UNCOVERING THE LINKS BETWEEN INTERNET USAGE, TRUST IN SCIENCE AND VACCINATION BASED ON THE CROSS-NATIONAL ONLINE SURVEY-2 WAVE 5 PANEL

Aistė Diržytė :: Gintarė Gulevičiūtė :: Aelita Skaržauskienė :: Monika Mačiulienė :: Asta Zelenkauskaitė

ORIGINAL RESEARCH ARTICLE / DOI: 10.20901/ms.15.30.4 / SUBMITTED: 5.2.2024.

ABSTRACT *Previous research to some extent evidenced the links between trust in science and vaccination, but the links between trust in science, vaccination, and Internet usage, have not been explored in depth yet. The purpose of this study was to examine the links between Internet usage, trust in science, and vaccination, based on data derived from the CROss-National Online Survey-2 (CRONOS-2) Wave 5 panel fielded in 11 European countries. The findings revealed males' significantly higher general trust in science in comparison to females, but no significant gender differences were observed in Internet usage or trust in different disciplines or statements made by scientists. Next, vaccinated individuals demonstrated significantly higher general trust in science, higher trust in scientific disciplines, and significantly higher trust in statements made by scientists than not-vaccinated individuals. Furthermore, this study revealed some weak but statistically significant positive correlations between Internet usage and general trust in science, trust in scientific disciplines, and trust in statements made by scientists, and a negative link between Internet usage and age. General trust in science, trust in scientific disciplines, and trust in statements made by scientists' subscales were significantly positively intercorrelated. SEM analysis revealed that Internet usage itself does not have a significant effect on vaccination, but Internet usage has a significant positive effect on trust in science, and trust in science has a significant positive effect on vaccination.*

KEYWORD

INTERNET USAGE, TRUST IN SCIENCE, VACCINATION, GENDERS, CRONOS-2

Authors' note

Aistė Diržytė :: Mykolas Romeris University **::** aiste.dirzyte@mruni.eu
Gintarė Gulevičiūtė :: Mykolas Romeris University **::** gintare.guleviciute@mruni.eu
Aelita Skaržauskienė :: Mykolas Romeris University **::** aelita@mruni.eu
Monika Mačiulienė :: Mykolas Romeris University **::** maciuliene@mruni.eu
Asta Zelenkauskaitė :: Mykolas Romeris University **::** az358@drexel.edu

Note: This work was supported by the CHIST-ERA grant CHIST-ERA-21-OSNEM-004, by Research Council of Lithuania (Grant No. S-CHIST-ERA-22-1).

ORIGINAL RESEARCH ARTICLE / DOI: 10.20901/ms.15.30.4 / SUBMITTED: 5.2.2024.

INTRODUCTION

Media can be a powerful tool for disseminating information (Frau-Meigs, 2019; Ramaiah & Saraswati Rao, 2021). The Internet provides easy access to a vast amount of information, including scientific research, educational materials, and expert analyses leading to the digital expansion of the mind (Marsh & Rajaram, 2019). Increased access to information can contribute to a better understanding of scientific findings. However, the abundance of information on the Internet also means that misinformation and pseudoscience can easily spread (Yeung et al., 2022). False or misleading information, especially, facilitated by social media, can erode trust in scientific institutions, authorities, or public confidence in vaccines (Bajwa et al., 2022; Keshavarz, 2021). Previous studies have shown that exposure to misinformation online and mistrust in science can impact people's attitudes and decisions in a way detrimental to public health (e.g., vaccine hesitancy) (Ouyang et al., 2022). Nevertheless, does time spent using the Internet matter in itself?

Although scientists and institutions can use the Internet to communicate their research directly to the public, scientific findings can be misinterpreted or misrepresented online, to support particular viewpoints, and may lead to confusion (Keshavarz, 2021). Moreover, though social media platforms can be used to share accurate scientific information, engage in discussions, and build communities interested in science, social media can also amplify misinformation (Chen et al., 2022; Jennings et al., 2021; Thelwall et al., 2021), which leads to the polarization of views and decreased trust in scientific consensus (Shabani & Keshavarz, 2022). Furthermore, even though the Internet enables access to scientific knowledge, allowing a broader audience to engage with research content might have positive practical consequences (Kelikume, 2021). A lack of scientific literacy or critical thinking skills may result in individuals being unable to distinguish reliable sources from unreliable ones, potentially leading to a decline in an overall trust in science or even government (Liu et al., 2023). The accessibility of scientific information online raises ethical questions about how to balance open access with the need to prevent the spread of partial or distorted interpretations. Besides, during crises (e.g., pandemics), the Internet enables rapid dissemination of information and updates from scientific authorities, helping to build trust through transparent and timely communication. However, conflicting messages from different sources can undermine public trust and lead to adverse decisions and behaviors (e.g., vaccine hesitancy) (Lee & You, 2022; Puri et al., 2020; Reno et al., 2021). Educational campaigns aimed at improving scientific literacy and critical thinking skills are essential. By equipping individuals with the ability to assess the credibility of sources, the risk of misinterpretation and propagation of misinformation can be mitigated. Targeted interventions, such as fact-checking initiatives and collaborations with social media platforms to flag dubious content, are also critical for maintaining trust in science. During crises, consistent and coordinated messaging across multiple platforms is crucial for minimizing confusion. Governments and scientific bodies could work collaboratively to ensure that their messages are not only aligned but also adapted to the evolving needs and concerns of the audience. This approach can help counteract the adverse effects of conflicting information. The provided insights highlight the dual role of the Internet and

ORIGINAL RESEARCH ARTICLE / DOI: 10.20901/ms.15.30.4 / SUBMITTED: 5.2.2024.

social media as powerful tools for disseminating scientific knowledge and as platforms where misinformation can thrive.

