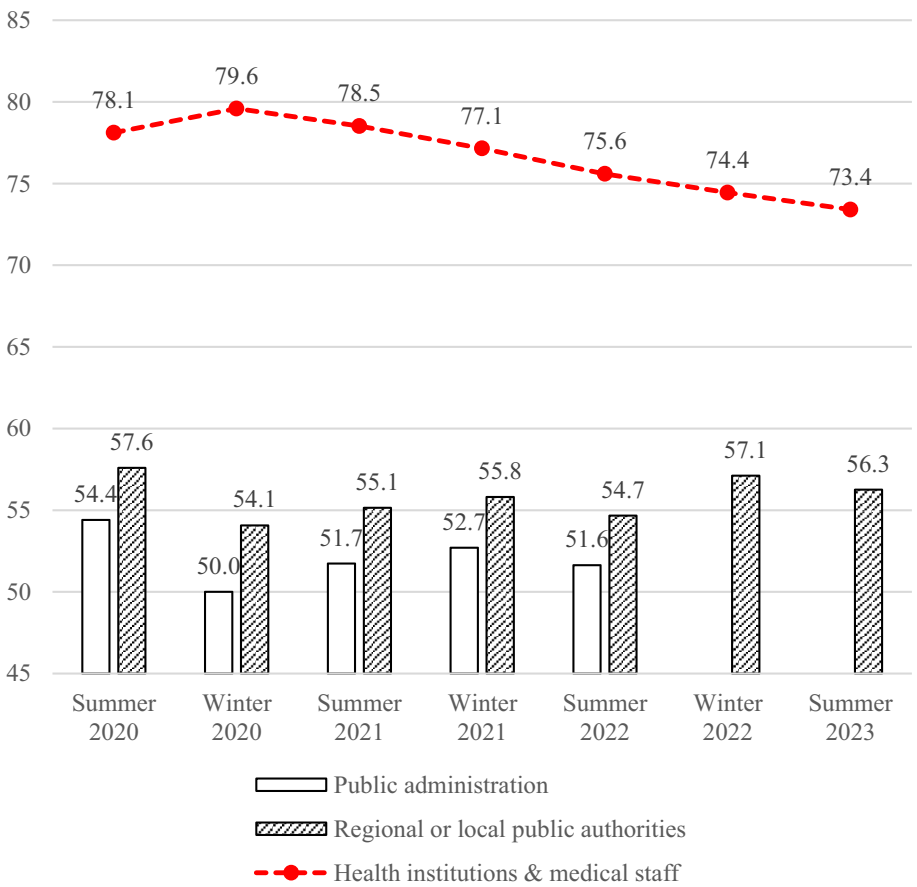

Fig. 1 Trust in "Public Administration", "Regional or Public Authorities" and "Health Institutions and Medical Staff" (HIMS), 2020–23

In contrast, the trend line tracking trust in health institutions and medical staff reveals a gradual decline across the European Union. This downward trajectory implies a diminishing level of trust in the healthcare sector over the specified timeframe. The mixed nature of the graph underscores the nuanced dynamics characterizing trust in different institutions, with relative stability in public administration and local authority trust and a discernible decline in trust in health-related institutions. Given that the study period coincides with the COVID-19 pandemic, a global health crisis, it is important to understand these trends in order to effectively shape future responses.

3.1 Spatial visualisation and clustering of high and low trust countries

Over the course of our study, a notable trend emerged at the country level—a general decrease in trust in health institutions and medical staff across most EU countries (20 out of 27) (Supplementary Table 1). This temporal analysis underscores the evolving nature of trust dynamics within the EU region. To elucidate these trends, we employed equal count (quantile) intervals for the Summer 2020 data (Standard Eurobarometer 93) using the % of

