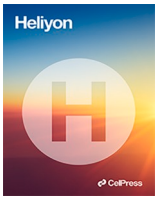
Heliyon 10 (2024) e35041

Contents lists available at ScienceDirect

Heliyon

journal homepage: www.cell.com/heliyon



Research article

Citizen attitudes towards e-government services during the COVID-19 pandemic: A case in Türkiye

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ARTICLE INFO

Keywords:
Covid-19 pandemic
Gender differences
Electronic government
E-government
Binary logistic regression
Türkiye

ABSTRACT

E-government services are essential to societies because they save time, reduce corruption, provide efficient, low-cost, and fast service, increase transparency, and enhance trust in the government. These applications save time, which translates to cost savings by reducing bureaucratic crowds and fatigue and eliminating the need for citizens to travel for offline transactions. This study investigates various factors related to citizens' use of e-government services according to gender differences during and before COVID-19. The microdata set from the Survey on Information and Communication Technology (ICT) Usage in Households conducted by TURKSTAT in 2018 and 2021 was used. Additionally, the binary logistic regression method was employed to analyze these factors. According to the research results, it has been determined that variables such as age, education level, occupation, e-commerce use, internet financial transaction status, number of people in the household, and region are associated with women's use of e-government services during the COVID-19 pandemic. The study found that the significance and impact of these variables on the use of e-government services differ based on the gender of individuals and the periods. The study provides recommendations for IT professionals, staff of the interior ministries, and researchers interested in increasing the use of e-government services. This research may also pioneer efforts to identify priority areas for expanding e-government services.

1. Introduction

Electronic government (e-government) refers to the reform of the public sector through the use of information and communication technology (ICTs) to promote service efficiency, management efficiency, transparency, and citizen engagement [1]. One of the primary objectives of governments is to provide electronic, digital, and offline access to governmental services for the entire population [2]. The rapid spread of innovative technologies and business methods allows states to transform face-to-face services into electronic services to meet the demands of their citizens [3].

Over the past two decades, governments across the globe have adopted ICTs for their core functions to improve their overall performance in civil service [4]. ICTs have a significant role in the political, social, cultural, and economic development of nations and

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https://doi.org/10.1016/j.heliyon.2024.e35041
Received 9 March 2024; Received in revised form 12 July 2024; Accepted 22 July 2024
Available online 23 July 2024

has become one of the fundamental pillars of modern society [5]. E-government (electronic government) is the use of ICT for government activities [6]. E-government involves providing public services online by utilizing the internet and new technologies to improve service delivery and advance democratic processes, as well as supporting ICTs and public policy implementations in public administration, where institutional change is gathered [7]. Through e-government, government services are efficiently delivered to citizens, businesses, and other government departments [8]. Since its emergence in the 1990s, most states have adopted the e-government applications [9]. E-government plays a crucial role in reducing communication and information costs, maximizing speed, expanding access, and eliminating distance [10]. Another goal of e-government is to improve service efficiency, management efficiency, and citizen participation using ICTs [1].

The use of e-government provides various advantages for both the government and the population, who are the primary users of e-government initiatives. These advantages include the transformation of services, the renewal of local democracy, and the promotion of the local economy [7]. E-government improves the administrative efficiency of governments, gains the trust of citizens, eliminates corruption among public officials, and ultimately promotes democratic governance [11]. The benefits of e-government can be considered independently by the public sector and the citizens. From the standpoint of the public sector, e-government contributes to trust in the government and strengthens adherence to the rule of law. From the citizen's standpoint, it provides the capacity to communicate with government entities online at any time and from any location, without physically visiting a government office [12].

Obtaining the trust of citizens is crucial to the successful implementation of e-government [8]. Despite the significant advantages and impact of ICTs on society, many people do not trust online services or e-government and prefer conventional face-to-face methods to access services rather than using web-based applications [8].

It is acknowledged that demographic factors such as gender, education, and age play a significant role in the adoption and utilization of ICT-related technologies. Gender is a key demographic determinant in the adoption of information technology and related applications, particularly in the context of e-government services [13]. Gender is one of the socioeconomic differences among internet users [14]. Gender biases continue to affect women's use of ICTs, even in developed countries such as Japan and Sweden [15]. Furthermore, the issue of gender discrimination has many dimensions, including the pattern of socialization between men and women, and is also affected by differences in education and employment between men and women [16].

The COVID-19 emerged in Wuhan, China, in December 2019 and rapidly spread to other countries. On March 11, 2020, the World Health Organization (WHO) declared the outbreak a global pandemic [17]. The COVID-19 pandemic has profoundly affected all aspects of social life, impeding economic progress and disrupted public administration. Social distancing and isolation measures have been prioritized to prevent the virus from spreading among the general population. Consequently, improvements in e-government applications have come essential. The COVID-19 pandemic has highlighted the importance of efficient and effective e-government services in providing online services during such extraordinary situations. Without these services, the majority of public services would either be unavailable or delivered inadequately [18]. In a time when physical interactions were limited, the use of e-government emerged as a solution for managing COVID-19 [19].

Due to the COVID-19 pandemic, which prompted a shift from traditional working methods to online platforms, the role of digital transformation, especially e-government, has gained global significance [20]. Timely information regarding the COVID-19 pandemic and its social impacts has been widely disseminated, particularly through the media and mobile technologies [21]. Furthermore, amidst misinformation surrounding the virus's spread during the COVID-19 pandemic, e-government services have facilitated governments' efforts in tracking the number of infected individuals and providing accurate information regarding the management of COVID-19 cases [22].