Previous research found that trust in science plays a significant role in people's decision-making regarding vaccination or health behavior (Achterberg et al., 2017; van Rijn et al., 2019). A lack of clear communication about safety, efficacy, and testing processes of vaccines can erode trust, making individuals more susceptible to vaccine hesitancy. When individuals trust the scientific findings, they are more likely to believe that vaccines are thoroughly tested. On the contrary, a lack of trust in scientific institutions can lead to skepticism about the effectiveness of vaccines. Next, trust in science often involves a perception of expertise and competence. When individuals trust the expertise of scientists, they are more likely to accept regulatory agencies' recommendations for vaccination, yet skepticism about the expertise of scientific authorities can lead to a reluctance to follow vaccination recommendations (Barve & Saini, 2021). Moreover, when individuals trust science institutions and regulatory agencies, they are more likely to have confidence in the vaccines they recommend. On the other hand, mistrust in institutions, whether due to perceived conflicts of interest or other factors, can contribute to vaccine hesitancy. Finally, previous research provides evidence that trust in science or misinformation can be influenced by social networks (Hori et al., 2023; Jo et al., 2022; O'Connor et al., 2022). When individuals trust the recommendations of their peers who support vaccination, it can positively impact their own attitudes, but if social networks propagate mistrust in science or anti-vaccine sentiments, individuals may be more susceptible to vaccine hesitancy. Social networks serve as critical mediators. When influential members of a network express trust in vaccines, their endorsement can have a cascading positive effect on others' attitudes. Conversely, networks that propagate anti-vaccine rhetoric or conspiracy theories can amplify mistrust and skepticism, even among those who were previously neutral.

All in all, previous studies established that trust in science and vaccination are interconnected, and their links are dynamic (Al-Hasan et al., 2021; Boudreau et al., 2022; Charron et al., 2020). The relationship between Internet usage and trust in science was found to be nuanced, with both positive and negative aspects (Orduña-Malea, 2021). However, the associations between Internet usage, trust in science, and vaccination have been underexplored, although such research is not only scientifically but also practically critical to prepare for communication strategies during crises. Examining the relationship between Internet usage and vaccination can provide insights into how information flows through online platforms are linked to behavior, and focus on sociodemographic variables such as gender or age might also provide some useful insights (Akbaş et al., 2019; Bracewell, 2021; Cheng et al., 2022; D. Zhou et al., 2020; Gao & Liu, 2023; Johnson, 2022; Kovacevic & Kascelan, 2020; Yufei et al., 2018). Studying links between Internet usage and vaccination could also help researchers understand how media might impact health decision-making processes. Research on Internet usage, trust in science, and vaccination could inform strategies to address vaccine hesitancy by identifying key factors that influence public trust and decision-making (Chan et al., 2021; Li et al., 2022; Ummah & Fajri, 2020).

ORIGINAL RESEARCH ARTICLE / DOI: 10.20901/ms.15.30.4 / SUBMITTED: 5.2.2024.

Insights into how Internet usage is related to trust in science can inform science communication strategies through social media (Shabani & Keshavarz, 2022). Research on perceptions of online trust enables us to design communication campaigns that effectively engage online audiences and build trust. Furthermore, understanding the impact of Internet usage on vaccination decisions could allow tailoring interventions to online communities. In addition, research findings can guide the development of digital literacy programs aimed at enhancing individuals' ability to critically evaluate online information, mitigating the influence of misinformation. Finally, policymakers could use research findings to inform the development of policies addressing online misinformation and supporting initiatives that strengthen trust in science.

In summary, research on the links between Internet usage, trust in science, and vaccination is critical for advancing understanding of information dynamics in the digital age. Practical applications of such research are instrumental in developing targeted interventions and effective science communication strategies to combat misinformation and address vaccine hesitancy. Previous research to some extent evidenced the links between trust in science and vaccination, but the links between trust in science, vaccination, and Internet usage, were not explored in depth yet. Therefore, the purpose of this study was to examine the links between Internet usage, trust in science, and vaccination. The overarching question of the study is whether trust in science is serving as a mediator between Internet usage and vaccination.

Based on previous research on sociodemographic differences, it was hypothesized that: (H1) females and males differ in trust in science; (H2) vaccinated and not vaccinated individuals differ in trust in science; (H3) Internet usage and trust in science are interrelated; (H4) Internet usage indicates trust in science, and trust in science predicts vaccination (trust in science is a mediator in the link between Internet usage and vaccination).

METHODOLOGY

Data

This research is based on data derived from the CROss-National Online Survey-2 (CRONOS-2) Wave 5[1] panel fielded in the following countries – Austria (n=604), Belgium (n=583), Czechia (n=288), Finland (n=724), France (n=707), Iceland (n=459), Italy (n=225), Portugal (n=382), Slovenia (n=534), Sweden (n=787) and the United Kingdom (n=472). CRONOS-2 Wave 5 measured trust in science, with questions on general trust in science, trust in specific scientific disciplines, and agreement to a series of scientific statements on gender, wealth redistribution, the universe, antibiotics, climate, and genetically modified crops.

Data were collected from November 2021 until March 2023 through the world's first large-scale, cross-national, probability-based input-harmonized web panel published by

[1] https://www.europeansocialsurvey.org/methodology/methodological-research/modes-data-collection/cronos

ORIGINAL RESEARCH ARTICLE / DOI: 10.20901/ms.15.30.4 / SUBMITTED: 5.2.2024.

the European Social Survey (ESS). All the data collected are freely available for download through the ESS Data Portal at https://ess.sikt.no/en/?tab=overview, accessed 18 November 2023.

Instruments

Internet Usage was assessed by applying a single question from the previously validated questionnaire CRONOS-2 W5[2]. Respondents were asked how often they use the Internet, and the response pattern followed a 5-point Likert scale from "Never" (1) to "Every day" (5).

Vaccination was evaluated by applying a single question from CRONOS-2 W5. Respondents were asked if they had ever been vaccinated against coronavirus, and they had to provide either answer "No" (0) or "Yes" (1).

Trust in science was assessed by applying three subscales from CRONOS-2 W5 proposed by researchers Achterberg and colleagues (Achterberg, Rekker, and Ivanova, 2021). The response pattern followed a Likert scale from "No trust at all" (0) to "Complete trust" (10):

The *General trust in science* subscale encompassed three questions: 1. "How much do you personally trust universities"? 2. "How much do you personally trust scientists"? 3. "How much do you personally trust scientific methods"?