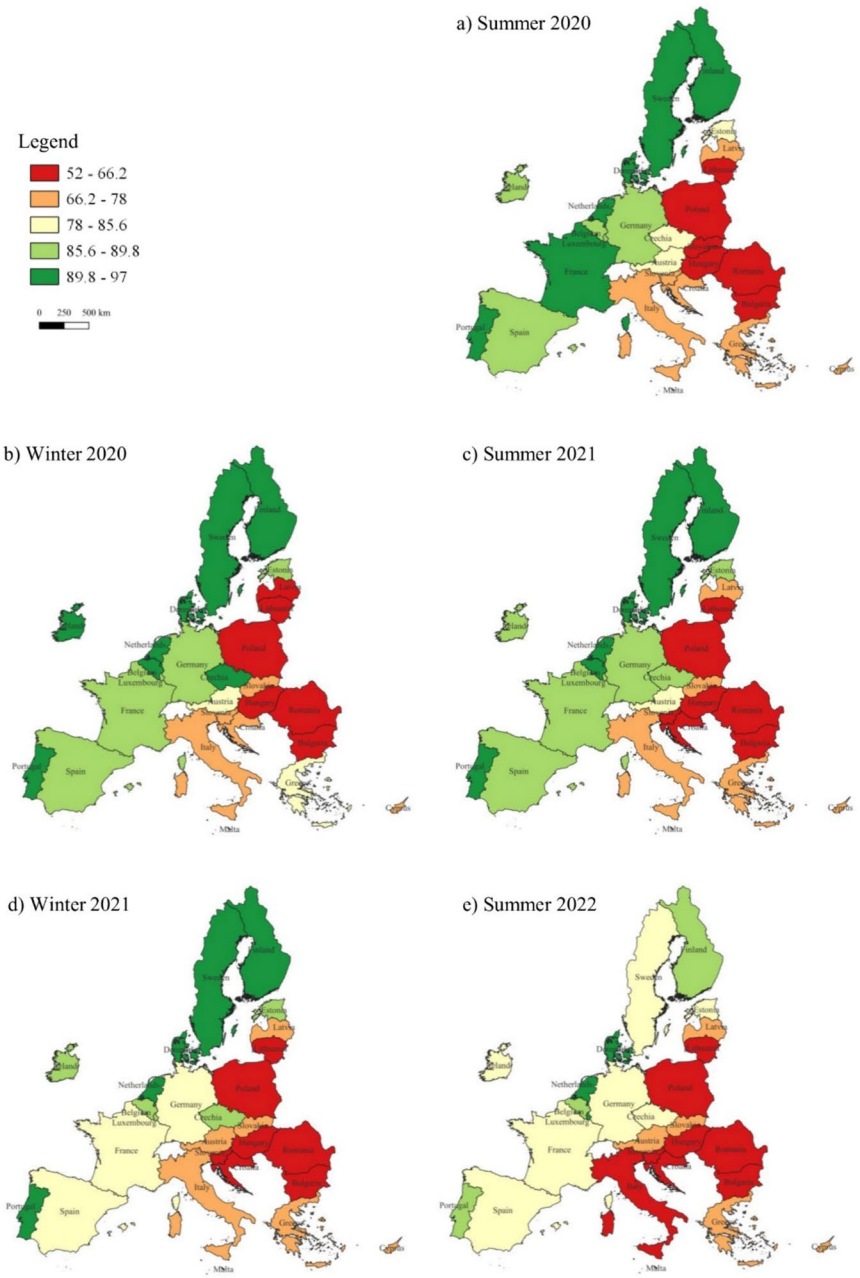

Fig. 2 Classification of trust in health institutions and medical staff (HIMS), 2020–22. The map was classified into 5 categories on the "Equal count (quantile)" function on Summer 2020 data and the same intervals were used to observe change in trust levels therafter