The use of e-government has significantly positively impacted citizens' perceptions of trust in the state, transparency, and the reputation of the government during the COVID-19 pandemic period, but not citizens' participation [23]. E-government maturity has contributed positively and significantly to the increased effectiveness and efficiency of governments in EU countries during the COVID-19 pandemic [18]. The roles of e-government applications and COVID-19 word of mouth are positively related to online social presence during the COVID-19 pandemic [24]. However, during the COVID-19 pandemic, e-government has negatively impacted corporate social responsibility [25]. The roles of e-government and social media during the COVID-19 pandemic are highly related to people's attitudes toward engaging in protective behaviors [17]. Moreover, during the COVID-19 pandemic, the Pakistani government's ICT-based public-private collaboration strategy, implemented through the mobile fund transfer program, has greatly assisted the citizens of Pakistan [21]. Considering the COVID-19 pandemic, e-government applications are very important for both developed and developing countries [20].

This paper investigates various factors related to citizens' use of e-government services in Turkey by gender differences during and before COVID-19. To the best of our knowledge, this is the first study to identify the factors affecting the use of e-government services by citizens in Turkey during the COVID-19 pandemic according to gender differences. For this reason, in the application part of the study, variables such as age, education level, occupation, e-commerce use, financial transactions over the internet, number of people in the household, and regional variables were analyzed in the context of the COVID-19 pandemic period and gender.

As a result of the study, it was determined that the use of e-government services differed according to gender and the COVID-19 pandemic period. In this respect, the study contributes to the literature. For this purpose, a rich dataset was used to detect the factors affecting citizens' use of e-government services in Turkey.

The rest of the paper is organized as follows: literature review, material and methods, results, discussion, and conclusion.

2. Literature review

The factors that affect the use of e-government vary from study to study. The development of e-government applications positively

Table 1
Summary of previous work on E-government services.

Authors	Dependent Variable	Independent Variable	Findings
Acilar [45]	Contracted applications satisfaction	Contracted applications, government application use, trust, citizen differences, access and skills, socioeconomic status	Internet use by women is lower than that of men. The gender digital gap in e-government use is higher than in internet use.
Ariansyah et al. [44]	E-Government use	Gender, education, employment status, family income, access, mobile broadband coverage, number of mobile operators, geographical location, the use of internet-based service by respondents, respondents' basic computer skills, respondents' exposure to harmful content	Women who are employed or entrepreneurs benefit from e-government applications more. In addition, education and income level positively affect the use of e-government.
Nookhao and Kiattisin [35]	Development of e-government	Information quality, system quality, service quality, perceived usefulness, social influence, facilitating condition, computer self-efficacy, perceived privacy, perceived security, citizen satisfaction, trust in government, behavioral intention	Citizen satisfaction, perceived usefulness, information quality, system quality, service quality, computer self-efficacy and trust in government positively affect the use of e-government during the COVID-19 pandemic.
Hodzic, Ravselj and Alibegovic [18]	Government effectiveness, Government efficiency	E-participation, economic prosperity, corruption control, human capital, democracy, political stability, economic freedom, rule of law, power distance, individualism, masculinity, uncertainity avoidance, public employee ratio	E-government services are a mandatory requirement for countries as they increase the effectiveness and efficiency of government.
Yasir et al. [24]	Role of e-government	Epidemic protection, social presence, attitude towards the epidemic outbreak	E-government and COVID-19 word of mouth are positively associated with online social presence during the pandemic.
Ali, Hoque and Alam [49]	E-government development	Income per capita, age, gender, government effectiveness, power distance, individualism, masculinity, long-term orientation	Political, social, economic, technological and demographic characteristics positively affect the development of digital economy and e-government.
Yera et al. [50]	E-government use	Number of children, income quartile, age range, gender, education level, employment, ICT occupation, manual occupation, internet access, computer use, internet use, buy online	In Europe, e− government applications are generally used by European citizens with a high level of education.
Kaya et al. [3]	E-government use	Perceived e-government benefits, nepotism, organizational agility, human rights, e-voting, social media	The development of e-government applications has positive effects on e-voting, perceived e-government benefits and organizational agility.
Rodriguez-Hevía, Navío-Marco and Ruiz-Gómez [26]	E-government use	Population density, development of the region, employment, level of education, age, gender, information, communication, problem solving, software skills for content manipulation, internet connection outside the home, mobile broadband at home, broadband internet at home	Interaction, transaction, participation and involvement are effective in the widespread use of e-government.
Zhang and Zhu [1]	Trust in government	Perceived ease of use, perceived service quality, perceived usefulness, perceived security, perceived behaviour control, perceived facility, subjective norm, resistance to change, intention to use, actual use behaviour	Compared to urban dwellers, facilitating and hindering factors affect rural dwellers' intention to adopt e-government more.
Ma [51]	E-government use	Government trust, political efficacy, gender, nationality, age, education, income	Citizens' trust in the government, education level, age and income strongly influence the use of e-government. The influence of political activity, gender, nationality, household types and occupations is not significant on e-government use.
Saxena [43]	Perception of corruption in public services	Age, marital status, gender, educational status, professional status, increased government inefficiency, extent of transparency in public services, time taken for securing public services, cost incurred in procuring public services, single portal for procuring public services	Demographic factors such as marital status, education, occupation and age do not have any effect on users' perception of corruption in e-government services.
Gauld, Goldfinch and Horsburgh [52]	E-government index score	Age, gender, income, education, residential location	Elderly and uneducated people use e-government applications less. In addition, those who use ICTs are more likely to use e-government services.
Verkijika and De Wet [11]	E-government development index	Corruption, gender equality, age differences, national income, cybersecurity, innovation	Age, national income, cybersecurity, corruption and gender equality and innovations positively affect the development of e-government.
Rosenberg [9]	Use of e-government, trust in government	Ethnicity, gender, education, internet use	Arab immigrants in Israel trust e-government applications less than Israeli Jews.
Mensah and Mi [7]	Willingness to use e-government services	Education, gender, age	While age is important on citizens' willingness to use e-government services, gender and education are insignificant.
Mensah, Vera and Mi [28]	Willingness to use e-government applications	Perceived service quality, perceived ease of use, perceived usefulness, trust, language barrier	Perceived service quality, perceived ease of use, trust and language positively affect the willingness to use e-government services.