The *Trust in scientific disciplines* subscale asked respondents whether they trust a specific discipline. It encompassed six items: 1. "Sociology"; 2. "Economics"; 3. "Physics"; 4. "Medical science"; 5. "Agricultural science"; 6. "Environmental science".

The *Trust in scientific statements* subscale encompassed five items. Respondents were presented with a score ranging from 0 to10 to indicate how much they personally trust each of the following statements from scientists: 1. – "Differences in behavior between men and women are not fixed at birth but are mainly caused by upbringing of parents and society"; 2. – "Increasing taxes on the rich will reduce government revenue because rich people will work less"; 3. – "The universe expands at an increasing rate"; 4. – "Antibiotics do not work against viruses because they only kill bacteria"; 5. – "The Earth's climate is changing as a result of greenhouse gas emissions caused by human activity"; 6. – "Genetic modification of plants improves the productivity of farming without posing health risks for consumers".

Additionally, we included a question on sociodemographic variables such as gender (we used binary denomination of gender), and age.

Statistical analyses were performed by applying SPSS, version 26, and JASP, version 0.16.4. Firstly, CFA (confirmatory factor analysis) was applied and Cronbach's α was calculated to explore the validity and reliability of the instruments (for variables that are

[2] https://stessrelpubprodwe.blob.core.windows.net/data/cronos2/CRON2W5_survey_flow_and_logic.pdf

ORIGINAL RESEARCH ARTICLE / DOI: 10.20901/ms.15.30.4 / SUBMITTED: 5.2.2024.

constructed from more than one question). Then, the normality of the data distribution was checked. Afterwards, the descriptive statistics and the Pearson correlations between the study variables were calculated. Then the independent samples' T-test was applied to evaluate the differences between females and males and groups of vaccinated and not vaccinated individuals. A structural equation modeling (SEM) was applied to examine the links between Internet use, trust in science, and vaccination. In this study, p-values less than 0.05 were considered statistically significant.

In this study, data distribution was considered normal as skewness did not exceed the range from -2 to 2, and kurtosis did not exceed the range from -3 to 3. In order to validate the Trust in Science scale and subscales, the Confirmatory Factor Analysis (CFA) was performed, and Cronbach alphas were calculated (Table 1).

Table 1. **Results of the CFA and Cronbach alphas of Trust in science scale and subscales (n=4778)**

	X^2	df	CFI	TLI	SRMR	RMSEA	Cronbach α
Trust in science, three-factor model							
	2430.621	87	0.990	0.988	0.049	0.075 [0.073-0.078]	0.861
General trust in science							
			1.000	1.000	0.000	0.000	0.859
Trust in scientific disciplines							
	456.447	9	0.994	0.989	0.040	0.097 [0.090-0.105]	0.865
Trust in scientific statements							
	442.285	9	0.933	0.889	0.056	0.096 [0.089-0.104]	0.570

RESULTS

The whole study sample consisted of 5765 participants, of which 3068 (53%) were females, and their ages ranged from 18 to 90 years old (M=50.58, SD=16.41). Descriptive statistics on the study variables are presented in Table 2. Respondents demonstrated the highest trust in scientific methods (10.4%), the discipline of Physics (17.3%), and the statement that the Earth's climate is changing as a result of greenhouse gas emissions caused by human activity (27.9%). On the contrary, respondents demonstrated the lowest complete trust in scientists (7.8%), Economics (3.2%), and the statement that increasing taxes on the rich will reduce government revenue because rich people will work less (2.2%). When it came to Internet use, most participants used the Internet daily (86.6%). The majority of the respondents reported to have been vaccinated against Covid19, with the 7.4% reporting to have never been vaccinated against coronavirus.

ORIGINAL RESEARCH ARTICLE / DOI: 10.20901/ms.15.30.4 / SUBMITTED: 5.2.2024.

Table 2. **Means, standard deviations, and frequencies (%) of the study variables**

	N	Mean	Std. Deviation	Complete trust, %
General trust in science	5598	7.631	1.44398	
How much do you personally trust universities?	5713	7.46	1.728	9.3
How much do you personally trust scientists?	5738	7.68	1.571	7.8
How much do you personally trust scientific methods?	5652	7.75	1.611	10.4
Trust in scientific disciplines	5234	7.308	1.34102	
Trust in Sociology	5435	6.56	1.862	3.4
Trust in Economics	5671	6.70	1.833	3.2
Trust in Physics	5609	8.10	1.583	17.3
Trust in Medical science	5705	7.93	1.610	12.6
Trust in Agricultural science	5582	7.39	1.638	6.6
Trust in Environmental science	5662	7.07	1.873	6.4
Trust in statements made by scientists	5184	6.331	1.36510	
Differences in behavior between men and women are not fixed at birth but are mainly caused by the upbringing of parents and society.	5710	6.92	2.300	12.0
Increasing taxes on the rich will reduce government revenue because rich people will work less.	5615	4.16	2.562	2.3
The universe expands at an increasing rate.	5418	6.57	2.368	11.9
Antibiotics do not work against viruses because they only kill bacteria.	5590	7.62	2.345	27.5
The Earth's climate is changing as a result of greenhouse gas emissions caused by human activity.	5713	7.82	2.241	27.9
Genetic modification of plants improves the productivity of farming without posing health risks for consumers.	5625	4.81	2.675	3.3
				Never, %
Internet usage, how often	5762	4.78	.631	86.6
				Every day, %
Have you ever been vaccinated against coronavirus?	5661	.92	.264	7.4

Independent samples' T-test, performed to assess the differences in respondents' trust in science and Internet usage in groups of females and males (H1), revealed statistically significant differences (Table 3) in the following ways: Males demonstrated statistically significantly higher general trust in science (M=7.701, SD=1.448) than females (M=7.568,

ORIGINAL RESEARCH ARTICLE / DOI: 10.20901/ms.15.30.4 / SUBMITTED: 5.2.2024.