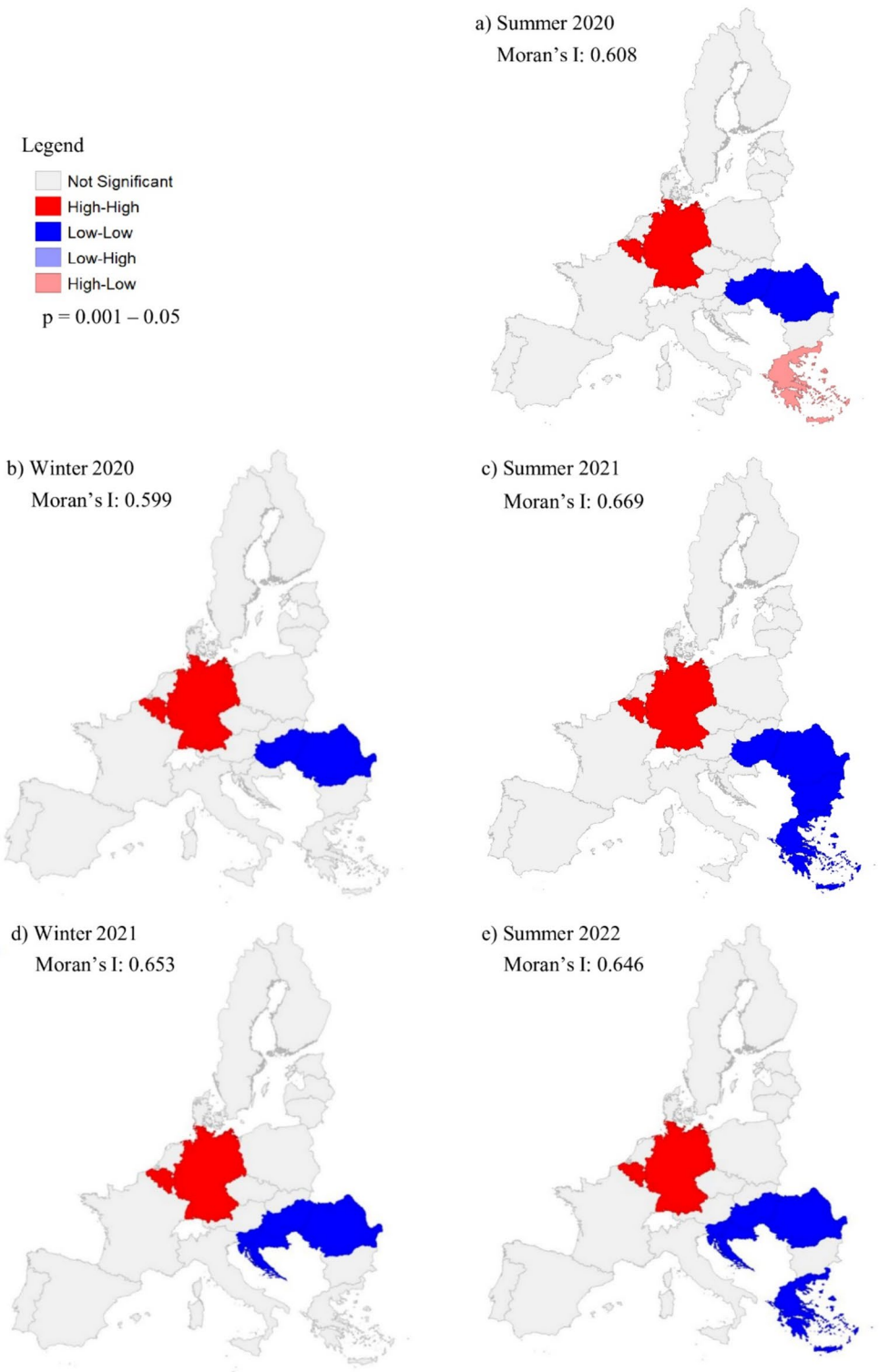

Fig. 3 Univariate LISA cluster maps of trust in health institutions and medical staff, 2020–22

the sample who "tend to trust" in public administration, regional or local public authorities and HIMS. The 5 equal count (quantile) intervals thus obtained were: 52–66.2%, 62.2–78%, 78–85.6%, 85.6–89.8%, and 89.8–97%. We used the same intervals thereafter for mapping trends in the Standard Eurobarometer 94, 95, 96 and 97 samples. This exercise revealed distinct clusters indicating varying degrees of trust in HMIS (Fig. 2), while trust in the other two did not reveal any spatial patterns. Notably, a conspicuous pattern emerged among Eastern European countries, consistently exhibiting lower trust levels in HIMS throughout the study period. This stands in contrast to the trend

observed in Northern, Central and Western EU countries. These regions, with initially higher trust levels, experienced a more pronounced decrease in trust over time.