impacts the benefits of e-voting, perceived e-government, and organizational agility [3]. Digital skills are crucial for e-government use [26]. In addition to internal characteristics such as the size of local government, administrative capacity, financial capacity, technical capacity, leadership, corporate culture, and experience, demographics, socioeconomic dynamism, and internet usage are determinants of e-government applications [27].

Research conducted in Sub-Saharan African countries indicates that corruption, gender equality, age, national income, cybersecurity, and innovations positively affect the development of e-government [11]. In Malawi, the use of e-government services is not affected by gender or education [7]. In Russian, age, gender, and education positively impact the perceived ease of use of e-government services [28]. In the United Arab Emirates, internet trust and performance expectations are among the strongest motivators for the intention to use e-government services [29].

In Malaysia, education and income levels significantly impact e-government use [30]. In rural India, demographic and personality characteristics affect the adoption of e-government portals [31]. Research from European countries shows that government investments in e-government applications contribute to increased use, but this does not imply that the increase in e-government users is proportional. Furthermore, not all countries benefit equally from their investment in e-government in terms of usage [32].

Reliability has played an important role in the adoption of e-government applications during the COVID-19 pandemic. Additionally, socio-political influences on citizens positively affect the use of e-government services [6]. In Türkiye, e-government services have accelerated processes such as document inquiry, application, and information tracking within the hospital information management system during the COVID-19 pandemic [33]. In Vietnam, the perceived level of risk during the COVID-19 pandemic strongly influences citizens' intention to use e-government [19]. The COVID-19 pandemic has demonstrated the benefits of e-government applications in preparing society for future crises in Lebanon [34]. In Thailand, information quality, system quality, service quality, citizen satisfaction, perceived usefulness, computer self-efficacy, and trust in government directly affect the use of e-government during the COVID-19 pandemic [35].

The intention to use e-government in Türkiye is positively affected by performance expectancy, social impact, facilitation conditions, and trust in the internet [36]. There is a positive correlation between eighteen literature-derived success criteria and e-government conversion success, but these success factors are not the sole reasons for conversion success [37]. Equal opportunities, affordable internet connectivity, and e-government applications should be made available in all areas of Türkiye. This framework should incorporate not only central government institutions but also the commercial sector, universities, professional associations and non-governmental groups [38].

Research on generational differences were categorized individuals as pre-techno individuals, techno individuals, and post-techno individuals. Pre-techno individuals use e-government more frequently than post-techno individuals. Contrary to expectations, post-techno individuals are less digital compared to techno individuals, likely because this age group has less demand for government services [39].

Government reform efforts influenced by the New Public Management movement and Türkiye's initiatives to adapt to the global political system, especially the European Union, have accelerated the promotion of e-government projects to the Turkish public through newspapers [40]. Another study on the development of e-government services investigated the educational component of e-government services and the historical development of e-government courses in postgraduate Public Administration programs in Türkiye. The study found that Turkish universities lack qualified e-government instructors [41].

Citizens' faith in e-government is affected by technology, government institution elements, risk, and the psychology of citizens [42]. In India, gender significantly affects the perception of corruption in e-government services, whereas demographic factors such as education, marital status, and age do not have any effect [43].

Factors influencing the use of e-government in Indonesia vary by gender. Employed women or female entrepreneurs are more likely to use e-government services, whereas this is not the case for men. Additionally, individuals with higher education and income levels are more motivated to use e-government services [44].

There is a significant gender digital divide in the use of e-government in Türkiye, with women lagging behind men in internet usage across all age groups [45]. Furthermore, the government of India has not met its goals for transparency in e-government services [46].

The use of e-government generally differs between user groups. In China, there are differences between urban and rural groups regarding e-government use. While many enabling and inhibiting factors positively influence rural residents' intentions to adopt e-government, they do not have a significant impact on urban residents' motivations [1]. In Nigeria, a digital divide exists between those living in urban regions and those in rural areas, with rural residents using e-government applications less frequently due to low internet usage and the lack of e-commerce [47].

Immigrant women in Israel are disadvantaged in terms of e-government use, regardless of their length of residence as immigrants [9]. In Israel, ethnicity, e-government, and trust in the government were examined. Arabs living in small settlements in Israel are less likely to use e-government than Israeli Jews [48]. In Korea, there are no gender differences in the use of e-government [14].

Gender is an important predictor of both usage intention and performance expectation of mobile government (m-government) services. Age and education are also significant predictors of performance expectations, mobile self-efficacy and intention to use mobile government services [13].

The results of the studies on e-government services are given in Table 1.

3. Material and method

3.1. Data source

In this study, the micro dataset from the Survey on Information and Communication Technology (ICT) Usage in Households conducted by TURKSTAT in 2018 and 2021 was used. The Survey on Information and Communication Technology Usage in Households, which has been conducted since 2004, aims to collect data regarding the ownership and use of information and communication technologies by households and individuals.