SD=1.438). However, it is worth highlighting, that in this study sample, female respondents (M=49.213, SD=16.364) were younger than males (M=52.161, SD=16.316). However, there were no statistically significant differences in Internet usage or trust in different disciplines or statements made by scientists.

Table 3. **Comparison of females (n=2688) and males (n=2495) in trust in science, respondents' age, and Internet usage variables**

	Females		Males		*t(5183)*	*p*	*Cohen's d*
	M	*SD*	*M*	*SD*			
Logistic parameter							
General trust in science							
	7.568	1.438	7.701	1.448	3.431	<0.001	0.092
Trust in scientific disciplines							
	7.312	1.341	7.303	1.342	-0.245	0.807	-0.007
Trust in statements made by scientists							
	6.316	1.340	6.346	1.392	0.770	0.442	0.021
Age of respondents, calculated							
	49.213	16.364	52.161	16.316	6.832	<0.001	0.180
Internet usage							
	4.784	0.624	4.762	0.638	0.208	0.835	0.006

Next, Independent samples' T-test was performed to compare differences in trust in science and Internet usage between groups (H2) of vaccinated and not-vaccinated individuals (Table 4). Although there were no significant differences in Internet usage, the analyzed groups significantly differed in trust in science. Vaccinated individuals demonstrated statistically significantly higher general trust in science (M=7.734, SD=1.359) than not vaccinated individuals (M=6.539, SD=1.822). Vaccinated respondents also showed higher trust in scientific disciplines (M=7.391, SD=1.269) than not vaccinated ones (M=6.402, SD=1.744). Moreover, vaccinated participants of the survey demonstrated significantly higher trust in statements made by scientists (M=6.417, SD=1.303) than not vaccinated participants (M=5.428, SD=1.624). Additionally, vaccinated participants in this study sample were older (M=51.302, SD=16.33) than not vaccinated (M=42.920, SD=14.971) participants.

Correlation analysis (H3) of the study variables (Table 5) revealed some weak but statistically significant positive correlations between Internet usage and general trust in science (r=0.063, p<0.01), Internet usage and trust in scientific disciplines (r=0.080, p<0.01), Internet usage and trust in statements made by scientists (r=0.045, p<0.01), and a negative link between Internet usage and age (r=-0.198, p<0.01). As evident from Table 5, the *Trust in science* subscales (general trust in science, trust in scientific disciplines, and trust in statements made by scientists) were fairly intercorrelated.

ORIGINAL RESEARCH ARTICLE / DOI: 10.20901/ms.15.30.4 / SUBMITTED: 5.2.2024.

Table 4. **Comparison of vaccinated (n=4716) and not vaccinated (n=427) respondents in trust in science, respondents' age, and Internet usage variables**

	Vaccinated (n=4716)		Not vaccinated (n=427)		*t(5183)*	*p*	*Cohen's d*
	M	*SD*	*M*	*SD*			
Logistic parameter							
General trust in science							
	7.734	1.359	6.539	1.822	-16.799	<0.001	-0.854
Trust in scientific disciplines							
	7.391	1.269	6.402	1.744	-14.409	<0.001	-0.754
Trust in statements made by scientists							
	6.417	1.303	5.428	1.624	-14.358	<0.001	-0.743
Age of respondents, calculated							
	51.302	16.33	42.920	14.971	-10.258	<0.001	-0.516
Internet usage							
	4.788	0.630	4.770	0.623	-0.542	0.588	-0.027

Table 5. **Pearson correlations for the study variables**

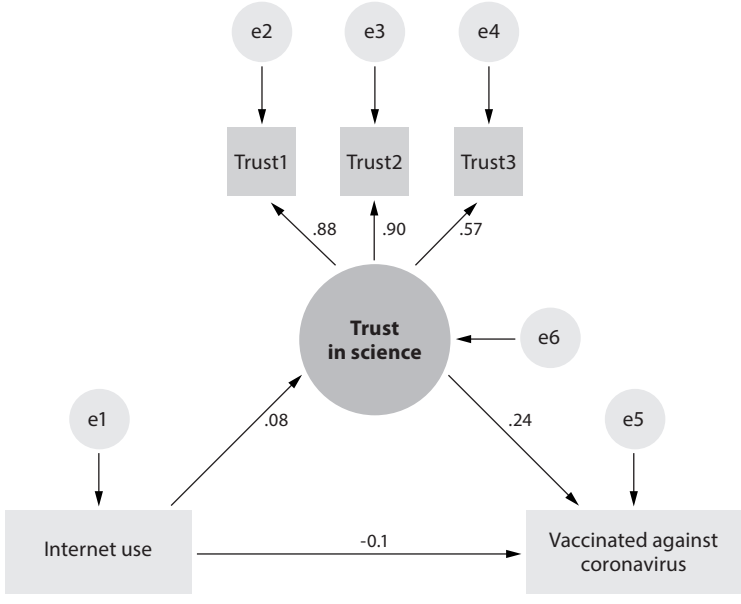
	1.	2.	3.	4.
1. General trust in science	-			
2. Trust in scientific disciplines	.792**	-		
3. Trust in statements made by scientists	.498**	.520**	-	
4. Age of respondents, calculated	.017	-.044**	-.076**	-
5. Internet usage, how often	.063**	.080**	.045**	-.198**

**. Correlation is significant at the 0.01 level (2-tailed).

To examine associations between Internet usage, trust in science, and vaccination in more depth by considering the role of trust in science as mediator (H4), a structural equation modeling (SEM) analysis was performed. Standardized results of the model are presented in Figure 1. Findings revealed that the fit of the model was good: $\chi 2 = 44.439$; Df=4; CFI=0.994; TLI=0.979; RMSEA= 0.042 [0.031-0.053].

The scalar estimates of the model of associations between Internet usage, different aspects of trust in science, and vaccination are presented in Table 6.

ORIGINAL RESEARCH ARTICLE / DOI: 10.20901/ms.15.30.4 / SUBMITTED: 5.2.2024.