We extended our investigation to local spatial autocorrelation (LISA) maps, to identify the core of these apparent clusters (Fig. 3). Spatial autocorrelation measures how similar values are in adjacent regions, allowing us to identify clusters of high or low trust. Germany and Belgium emerged as a high-high trust cluster ($I = 0.6$, $p = 0.05$), signifying regions where high trust percentages are not only prevalent but also spatially concentrated. This suggests a core of trust within these areas, potentially influenced by shared cultural, economic, or social factors. Furthermore, in 2020, a cluster characterized by low trust levels, encompassing Romania and Hungary, was identified. Over time, this cluster expanded southward, encompassing Bulgaria and Greece by 2021, and westward encompassing Slovenia, Croatia and Italy by 2022. Notably, Greece, initially identified as a significant ($I = 0.6$, $p = 0.001$) high-low cluster core (also known as a spatial outlier), denoting a country with high trust levels surrounded by low trust countries, transitioned to become part of the low-low cluster ($I = 0.6$, $p = 0.05$) by 2022 (Refer to Supplementary Fig. 1 for statistical significance of clusters). This raises an intriguing question: does this shift suggest an internal trend? It is important to keep in mind that LISA clustering identifies the core of the clusters, wherein the cluster itself also includes neighbours. Also, this method only suggests significant spatial structure and identifies interesting locations and does not aim to analyse it.

3.2 H1: Socio-economic variations and factors associated with trust

To examine the relationships outlined in the hypothesis H1 (Socio-economic factors and beyond), which proposed that socio-economic factors—such as age, gender, health conditions, education, income, as well as broader factors like political context and perceptions of life and national affairs—would be significantly related to public trust in health institutions during the COVID-19 pandemic, these factors were explored to assess their influence on trust levels across different populations. Out of the 17 variables included in the analysis, only 8 emerged as significant through a series of one-way ANOVA or non-parametric Kruskal Wallis tests wherever applicable, revealing that the most recurring factors—as reported by studies on trust in government and public authorities—in fact, did not vary when it came to trust in HIMS at the EU level (Table 2).

We then used Tukey's HSD Test for multiple comparisons to determine where the differences between groups lie for significant one-way ANOVA tests (See Supplementary Table 2 for significant and 95% C.I. boundaries). At EU level, the tests revealed that the mean value of trust in HMIS was significantly different between those who faced difficulty in paying bills "almost never/never" and "most of the time" ($p = 0.001$, 95% C.I. [5.38, 23.22]) implying that those who did not face difficulties exhibited significantly higher trust in HMIS.

Pairwise comparisons were performed as post-hoc tests for significant Kruskal Wallis Tests which revealed the differences between groups. The tests revealed that the mean trust in HIMS was lower in the group with things in their life going in the "wrong direction" than those in the groups "right direction" ($p < 0.001$) and "neither" ($p = 0.014$). The mean trust was higher in the group with things in their country going in the "right direction" than the groups "wrong direction" ($p < 0.001$) and "neither" ($p = 0.021$). Also, for things in EU going in the "right direction" had higher trust than the group "wrong direction" ($p < 0.001$).

Looking at the descriptive tables where there were less than two groups revealed the rest of the differences between groups. The mean trust of the group that was "satisfied" (mean = 78.3) with the life they lead was higher than those who were "not satisfied" (mean = 61.3), those who were "satisfied" (mean = 82.8) with the measures taken to fight the COVID-19 pandemic by the government exhibited greater trust in HIMS than those who were "not satisfied" (mean = 65.3), and those who were "satisfied" (mean = 82.6) with the measures taken to fight the pandemic by the EU had greater trust than those who were "not satisfied" (mean = 64.2). Additionally, for trust in the EU to make the right decisions in the future regarding the coronavirus pandemic, the mean trust of group "yes" (mean = 82.7) was higher than that of the group "no" (mean = 62.0).

There were no significant differences between groups of variables age, gender, household composition, marital status, left–right political scale, and use of the internet. Therefore, H1 was partially supported, with a significant relationship of trust in HIMS with factors of perception of life and national affairs, but the relationship of demographics with trust was not supported by the data.