Every settlement in Türkiye was included in the sample selection for this survey. This study includes households from every settlement within Türkiye's borders. However, the institutional population, which comprises those in schools, dormitories, hotels, kindergartens, nursing homes, hospitals, and prisons, as well as those living in barracks and army houses, are not included. Additionally, settlements with populations estimated to be less than 1 % of the total population (such as small villages, nomad camping sites, and hamlets) and where the sample household count could not be reached are excluded from the scope. The participants included in the study are aged 16 to 74 [53].

The survey was conducted on a total of 59,418 individuals: 28,888 in 2018 (13,719 men and 15,169 women) and 30,530 in 2021 (15,080 men and 15,450 women). As of the survey period, data was edited as it asked about the status of communicating with public institutions/organizations (using e-government services) through their websites or mobile applications for private purposes in the last 12 months. The selection process of the sample included in the study is illustrated in Fig. 1.

3.2. Outcome variables

The following questions were asked to the participants regarding their communication with public institutions/organizations for private purposes via websites or mobile applications over the previous 12 months: "Did you get information from the websites of public institutions?", "Did you download official forms/documents?", and "Have you filled out an online form on the websites of public institutions/organizations? (For example, filling out tax returns, hospital appointments, e-school applications, MEBBIS applications, exam applications such as university placement exams, public personnel selection examinations, etc.)".

The dependent variable of the study is the status of communication with public institutions/organizations for private purposes via their websites or mobile applications in the previous 12 months as of the survey's period of administration. Participants in the survey were assigned the code "1" if they communicated with public institutions or organizations through their websites or mobile applications, and "0" otherwise.

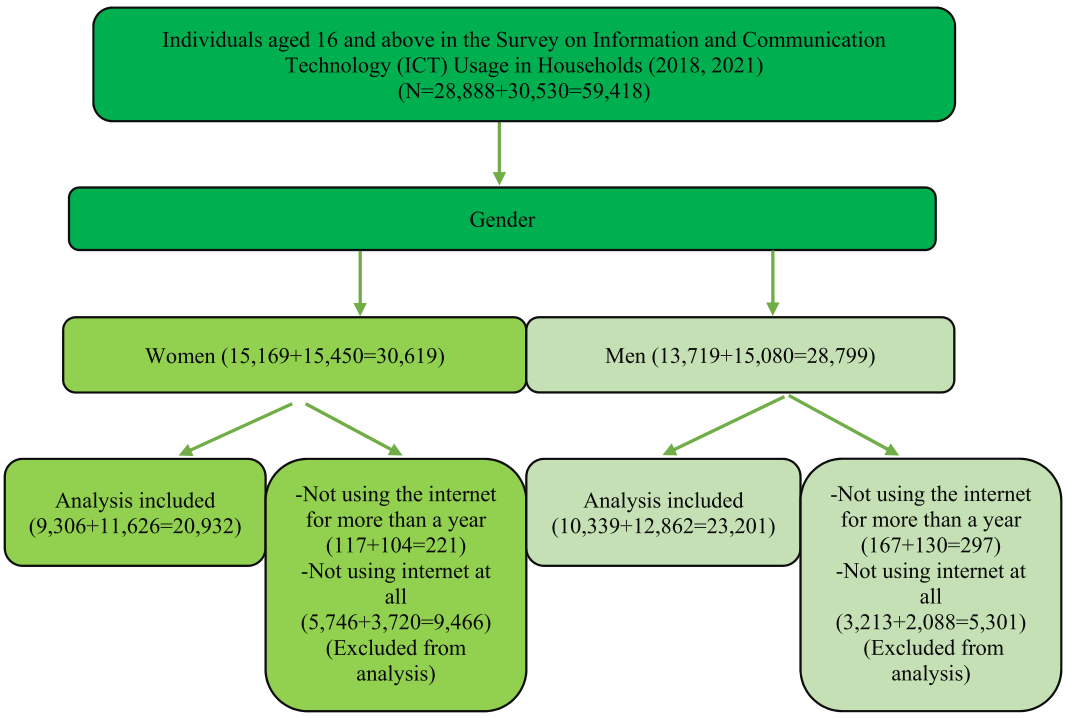

Fig. 1. The sample selection process to determine the factors affecting the use of e-government services according to gender differences during and before COVID-19 (generated by authors).

3.3. Independent variables

The independent variables in the study are age (15–24, 25–34, 35–44, 45–54, 55–64, 65+), education level (no degree, primary school, secondary school, high school, bachelor's degree), occupation (managers; professionals; technicians; technical and assistant professionals; office staff; service and sales staff; qualified agriculture, forestry, and aquaculture workers; craftsmen and related workers; plant and machine operators and assemblers; non-qualified workers; unemployed), internet usage (within the last three months, between the last three months and 1 year), e-commerce usage (yes, no), making financial transactions on the internet (yes, no), number of people in the household (1–3, 4–5, 6 and above), having a desktop computer (yes, no), having a laptop (yes, no), having a tablet (yes, no), income level (1st income level, 2nd income level, 3rd income level, 4th income level, 5th income level) and region (west, middle, east).

3.4. Analysis method

Survey statistics in Stata 15 (Stata Corporation) were used to account for the complex sampling design and weights. Weighted analysis was performed [54]. First, the use of e-government services by men and women who participated in the study and the frequency and percentage of independent variables were obtained. In this study, a binary logistic regression method was used to investigate the differences in the use of e-government services by gender during the pre-COVID-19 and COVID-19 pandemic periods

Table 2
Findings on the factors affecting the use of E-government services by gender of individuals.