▲ *Figure 1.*
Standardized results on the model of associations between Internet usage, different aspects of trust in science, and vaccination.
Trust1='General trust in science'; Trust2='Trust in scientific disciplines';
Trust3='Trust in statements made by scientists'.

Table 6. **Scalar estimates of the model of associations between Internet usage, different aspects of trust in science, and vaccination**

Regression	B	S.E.	C.R.	P	B
Internet usage → Trust in science	.159	.028	5.631	<0.001	.079
Trust in science → General trust in science	1.000				.879
Trust in science → Trust in disciplines	.953	.016	57.904	<0.001	.900
Trust in science → Trust in statements	.615	.015	42.007	<0.001	.571
Internet usage → Vaccination	-.005	.005	-.912	.362	-.012
Trust in science → Vaccination	.050	.003	17.074	<0.001	.240

The SEM analysis revealed that Internet usage itself does not have a significant effect on vaccination (p=0.362). However, Internet usage has a significant positive effect on trust in science, and trust in science has a significant positive effect on vaccination (p<0.001).

ORIGINAL RESEARCH ARTICLE / DOI: 10.20901/ms.15.30.4 / SUBMITTED: 5.2.2024.

DISCUSSION

This study intended to explore the associations between Internet usage, trust in science, and vaccination, and to answer the research question of whether trust in science mediates the link between Internet usage and vaccination. Empirical evidence was derived from the Cross-National Online Survey-2 (CRONOS-2) Wave 5 panel, administered across 11 European countries.

Building upon prior research (Akbaş et al., 2019; Bracewell, 2021; Cheng et al., 2022; Johnson, 2022; D. Zhou et al., 2020), we expected to reveal gender differences in the level of trust individuals place in science. Independent samples' T-test, conducted to test perceptions on both trust in science and Internet use revealed statistical differences between female and male respondents. Specifically, males exhibited a higher degree of general trust in science compared to their female counterparts. Nevertheless, no statistically significant distinctions were observed either in Internet use or trust in various scientific disciplines or statements articulated by scientists. These findings support the results of previous studies which showed gender differences in trust in science and revealed no differences in the Internet use patterns (Cheng et al., 2022; D. Zhou et al., 2020).

Furthermore, in this study, based on previous research (Al-Hasan et al., 2021; Charron et al., 2020; Liu et al., 2023; Reno et al., 2021), it was assumed that apparent disparities in trust in science exist between individuals who have received vaccination and those who have not. Independent samples' T-test was conducted to assess distinctions in both trust in science and Internet usage among cohorts of vaccinated and non-vaccinated individuals. Despite the absence of statistically significant differences in Internet usage patterns, statistically significant differences were observed in the realm of trust in science. Specifically, individuals who had undergone vaccination exhibited a higher level of general trust in science when juxtaposed with their non-vaccinated counterparts. Additionally, the vaccinated cohort manifested higher levels of trust in various scientific disciplines relative to their non-vaccinated counterparts. Participants who had been vaccinated displayed a higher degree of trust regarding statements articulated by scientists compared to their non-vaccinated counterparts. These discerned variations contribute to a nuanced comprehension of the intricate dynamics between vaccination status, trust in science, and associated factors, thus augmenting the existing body of knowledge in this domain. However, the findings indicate the need for further examination.

Subsequently, this research, based on previous studies on Internet usage (Bilal et al., 2020; Larose et al., 2001; Li et al., 2022; Oswald & Wagner, 2023; Pinto & Poornananda, 2017; Toktam Namayandeh Joorabchi et al., 2013), posited the hypothesis that there exists an interrelationship between Internet usage and trust in science. The analysis of correlations among the study variables unveiled a set of statistically significant yet modest positive correlations. Specifically, positive associations were observed between Internet usage and general trust in science, Internet usage and trust in scientific disciplines, as well as Internet usage and trust in statements made by scientists. Concurrently, a negative

ORIGINAL RESEARCH ARTICLE / DOI: 10.20901/ms.15.30.4 / SUBMITTED: 5.2.2024.

correlation was identified between Internet usage and age. Furthermore, the subscales measuring general trust in science, trust in scientific disciplines, and trust in statements made by scientists exhibited statistically significant positive intercorrelations. These findings contribute to a nuanced understanding of the intricate dynamics linking Internet usage, trust in science, and demographic factors, thereby enriching the scholarly discourse within this field (H. Chen et al., 2022; Gao & Liu, 2022; Nguyen et al., 2022; Silviana et al., 2023; H. Zhou et al., 2020).

Ultimately, the present study posited the conjecture that Internet usage serves as a predictor of trust in science, and in turn, trust in science predicts vaccination, thereby proposing trust in science as a mediating factor in the association between Internet usage and vaccination. Employing structural equation modeling (SEM), the analysis disclosed that Internet usage, in isolation, did not exert a statistically significant influence on vaccination. Nevertheless, a noteworthy positive effect of Internet usage on trust in science emerged, demonstrating a significant association between increased Internet usage and heightened levels of trust in science. Moreover, the study found that trust in science exhibited a significant positive effect on vaccination, suggesting that individuals with greater trust in science are more inclined to adhere to vaccination practices. These discerned relationships underscore the complex interplay among Internet usage, trust in science, and vaccination, thereby contributing to a more nuanced comprehension of the underlying dynamics in the media role context, explored by previous studies (Lee & You, 2022).

In future research, it could be recommended to apply validated scales to assess Internet usage (Rosen et al., 2013),

While this study analyzed sociodemographic variables such as gender and age, future studies should look more closely into educational level as yet another potential mediator of trust in science, to assess if Internet use is also correlated to educational levels. Also, longitudinal studies could be conducted by assessing changes over time to strengthen causative interpretations.

Limitations of this study are focused on sample constraints: the survey is restricted to 11 European countries, which may not generalize globally. The educational level of respondents, which can influence trust in science and socioeconomic status, which can potentially impact Internet access and trust can be defined as possible confounders of this study. At the same time, there can be defined main strengths: large sample size, ability to explore complex relationships among variables.