Table 2 Results of ANOVA or Kruskal–Wallis Test (wherever applicable)

S. No	Factors	EU	High trust	Low trust	Positively deviant	Negatively deviant
1	Age	–	–	–	–	–
2	Gender	–	–	–	–	–
3	Education	–	p = 0.008^	–	–	–
4	Socio-professional category	–	p = 0.013^	–	–	–
5	Household composition	–	–	–	–	–
6	Marital status	–	–	–	–	–
7	Consider belonging to (economic class)	–	F = 9.473, p < 0·001	–	–	–
8	Difficulty in paying bills	F = 7.437, p = 0.001	F = 9.582, p < 0.001	F = 10.267, p < 0.001	–	p = 0.013^
9	Left–right political scale	–	–	–	–	–
10	Use of the internet	–	–	–	–	–
11	Things in your life are going in the right/wrong direction	p < 0.001^	p < 0.001^	F = 27.098, p < 0.001	F = 5.777, p = 0.012	p < 0.001^
12	Things in your country are going in the right/wrong direction	p < 0.001^	p < 0.001^	F = 14.590, p < 0.001	F = 5.015, p = 0.019	F = 9.276, p < 0.001
13	Things in EU are going in the right/wrong direction	p < 0.001^	p < 0.001^	F = 18.549, p < 0.001	–	F = 8.940, p < 0.001
14	Satisfaction with the life you lead	F = 24.703, p < 0.001	p < 0.001^	F = 36.323, p < 0.001	F = 6.516, p = 0.025	F = 19.037, p < 0.001
15	Satisfaction with measures taken to fight the COVID-19 pandemic by the government	F = 27.033, p < 0.001	F = 60.326, p < 0.001	F = 31.820, p < 0.001	F = 8.482, p = 0.013	F = 20.456, p < 0.001
16	Satisfaction with measures taken to fight the COVID-19 pandemic by the EU	p < 0.001^	p < 0.001^	F = 36.642, p < 0.001	–	p < 0.001^
17	Trust the EU to make right decisions in the future regarding the coronavirus pandemic	p < 0.001^	F = 49.497, p < 0.001	F = 47.081, p < 0.001	F = 5.875, p = 0.032	p < 0.001^

F and p values for only significant one-way ANOVA tests are presented in this table. ^ = Kruksal Wallis test significance

3.3 H2: Differences between high and low trust countries

To test the potential variation between high-trust and low-trust countries as proposed in H2 (Variation between high-trust and low-trust countries), we classified the 27 EU countries into high and low trust categories, building on our mapping results. Interestingly, while low trust countries showed variability among the same ten significant variables, higher trust countries exhibited additional distinctions in education, socio-professional category, and economic class.

The post-hoc tests revealed similar directionalities for the variables that were common for EU and low trust countries. In the additional variables, in the groups of education level, the "still studying" group exhibited significantly higher trust in HIMS than the group that ended education at "less than 15 years" ($p = 0.014$). Also, the mean trust was higher in the socio-professional category of "students" than "unemployed" ($p = 0.005$). Several differences between groups were revealed for the variable of perceived economic class with "the upper class" having greater trust than "the middle class" ($p = 0.007$, 95% C.I. [1.6, 14.4]), "the lower middle class" ($p < 0.001$, 95% C.I. [5.32, 18.11]) and "the working class" ($p < 0.001$, 95% C.I. [5.74, 18.54]). Therefore, our findings demonstrate that the socio-economic determinants of trust in health institutions vary between countries characterized by high levels of trust and those with low levels of trust, supporting H2.

3.4 H3: Differences between negatively and positively deviant countries

Taking our investigation further, H3 (Variation in Increasing vs. Decreasing Trust Countries) addressed the idea that countries experiencing shifts in trust levels—either increasing or decreasing—would exhibit differing socio-economic determinants of trust. We classified countries into positively and negatively deviant categories based on trust trends from 2020 to 2022. Negatively deviant countries, where trust decreased, mirrored the same eight significant variables as low trust countries and the entire EU. Positively deviant countries, where trust increased, demonstrated a unique pattern. Interestingly, only five of the eight significant variables were applicable, excluding factors external to the country such as opinions on EU's response to the pandemic, and were rather focused on their own government's response. Moreover, difficulty in paying bills was not a significant factor, revealing a subordinate set of variables shaping trust in these countries.