Variables		Pre-COVID-19 period		COVID-19 period	
		Women	Men	Women	Men
		n (%)	n (%)	n (%)	n (%)
Age	15–24	2,136 (23.0)	2,162 (20.9)	2,546 (21.9)	2,554 (19.9)
	25–34	2,481 (26.7)	2,392 (23.1)	2,804 (24.1)	2,840 (22.1)
	35–44	2,438 (26.2)	2,586 (25.0)	2,803 (24.1)	3,070 (23.9)
	45–54	1,403 (15.1)	1,852 (17.9)	2,000 (17.2)	2,370 (18.4)
	55–64	671 (7.2)	1,030 (10.0)	1,096 (9.4)	1,474 (11.5)
	65 and above	177 (1.9)	317 (3.1)	377 (3.2)	554 (4.3)
Education	No degree	364 (3.9)	161 (1.6)	621 (5.3)	189 (1.5)
	Primary school	2,489 (26.7)	2,373 (23.0)	3,183 (27.4)	3,018 (23.5)
	Secondary school	2,067 (22.2)	2,586 (25.0)	2,067 (17.8)	2,854 (22.2)
	High school	2,255 (24.2)	2,713 (26.2)	3,023 (26.0)	3,694 (28.7)
	Bachelor's degree	2,131 (22.9)	2,506 (24.2)	2732 (23.5)	3,107 (24.2)
Occupation	Managers	79 (0.8)	300 (2.9)	159 (1.4)	635 (4.9)
	Professionals	730 (7.8)	966 (9.3)	977 (8.4)	1,156 (9.0)
	Technicians/assistant professionals	77 (0.8)	143 (1.4)	275 (2.4)	623 (4.8)
	Staff working in office services	447 (4.8)	654 (6.3)	328 (2.8)	486 (3.8)
	Service/salespersons	533 (5.7)	1,467 (14.2)	554 (4.8)	1,436 (11.2)
	Qualified agriculture/forestry/aquaculture workers	107 (1.1)	363 (3.5)	147 (1.3)	553 (4.3)
	Craftsmen/workers in related businesses	77 (0.8)	524 (5.1)	131 (1.1)	1,347 (10.5)
	Plant-machine operators/assemblers	59 (0.6)	477 (4.6)	128 (1.1)	1,104 (8.6)
	Employees in unqualified jobs	692 (7.4)	2,527 (24.4)	460 (4.0)	1,150 (8.9)
	Unemployed	6,505 (69.9)	2,918 (28.2)	8,467 (72.8)	4,372 (34.0)
Internet usage	Within the last three months	116 (1.2)	140 (1.4)	82 (0.7)	78 (0.6)
	Between the last three months and 1 year	9,190 (98.8)	10,199 (98.6)	11,544 (99.3)	12,784 (99.4)
E-commerce usage	Yes	5,781 (62.1)	6,119 (59.2)	5,634 (48.5)	5,898 (45.9)
	No	3,525 (37.9)	4,220 (40.8)	5,992 (51.5)	6,964 (54.1)
Financial transaction	Yes	8,735 (93.9)	8,845 (85.5)	10,924 (94.0)	10,496 (81.6)
	No	571 (6.1)	1,494 (14.5)	702 (6.0)	2,366 (18.4)
Number of people in the household	1–3	4,067 (43.7)	4,391 (42.5)	4,967 (42.7)	5,389 (41.9)
	4–5	4,164 (44.7)	4,507 (43.6)	5,191 (44.6)	5,647 (43.9)
	6 and above	1,075 (11.6)	1,441 (13.9)	1,468 (12.6)	1,826 (14.2)
Desktop	Yes	7,026 (75.5)	7,691 (74.4)	9,332 (80.3)	10,247 (79.7)
	No	2,280 (24.5)	2,648 (25.6)	2,294 (19.7)	2,615 (20.3)
Laptop	Yes	4,810 (51.7)	5,814 (56.2)	6,181 (53.2)	7,358 (57.2)
	No	4,496 (48.3)	4,525 (43.8)	5,445 (46.8)	5,504 (42.8)
Tablet	Yes	5,679 (61.0)	6,871 (66.5)	7,823 (67.3)	9,059 (70.4)
	No	3,627 (39.0)	3,468 (33.5)	3,803 (32.7)	3,803 (29.6)
Income level	1st income level (lowest)	1,973 (21.2)	2,148 (20.8)	908 (7.8)	964 (7.5)
	2nd income level	2,364 (25.4)	2,573 (24.9)	1,349 (11.6)	1,532 (11.9)
	3rd income level	1,953 (21.0)	2,267 (21.9)	3,139 (27.0)	3,388 (26.3)
	4th income level	1,845 (19.8)	2,027 (19.6)	2,603 (22.4)	2,853 (22.2)
	5th income level (highest)	1,171 (12.6)	1,324 (12.8)	3,627 (31.2)	4,125 (32.1)
Region	Western region	4,001 (43.0)	4,306 (41.6)	4,847 (41.7)	5,203 (40.5)
	Middle region	3,406 (36.6)	3,639 (35.2)	3,999 (34.4)	4,172 (32.4)
	Eastern region	1,899 (20.4)	2,394 (23.2)	2,780 (23.9)	3,487 (27.1)

[55].

Non-parametric statistics are used for categorical data (nominal, ordinal). Logistic regression, which is a non-parametric statistical method, is used when the dependent variable is categorical with exactly two outcomes [56].