Implications for practice are focused on health communication and policy design – this research encourages tailored communication strategies for different demographic groups to build trust in science and supports integration of Internet literacy in public health frameworks.

ORIGINAL RESEARCH ARTICLE / DOI: 10.20901/ms.15.30.4 / SUBMITTED: 5.2.2024.

CONCLUSIONS

This study based on data derived from the CROss-National Online Survey-2 (CRONOS-2) Wave 5 panel fielded in 11 European countries, revealed that females and males differ in trust in science: males demonstrated significantly higher general trust in science than females, but no significant differences were observed in Internet usage or trust in different disciplines or statements made by scientists. Next, the study demonstrated that vaccinated and not-vaccinated individuals differ in trust in science: vaccinated individuals demonstrated significantly higher general trust in science, higher trust in scientific disciplines, and significantly higher trust in statements made by scientists than not-vaccinated individuals. Furthermore, this study revealed some weak but statistically significant positive correlations between Internet usage and general trust in science, Internet usage and trust in scientific disciplines, Internet usage and trust in statements made by scientists, and a negative link between Internet usage and age. The *General trust in science*, *Trust in scientific disciplines*, and *Trust in statements made by scientists* subscales were significantly positively correlated. Finally, this study provided evidence that Internet usage predicts trust in science, and trust in science predicts vaccination (trust in science is a mediator in the link between Internet usage and vaccination). SEM analysis revealed that Internet usage itself does not have a significant effect on vaccination. However, Internet usage has a significant positive effect on trust in science, and trust in science has a significant positive effect on vaccination.

References

>Achterberg, P., de Koster, W., & van der Waal, J. (2017). A science confidence gap: Education, trust in scientific methods, and trust in scientific institutions in the United States. *Public Understanding of Science*, *26*(6). https://doi.org/10.1177/0963662515617367

>Akbaş, U., Atalan Ergin, D., & Tatlı, C. (2019). The Effect of Gender on Problematic Internet Usage: A Meta-Analysis. *Addicta: The Turkish Journal on Addictions*, *6*(2). https://doi.org/10.15805/addicta.2019.6.2.0064

>Al-Hasan, A., Khuntia, J., & Yim, D. (2021). Does Seeing What Others Do Through Social Media Influence Vaccine Uptake and Help in the Herd Immunity Through Vaccination? A Cross-Sectional Analysis. *Frontiers in Public Health*, *9*. https://doi.org/10.3389/fpubh.2021.715931

>Bajwa, S., Khan, M. A., & Waheed, S. (2022). Role of Social Media in Perspective of Media Information Literacy During Pandemic Covid-19. *International Journal of Media and Information Literacy*, *7*(2). https://doi.org/10.13187/ijmil.2022.2.305

>Barve, Y., & Saini, J. R. (2021). Healthcare Misinformation Detection and Fact-Checking: A Novel Approach. *International Journal of Advanced Computer Science and Applications*, *12*(10). https://doi.org/10.14569/IJACSA.2021.0121032

>Bilal, M., Jianqiu, Z., Akram, U., Tanveer, Y., Sardar, T., & Rasool, H. (2020). Understanding the effects of internet usage behavior on eWOM. *International Journal of Information Systems in the Service Sector, 12*(3). https://doi.org/10.4018/IJISSS.2020070106

>Boudreau, H., Singh, N., & Boyd, C. J. (2022). Understanding the impact of social media information and misinformation producers on health information seeking: Comment on "Health information seeking behaviors on social media during the COVID-19 pandemic among American social networking site users: Survey study." *Journal of Medical Internet Research*, *24*(2). https://doi.org/10.2196/31415

>Bracewell, L. (2021). Gender, Populism, and the QAnon Conspiracy Movement. *Frontiers in Sociology*, *5*. https://doi.org/10.3389/fsoc.2020.615727

ORIGINAL RESEARCH ARTICLE / DOI: 10.20901/ms.15.30.4 / SUBMITTED: 5.2.2024.