The directionality as revealed by the post-hoc tests was the same as that of EU and low trust countries for the negatively deviant countries. Similarly, the direction of low and high trust was the same in all of the significant variables in the positively deviant countries (Refer to Supplementary Table 2 for significant and 95% C.I. boundaries). In this way, the analysis supports H3, revealing differences in socio-economic determinants between countries where trust in health institutions is increasing and those where it is decreasing.

4 Discussion

4.1 Main findings

Understanding the patterns of trust in health institutions and medical staff is crucial in dealing with health crises, such as the ongoing coronavirus pandemic. We found that there was a decline in trust in HIMS in a majority of EU countries from 2020 to 2022, significantly impacting the outreach of government policies towards COVID-19. Our spatial analysis that revealed clusters of high and low trust that is unique to HIMS and does not follow the same pattern for other institutions, indicates a possible direct effect of the pandemic as a health crisis. Our findings of association of trust with respondents' financial difficulties and their own perceptions of life and the country is in line with previous research that shows a fall in positive perception of health care system during a financial crisis and the association of these perceptions with respondents' perception of their own social and financial status, and overall satisfaction in life [25, 26]. Although "economic class" was not significantly associated with trust in HIMS (except in high trust countries), the role that income and finances play in trust [8] were highlighted through the significant test for "difficulty in paying bills". Contrary to most studies that described age, gender, education and household composition to influence governmental/institutional trust previously [9, 11, 20, 21], we find that that is not the case for trust in HIMS. It is solely the satisfaction with the measures taken towards the pandemic, and the perceptions of overall satisfaction in life that define trust in the health sector during a health crisis.

4.2 Spatial clusters of high and low trust countries

The high trust countries in Western and Central Europe and the high-high cluster in Germany and Belgium imply shared characteristics such as health systems, for example, higher financial input for healthcare and higher input of healthcare workforce during the pandemic [37]; governance, for instance, the decentralized approach in Sweden and Germany [12, 38]; and responses during the COVID-19 pandemic, for example, the scientific advisory council for policymaking of the Western European countries that was interconnected and thus addressed similar questions and drew on similar evidence bases at the same time [16]. Understanding the interplay of these structures with public trust could inform strategies for fostering trust in other regions lacking them.

Conversely, the low-low cluster in Romania, Croatia, and Italy necessitates targeted interventions to address trust deficits in these areas. Primarily in Eastern and Southern Europe, that formed the low trust cluster and remained low trusting throughout, this pattern could be a reflection of the slow and delayed response of these governments to the second wave of the pandemic because of nonchalance arising from their success during the first wave [13]. Additionally, the differences in policy implementation style between the Eastern and Southern low-trust countries and Western high-trust countries, as exemplified in the study on the difference between Greece and Sweden [12], illustrate how Italy for instance, adopted a centralized and authoritative approach to manage the COVID-19 crisis, reflective of a low-trust environment. This administrative style, characterized by concentrated decision-making and stringent enforcement [39], contrasts sharply with Germany's decentralized [38], expert-driven approach, which relied heavily on public trust and inclusivity.

However, the greater decline in trust observed in traditionally higher-trust countries like Germany indicates potential challenges in maintaining trust even in well-established social contexts. Understanding the drivers behind this decline can inform strategies to reverse or mitigate such trends. For instance in the case of Germany, the expected standard low-trust parameters afflicting East European countries are not evident. Nevertheless, our findings suggest that spatial dependency exists, supporting the argument that the actions of a country have an effect on other countries [14].

4.3 Factors associated with trust in HIMS

Our comprehensive analysis of the Eurobarometer dataset, utilizing one-way ANOVA tests, has provided valuable insights into the nuanced dynamics shaping trust across different groupings of EU countries. The significant associations found across all dimensions within the EU level analysis underscore the universality of certain factors impacting trust in health institutions and beyond. The pervasive impact of trust in the EU's decision-making, satisfaction with pandemic measures, financial difficulties, and perceptions of life direction suggests a common thread influencing trust levels throughout the EU. This is not surprising as it ascertains the evident relationship between overall COVID-19 response satisfaction with trust in health institutions.