In social sciences, especially in socio-economic research, some of the variables examined are measured on a sensitive scale, while others consist of dichotomous data such as positive-negative, successful-unsuccessful, and yes-no. Dichotomous data are the most commonly used form of categorical data. When the dependent variable is dichotomous categorical data, logistic regression analysis is used to examine the cause-and-effect relationship between the dependent variable and the independent variable(s) [57].

Logistic regression is a statistical method that allows for classification in accordance with probability rules by calculating the predicted values of the dependent variable as probabilities [58].

The logistic model was initially developed for use in survival analysis. Here, the dependent variable (Y) takes values of 1 or 0, depending on whether the event of interest occurs. The expected value, E(Y), never falls below 0 or above 1. Therefore, the predicted values of $\hat{y}$ in the logistic model range between 0 and 1 [59,60].

Logistic model is written as,

$$E(Y) = \pi = P(Y = 1) = \frac{e^{\beta_0+\beta_1 X_i}}{1 + e^{\beta_0+\beta_1 X_i}} \; or \; \frac{\exp(\beta_0 + \beta_0 X_i)}{1 + \exp(\beta_0 + \beta_0 X_i)} \quad 1$$

After dividing the numerator and denominator of Equation (1) by $e^{\beta_0+\beta_1 X_i}$ or exp $(\beta_0 + \beta_0 X_i)$,

Table 3
Estimated model results of factors affecting the use of E-government services by gender of individuals.

Variables	Pre-COVID-19 period				COVID-19 period			
	Women		Men		Women		Men	
	β	Std. E	β	Std. E	β	Std. E	β	Std. E
Age (reference category: 15–24)								
25–34	−0.707[a]	0.087	−0.040	0.099	−0.180[b]	0.081	0.170[c]	0.093
35–44	−0.854[a]	0.095	−0.131	0.099	−0.0.207[b]	0.085	0.200[b]	0.094
45–54	−1.368[a]	0.110	−0.471[a]	0.103	−0.604[a]	0.093	−0.144	0.093
55–64	−1.511[a]	0.140	−1.108[a]	0.115	−1.152[a]	0.110	−0.575[a]	0.100
65+	−2.300[a]	0.247	−1.242[a]	0.168	−1.404[a]	0.161	−0.920[a]	0.130
Education level (reference category: bachelor's degree)								
No degree	−2.852[a]	0.240	−2.409[a]	0.244	−2.431[a]	0.150	−1.722[a]	0.203
Primary school	−1.79[a]	0.111	−1.533[a]	0.123	−1.762[a]	0.110	−1.204[a]	0.111
Secondary school	−1.221[a]	0.108	−1.184[a]	0.120	−1.501[a]	0.111	−1.047[a]	0.113
High school	−0.723[a]	0.102	−0.647[a]	0.117	−1.090[a]	0.106	−0.667[a]	0.110
Occupation (reference category: unemployed)								
Managers	0.768[c]	0.462	0.692[a]	0.226	0.864[b]	0.426	0.323[b]	0.157
Professionals	1.525[a]	0.213	0.880[a]	0.199	0.833[a]	0.198	0.485[a]	0.173
Technicians/assistant professionals	1.091[a]	0.381	0.455	0.410	0.079	0.232	0.207	0.164
Staff working in office services	1.155[a]	0.188	0.552[a]	0.169	0.594[b]	0.234	0.338[c]	0.190
Service/salespersons	0.550[a]	0.134	0.118	0.100	0.183	0.124	0.062	0.094
Qualified agriculture/forestry/aquaculture workers	−0.597[c]	0.321	−0.666[a]	0.148	−0.396	0.206	−0.140	0.109
Craftsmen/workers in related businesses	0.076	0.327	0.161	0.141	0.481[b]	0.218	0.201[b]	0.093
Plant-machine operators/assemblers	0.741[b]	0.320	0.052	0.147	0.723[a]	0.260	0.311[a]	0.101
Employees in unqualified jobs	0.181[c]	0.106	−0.322[a]	0.081	0.711[a]	0.125	0.177[c]	0.093
Internet usage (reference category: between the last three months and 1 year)								
Within the last three months	0.657[b]	0.292	0.904[a]	0.904	0.566	0.327	0.815[b]	0.321
E-commerce usage (reference category: no)								
Yes	0.849[a]	0.067	1.058[a]	1.058	0.929[a]	0.059	0.933[a]	0.062
Financial transaction (reference category: no)								
Yes	1.701[a]	0.222	1.097[a]	1.097	0.799[a]	0.168	0.751[a]	0.096
Number of people in the household (reference category: 6 and above)								
1–3	0.221[b]	0.105	0.120	0.093	0.340[a]	0.087	0.284[a]	0.083
4–5	0.125	0.125	0.179[b]	0.086	0.200[b]	0.078	0.149[b]	0.149
Income level (reference category: 4th income level)								
1st income level (lowest)	−0.69	0.096	−0.047	0.098	0.005	0.104	−0.210[b]	0.104
2nd income level	0.031	0.088	0.019	0.092	−0.005	0.087	−0.246[a]	0.087
3rd income level	0.038	0.092	0.036	0.096	0.027	0.069	−0.190[b]	0.073
5th income level (highest)	0.191	0.121	0.032	0.131	0.131	0.073	−0.072	0.080
Region (reference category: Eastern region)								
Western region	0.510[a]	0.088	0.333[a]	0.082	0.487[a]	0.068	0.069[c]	0.069
Middle region	0.560[a]	0.085	0.507[a]	0.081	0.101	0.068	0.067	0.067

[a] $p < 0.01$.
[b] $p < 0.05$.
[c] $p < 0.10$.

$$E(Y)=\pi=\frac{1}{1+e^{-(\beta_0+\beta_1 X_i)}} \text{ or } \frac{1}{1+\exp\left(-\beta_0-\beta_0 X_i\right)} \quad 2$$

In the equation, there is a condition that $Y=\begin{cases}1, \textit{if event A occurs}\\ 0, \textit{if event B occurs}\end{cases}$ and X values are qualitative or quantitative independent variables.