>Chan, H. F., Rizio, S. M., Skali, A., & Torgler, B. (2021). Early COVID-19 Government Communication Is Associated With Reduced Interest in the QAnon Conspiracy Theory. *Frontiers in Psychology*, *12*. https://doi.org/10.3389/fpsyg.2021.681975
>Charron, J., Gautier, A., & Jestin, C. (2020). Influence of information sources on vaccine hesitancy and practices. *Medecine et Maladies Infectieuses*, *50*(8). https://doi.org/10.1016/j.medmal.2020.01.010
>Chen, H., Chen, C. ping, Li, Y., Qin, L., & Qin, M. S. (2022). How Internet usage contributes to livelihood resilience of migrant peasant workers? Evidence from China. *Journal of Rural Studies*, *96*. https://doi.org/10.1016/j.jrurstud.2022.09.028
>Chen, T. Y. T., Piltch-Loeb, R., Harriman, N. W., Testa, M., & Savoia, E. (2022). A Descriptive Analysis of the Relationship between Social Media Use and Vaccine Hesitancy among a Sample of Unvaccinated Adults in Canada. *Vaccines*, *10*(12). https://doi.org/10.3390/vaccines10122096
>Cheng, C. S., Huang, Y. J., Sun, C. A., An, C., Chang, Y. T., Chu, C. M., & Chang, C. W. (2022). Gender-Specific Determinants of eHealth Literacy: Results from an Adolescent Internet Behavior Survey in Taiwan. *International Journal of Environmental Research and Public Health*, *19*(2). https://doi.org/10.3390/ijerph19020664
>Frau-Meigs, D. (2019). Information disorders: Risks and opportunities for digital media and information literacy? *Medijske Studije*, *10*(19). https://doi.org/10.20901/ms.10.19.1
>Gao, J., & Liu, Y. (2022). The influence of internet usage on gender division of labour bias: Evidence from Chinese general social survey data. *Human Behavior and Emerging Technologies*. https://doi.org/10.1155/2022/6948934
>Gao, J., & Liu, Y. (2023). Has Internet Usage Really Narrowed the Gender Wage Gap?: Evidence from Chinese General Social Survey Data. *Human Behavior and Emerging Technologies*. https://doi.org/10.1155/2023/7580041
>Hori, D., Takahashi, T., Kaneda, Y., Ozaki, A., & Tabuchi, T. (2023). The influence of information sources on intention changes to receive COVID-19 vaccination: A prospective cohort study in Japan. *Environmental Health and Preventive Medicine*, *28*(1). https://doi.org/10.1265/ehpm.22-00266
>Jennings, W., Stoker, G., Bunting, H., Valgarðsson, V. O., Gaskell, J., Devine, D., McKay, L., & Mills, M. C. (2021). Lack of trust, conspiracy beliefs, and social media use predict COVID-19 vaccine hesitancy. *Vaccines*, *9*(6). https://doi.org/10.3390/vaccines9060593
>Jo, S., Pituch, K. A., & Howe, N. (2022). The Relationships Between Social Media and Human Papillomavirus Awareness and Knowledge: Cross-sectional Study. *JMIR Public Health and Surveillance*, *8*(9). https://doi.org/10.2196/37274
>Johnson, J. (2022). *Global internet usage rate by gender and region 2020*. Statista. Retrieved 20/12/2023, from https://www.statista.com/statistics/491387/gender-distribution-of-internet-users-region/
>Kelikume, I. (2021). Digital financial inclusion, informal economy and poverty reduction in Africa. *Journal of Enterprising Communities*, *15*(4). https://doi.org/10.1108/JEC-06-2020-0124
>Keshavarz, H. (2021). Evaluating credibility of social media information: Current challenges, research directions, and practical criteria. *Information Discovery and Delivery, 49*(4). https://doi.org/10.1108/IDD-03-2020-0033
>Kovacevic, D., & Kascelan, L. (2020). Internet usage patterns and gender differences: A deep learning approach. *IEEE Consumer Electronics Magazine, 9*(6). https://doi.org/10.1109/MCE.2020.2986817
>Larose, R., Mastro, D., & Eastin, M. S. (2001). Understanding Internet usage: A social-cognitive approach to uses and gratifications. *Social Science Computer Review*, *19*(4). https://doi.org/10.1177/089443930101900401
>Lee, M., & You, M. (2022). Direct and Indirect Associations of Media Use With COVID-19 Vaccine Hesitancy in South Korea: Cross-sectional Web-Based Survey. *Journal of Medical Internet Research*, *24*(1). https://doi.org/10.2196/32329
>Li, C., Ning, G., Xia, Y., Guo, K., & Liu, Q. (2022). Does the Internet Bring People Closer Together or Further Apart? The Impact of Internet Usage on Interpersonal Communications. *Behavioral Sciences*, *12*(11). https://doi.org/10.3390/bs12110425

ORIGINAL RESEARCH ARTICLE / DOI: 10.20901/ms.15.30.4 / SUBMITTED: 5.2.2024.

>Liu, P. L., Zhao, X., & Wan, B. (2023). COVID-19 information exposure and vaccine hesitancy: The influence of trust in government and vaccine confidence. *Psychology, Health and Medicine*, *28*(1). https://doi.org/10.1080/13548506.2021.2014910
>Marsh, E. J., & Rajaram, S. (2019). The Digital Expansion of the Mind: Implications of Internet Usage for Memory and Cognition. *Journal of Applied Research in Memory and Cognition*, 8 (1). https://doi.org/10.1016/j.jarmac.2018.11.001
>Nguyen, C. P., Schinckus, C., Nguyen, B. Q., & Le Tran, D. T. (2022). Influence of internet and mobile usage on the institutional quality: An environmental perspective. *Environmental and Sustainability Indicators*, *16*. https://doi.org/10.1016/j.indic.2022.100216
>O'Connor, C., O'Grady, C., & Murphy, M. (2022). Spotting fake news: a qualitative review of misinformation and conspiracy theories in acne vulgaris. *Clinical and Experimental Dermatology*, *47*(9). https://doi.org/10.1111/ced.15222
>Orduña-Malea, E. (2021). Dot-science top level domain: Academic websites or dumpsites? *Scientometrics*, *126*(4). https://doi.org/10.1007/s11192-020-03832-8
>Oswald, V., & Wagner, M. (2023). Internet usage among the oldest-old: does functional health moderate the relationship between internet usage and autonomy? *European Journal of Ageing*, *20*(1). https://doi.org/10.1007/s10433-023-00748-z
>Ouyang, H., Ma, X., & Wu, X. (2022). The prevalence and determinants of COVID-19 vaccine hesitancy in the age of infodemic. *Human Vaccines and Immunotherapeutics*, *18*(1). https://doi.org/10.1080/21645515.2021.2013694
>Pinto, M. S., & Poornananda, D. S. (2017). The internet usage among students: A uses and gratifications perspective. *Media Watch*, *8*(3). https://doi.org/10.15655/mw/2017/v8i3/49148
>Puri, N., Coomes, E. A., Haghbayan, H., & Gunaratne, K. (2020). Social media and vaccine hesitancy: new updates for the era of COVID-19 and globalized infectious diseases. *Human Vaccines and Immunotherapeutics*, 16(11). https://doi.org/10.1080/21645515.2020.1780846
>Ramaiah, C. K., & Saraswati Rao, M. (2021). Media and information literacy: A bibliography. *DESIDOC Journal of Library and Information Technology*, *41*(4). https://doi.org/10.14429/DJLIT.41.4.17358
>Reno, C., Maietti, E., Di Valerio, Z., Montalti, M., Fantini, M. P., & Gori, D. (2021). Vaccine hesitancy towards COVID-19 vaccination: Investigating the role of information sources through a mediation analysis. *Infectious Disease Reports*, *13*(3). https://doi.org/10.3390/IDR13030066
>Rosen, L. D., Whaling, K., Carrier, L. M., Cheever, N. A., & Rokkum, J. (2013). The Media and Technology Usage and Attitudes Scale: An empirical investigation. *Computers in Human Behavior*, *29*(6). https://doi.org/10.1016/j.chb.2013.06.006
>Shabani, A., & Keshavarz, H. (2022). Media literacy and the credibility evaluation of social media information: students' use of Instagram, WhatsApp and Telegram. *Global Knowledge, Memory and Communication*, *71*(6–7). https://doi.org/10.1108/GKMC-02-2021-0029
>Silviana, D., Musafik, M. N., & Sulistyanto, I. (2023). The Effect of Internet Media Usage towards Learning Interest through Learning Motivation as a Moderator Variable. *Jurnal Pendidikan Bahasa Inggris Proficiency*, *5*(1). https://doi.org/10.32503/proficiency.v5i1.3288
>Thelwall, M., Kousha, K., & Thelwall, S. (2021). Covid-19 vaccine hesitancy on English-language Twitter. *Profesional de La Informacion*, *30*(2). https://doi.org/10.3145/epi.2021.mar.12
>Joorabchi, T. N., Hassan, M. S. H., & Osman, M. N. (2013). Usage of the internet and its effect on youth development. *Universiti Putra Malaysia, 45*(October).
>Ummah, N. H., & Fajri, M. S. Al. (2020). Communication Strategies Used in Teaching Media Information Literacy for Combating Hoaxes in Indonesia: A Case Study of Indonesian National Movements. *Informacijos Mokslai, 90*. https://doi.org/10.15388/Im.2020.90.48
>van Rijn, M., Haverkate, M., Achterberg, P., & Timen, A. (2019). The public uptake of information about antibiotic resistance in the Netherlands. *Public Understanding of Science*, *28*(4). https://doi.org/10.1177/0963662518823701