On the other hand, the higher trust countries exhibit unique associations, including the impact of education and socio-professional category. This is perhaps a key aspect in identifying the unifying force behind knowledge and perception, whereby having a basic understanding of scientific processes allows for a more comprehensive and balanced view of trust in health institutions. Furthermore, positively deviant countries show associations with trust with only factors within the borders and do not expand to perceptions of things beyond the borders such as the EU which is an interesting finding that needs further investigation.

4.4 Strengths and limitations

We analysed data from 27 EU countries spatio-temporally, to assess trends in trust in health institutions and medical staff, especially during the COVID-19 crisis. Since the dataset is from a representative survey, it has enabled us to derive unique insights that are comparable on the country level. The study is guided by a spatial visualisation and spatial statistics approach, which provides a fresh perspective and points towards the missing dimension of spatial influences of public perceptions, especially in the health sector where multidisciplinary integration of health geographers is not entirely new.

However, since the survey is cross-sectional, it limits the potential to find causalities or track changes in individual variable level perceptions. Nevertheless, the comparisons as an aggregate representation of the countries or socio-demographic groups are meaningful because of the large sample size and the statistical significance of the underlying relations. Another limitation of the study is that the survey used a single question with the possibility of a yes or no

response to assess the level of trust, which limits the ability to capture the intricate dimensions of public trust in a more comprehensive way. Like all public perception studies, this study is also limited by respondents' understanding of what the subjective factors, for example, "trust" and "satisfaction with the measures taken..", mean for them. However, for our purposes, even a basic understanding of these concepts allows for valid inferences.

5 Conclusion

Our research provides a detailed mapping of trust perceptions across the EU uncovering spatial patterns that highlight regional variations. The analysis contributes to a nuanced understanding of trust dynamics, offering valuable insights in the development of trust in different socio-economic contexts. The results can be useful for scientific advisory councils and policymakers aiming to strengthen social cohesion and trust within the European Union. Understanding how high-high or low-low clusters evolve over time provides insights into the resilience or vulnerability of trust dynamics in specific regions. As the global community navigates the complexities of recovering from the COVID-19 pandemic, our insights underscore the importance of trust-building strategies, not only for enhancing confidence in health institutions but also for promoting positive health behaviours, such as vaccination uptake [14, 40, 41], and outcomes such as mortality [42].

The insights presented here can point to important aspects for policy makers aiming to improve trust in health institutions. As mentioned, the influence of individual factors such as satisfaction with pandemic measures or financial situation are common aspects that influence trust levels in different spatial settings. Aims at influencing the development of trust (especially away from low-low dynamics) requires more nuanced approaches, based on a variety of assumptions. These should include the understanding by policy makers that values and identities as well as framings and narratives are key aspects when shaping (new) health policy measures. Teams of scientists, policy makers but also stakeholders and citizens could be established with the aim of scoping out and assessing of relevant and realistic policy measures. Also, "honest brokers" [43] or "boundary organisations" [44] can support knowledge exchange and communication between different groups.

Further research in contextual factors contributing to these differences at the country level are needed to help understand how to prevent a decline in trust during a health crisis in the future. It could be useful to combine analysis like presented above to identify "geographies of trust" with qualitative methods such as interviews with (health) policy makers or citizens. This can help understand the dual nature of trust in more detail and how policy interventions may need to be adjusted and adapted if a major health event occurs in order to ensure acceptance and effectivity. This can also support the adoption of interventions that might help raise trust levels and direct how they may have to be shaped according to geographical, contextual, social and cultural dependencies.

Author contributions LY, JH and ML conceptualized the study. LY obtained the data and JH verified the data. LY primarily analysed the data. LY, JH and ML interpreted the results. LY and JH contributed to the literature search and synthesis quoted in the manuscript. LY and JH prepared the first draft, JH and ML worked on finalising the manuscript text. All authors read and approved the final manuscript.

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Data availability The Standard Eurobarometer data used in this study is publicly available and downloadable at https://europa.eu/eurobarometer/surveys/browse/all/series/4961.

Declarations

Competing interests The authors declare no competing interests.

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