4. Results

4.1. Descriptive statistics

Table 2 shows the findings related to the factors affecting the use of e-government services according to the gender of the individuals in Türkiye during the pre-COVID-19 (2018) and COVID-19 (2021) periods.

4.2. Model estimation

In the study, multicollinearity between the independent variables included in the binary logistic regression model was tested. The variance inflation factor (VIF) indicates a moderate degree of multicollinearity with values of 5 and above, and a high degree with values of 10 and above [61,62]. In this study, no variable that contributed to the multicollinearity problem between the independent

Table 4
Marginal effects of factors affecting the use of E-government services by gender of the individuals.

Variables	Pre-COVID-19 period				COVID-19 period			
	Women		Men		Women		Men	
	M.E	Std. E	M.E	Std. E	M.E	Std. E	M.E	Std. E
Age (reference category: 15–24) rowhead								
25–34	−0.0283[a]	0.035	−0.010	0.025	−0.054[b]	0.024	0.034[c]	0.019
35–44	−0.352[a]	0.039	−0.034	0.026	−0.062[b]	0.026	0.039[b]	0.019
45–54	−0.624[a]	0.053	−0.134[a]	0.030	−0.202[a]	0.031	−0.032	0.020
55–64	−0.707[a]	0.076	−0.373[a]	0.043	−0.440[a]	0.046	−0.146[a]	0.026
65+	−1.223[a]	0.169	−0.432[a]	0.071	−0.567[a]	0.079	−0.260[a]	0.043
Education level (reference category: bachelor's degree) rowhead								
No degree	−1.48[a]	0.171	−0.785[a]	0.121	−0.810[a]	0.065	−0.390[a]	0.065
Primary school	−0.760[a]	0.045	−0.382[a]	0.027	−0.479[a]	0.026	−0.225[a]	0.018
Secondary school	−0.452[a]	0.038	−0.262[a]	0.023	−0.374[a]	0.025	−0.184[a]	0.018
High school	−0.234[a]	0.031	−0.118[a]	0.019	−0.235[a]	0.020	−0.100[a]	0.015
Occupation (reference category: unemployed) rowhead								
Managers	0.324	0.166	0.160[a]	0.043	0.253	0.098	0.070[b]	0.031
Professionals	0.550[a]	0.054	0.192[a]	0.035	0.246[a]	0.047	0.100[a]	0.031
Technicians/assistant professionals	0.431[a]	0.117	0.113	0.089	0.028	0.081	0.046	0.035
Staff working in office services	0.450[a]	0.057	0.127[a]	0.036	0.186[a]	0.063	0.073[c]	0.037
Service/salespersons	0.242[a]	0.054	0.032	0.027	0.063	0.042	0.015	0.022
Qualified agriculture/forestry/aquaculture workers	−0.322	0.189	−0.224[a]	0.056	−0.157[c]	0.088	−0.035	0.028
Craftsmen/workers in related businesses	0.037	0.155	0.043	0.037	0.155[b]	0.062	0.045[b]	0.020
Plant-machine operators/assemblers	0.314[a]	0.116	0.014	0.040	0.220[a]	0.065	0.067[a]	0.021
Employees in unqualified jobs	0.085	0.049	−0.100[a]	0.25	0.217[a]	0.032	0.040[c]	0.021
Internet usage (reference category: between the last three months and 1 year) rowhead								
Within the last three months	0.337[b]	0.165	0.324[a]	0.097	0.222	0.143	0.232[b]	0.113
E-commerce usage (reference category: no) rowhead								
Yes	0.370[a]	0.028	0.266[a]	0.016	0.309[a]	0.019	0.196[a]	0.012
Financial transaction (reference category: no) rowhead								
Yes	0.573[a]	0.049	0.244[a]	0.021	0.231[a]	0.039	0.138[a]	0.014
Number of people in the household (reference category: 6 and above) rowhead								
1–3	0.103[b]	0.050	0.035	0.028	0.120[a]	0.032	0.064[a]	0.019
4–5	0.059	0.046	0.052[b]	0.026	0.073[b]	0.029	0.035[c]	0.018
Income level (reference category: 4th income level) rowhead								
1st income level (lowest)	−0.033	0.045	−0.014	0.028	0.002	0.037	−0.046[c]	0.023
2nd income level	0.014	0.041	0.005	0.026	−0.001	0.031	−0.055[a]	0.019
3rd income level	0.017	0.042	0.010	0.027	0.010	0.024	−0.041[a]	0.016
5th income level (highest)	0.086	0.054	0.009	0.037	0.045[c]	0.025	−0.015	0.017
Region (reference category: Eastern region) rowhead								
Western region	0.252[a]	0.045	0.104[a]	0.026	0.171[a]	0.025	0.029[c]	0.015
Middle region	0.274[a]	0.043	0.152[a]	0.025	0.039	0.026	−0.021	0.016

[a] $p < 0.01$.
[b] $p < 0.05$.
[c] $p < 0.10$.

variables. The estimated results of the binary logistic regression model are shown in Table 3.