ORIGINAL RESEARCH ARTICLE / DOI: 10.20901/ms.15.30.4 / SUBMITTED: 5.2.2024.

>Yeung, A. W. K., Tosevska, A., Klager, E., Eibensteiner, F., Tsagkaris, C., Parvanov, E. D., Nawaz, F. A., Völkl-Kernstock, S., Schaden, E., Kletecka-Pulker, M., Willschke, H., & Atanasov, A. G. (2022). Medical and Health-Related Misinformation on Social Media: Bibliometric Study of the Scientific Literature. *Journal of Medical Internet Research*, *24*(1). https://doi.org/10.2196/28152
>Yufei, M., Xiangquan, Z., & Wenxin, H. (2018). Does Internet Usage Reduce the Gender Wage Gap? Empirical Analysis based on CFPS Data. *Journal of Finance and Economics*, *44*(7).
>Zhou, D., Peng, L., & Dong, Y. (2020). The impact of Internet usage on gender role attitudes. *Applied Economics Letters*, *27*(2). https://doi.org/10.1080/13504851.2019.1610692
>Zhou, H., Zhang, J., & Su, J. (2020). Internet access, usage and trust among medical professionals in China: A web-based survey. *International Journal of Nursing Sciences*, *7*. https://doi.org/10.1016/j.ijnss.2020.07.003

ORIGINAL RESEARCH ARTICLE / DOI: 10.20901/ms.15.30.4 / SUBMITTED: 5.2.2024.

OTKRIVANJE VEZA IZMEĐU KORIŠTENJA INTERNETA, POVJERENJA U ZNANOST I CIJEPLJENJA NA TEMELJU PODATAKA IZ ISTRAŽIVANJA CROSS-NATIONAL ONLINE SURVEY 2 (WAVE 5)

Aistė Diržytė :: Gintarė Gulevičiūtė :: Aelita Skaržauskienė :: Monika Mačiulienė :: Asta Zelenkauskaitė

SAŽETAK *Prethodna su istraživanja donekle potvrdila povezanost između povjerenja u znanost i cijepljenja, no povezanost povjerenja u znanost, cijepljenja i korištenja interneta još nije detaljno istražena. Cilj je ove studije bio ispitati upravo te veze, veze između korištenja interneta, povjerenja u znanost i cijepljenja, na temelju podataka dobivenih u istraživanju CROss-National Online Survey 2 (CRONOS-2) Wave 5, provedenom u 11 europskih zemalja. Rezultati su otkrili da muškarci imaju znatno veće opće povjerenje u znanost u usporedbi sa ženama, ali nisu uočene značajne rodne razlike u korištenju interneta niti u povjerenju prema različitim disciplinama ili izjavama znanstvenika. Nadalje, cijepljene osobe pokazale su znatno veće opće povjerenje u znanost, veće povjerenje u znanstvene discipline te znatno veće povjerenje u izjave znanstvenika nego necijepljene osobe. Ova studija također je otkrila slabe, ali statistički značajne pozitivne korelacije između korištenja interneta i općeg povjerenja u znanost, povjerenja u znanstvene discipline te povjerenja u izjave znanstvenika, kao i negativnu povezanost između korištenja interneta i dobi. Podskale općeg povjerenja u znanost, povjerenja u znanstvene discipline i povjerenja u izjave znanstvenika bile su značajno pozitivno međusobno povezane. Modeliranje strukturnim jednadžbama pokazalo je da samo korištenje interneta nema značajan učinak na cijepljenje, ali korištenje interneta ima značajan pozitivan učinak na povjerenje u znanost, a povjerenje u znanost ima značajan pozitivan učinak na cijepljenje.*

KLJUČNE RIJEČI

KORIŠTENJE INTERNETA, POVJERENJE U ZNANOST, CIJEPLJENJE, RODNE RAZLIKE, CRONOS-2

Bilješka o autorima

Aistė Diržytė :: Sveučilište Mykolas Romeris **::** aiste.dirzyte@mruni.eu
Gintarė Gulevičiūtė :: Sveučilište Mykolas Romeris **::** gintare.guleviciute@mruni.eu
Aelita Skaržauskienė :: Sveučilište Mykolas Romeris **::** aelita@mruni.eu
Monika Mačiulienė :: Sveučilište Mykolas Romeris **::** maciuliene@mruni.eu
Asta Zelenkauskaitė :: Sveučilište Mykolas Romeris **::** az358@drexel.edu