During the COVID-19 pandemic period, the following variables were found to be significant in the model estimated for women:

- Age: 25–34, 35–44, 45–54, 55–64, 65+
- Education level: No degree, primary, secondary, high school
- Occupation: Managers; professionals; office workers; craftsmen and related workers; plant and machine operators and assemblers; non-qualified workers
- E-commerce use
- Making financial transactions on the internet
- Number of people in the household: 1–3, 4-5
- Region: West

For men, the following variables were significant:

- Age: 25–34, 35–44, 55–64, 65+
- Education level: No degree, primary school, secondary school, high school
- Occupation: Managers; professionals; office workers; craftsmen and related workers; plant and machine operators and assemblers; non-qualified workers
- Internet use
- E-commerce use
- Making financial transactions on the internet
- Number of people in the household: 1–3, 4-5
- Income level: 1st income level, 2nd income level, 3rd income level
- Region: West

The marginal effects of the factors affecting the use of e-government before COVID-19 and during the COVID-19 pandemic period by the gender of the individuals are presented in Table 4.

During the COVID-19 pandemic, the probability of using e-government services is 5.4 %, 6.2 %, 20.2 %, 44 %, and 56.7 % lower for women aged 25–34, 35–44, 45–54, 55–64, and 65+ compared to women aged 15–24. A woman with only a primary, secondary, or high school diploma is 81 %, 47.9 %, 37.4 %, and 23.5 % less likely to use e-government services than a woman with a bachelor's degree. Women employed in skilled agriculture, forestry, and aquaculture are 15.7 % less likely to use e-government services than unemployed women.

The probability of using e-government services is 24.6 %, 18.6 %, 15.5 %, 22 %, and 21.7 % higher for professionals, office workers, craftsmen and related workers, plant and machine operators and assemblers, and women in non-qualified jobs, respectively, compared to unemployed women. A woman using e-commerce is 30.9 % more likely to use e-government services than others. A woman who conducts financial transactions online is 23.1 % more likely to use e-government services than other women.

A woman with 1–3 and 4–5 people in her household is 12 % and 7.3 % more likely to use e-government services, respectively, compared to a woman with 6 or more people in her household. A woman in the 5th income level is 4.5 % more likely to use e-government services than a woman in the 4th income level. Additionally, a woman residing in the western region is 17.1 % more likely to use e-government services than a woman living in the eastern region.

During the COVID-19 pandemic, men aged 25–34 and 35–44 were 3.4 % and 3.9 % more likely to use e-government services, respectively, compared to men aged 15–24. Men aged 55–64 and 65+ were 14.6 % and 26 % less likely, respectively, to use e-government services compared to men aged 15–24. A man with no degree, a primary, secondary, or high school diploma was 39 %, 22.5 %, 18.4 %, and 10 % less likely, respectively, to use e-government services than a man with a bachelor's degree.

Managers, professionals, office service workers, plant and machine operators and assemblers, and men in non-qualified jobs were 7 %, 10 %, 7.3 %, 6.7 %, and 4 % more likely to use e-government services, respectively, compared to men who do not work at all. A man who used the internet in the past three months was 23.2 % more likely to use e-government services than others. Men who engaged in e-commerce were 19.6 % more likely, and those who conducted financial transactions online were 13.8 % more likely to use e-government services compared to others.

Men with 1–3 or 4–5 people in their household were 6.4 % and 3.5 % more likely, respectively, to use e-government services compared to men with 6 or more people in their household. Men with income levels 1, 2, and 3 were 4.6 %, 5.5 %, and 4.1 % less likely, respectively, to use e-government services compared to men with income level 4. Additionally, men living in the western region were 2.9 % more likely to use e-government services compared to men living in the eastern region.

5. Discussion

E-government encompasses various aspects, including social, technical, economic, political, and public administration [50]. Governments continually introduce new e-government services [49]. Research on the digital divide, particularly regarding e-government usage, has primarily focused on technology accessibility and geographical disparities, overlooking other factors. Amid the COVID-19 pandemic, rising healthcare expenses have heightened the importance of e-government services in providing citizens with information on COVID-19 diagnosis, treatment, and risk factors [63]. Furthermore, the pandemic has prompted analysis of job loss and

insecurity resulting from remote work. Job insecurity during the pandemic has motivated employees to enhance task performance [64]. Perceived job instability has adverse effects on individual job satisfaction, supervisor support satisfaction, and opportunities for promotion [65].

Gender is often overlooked as a contributing factor, even in developed countries like Sweden and Japan, where women's access to ICT services remains comparatively low [15]. In addition, the COVID-19 pandemic has significantly impacted the utilization of e-government services, deeply affecting the proper functioning of public administration, the economic supply chain, and social life. Social distancing and self-isolation have become crucial measures to prevent the spread of the COVID-19 [18]. The COVID-19 pandemic has underscored the importance of e-government services, particularly in light of social isolation and movement restrictions. Moreover, during such crisis situations, e-government and social media have been instrumental in disseminating information about COVID-19 and educating individuals about protective measures [17].

Before and during the COVID-19 pandemic, social and cultural differences influenced the usage of e-government, leading to varied behavioral patterns based on gender (women and men). This study employed binary logistic regression analysis to assess factors related to the usage of e-government services by gender and period among individuals in Türkiye (pre-COVID-19 and COVID-19 pandemic periods). The study found that the significance and impact of the variables on the use of e-government services varied by gender and time period.

Before COVID-19, variables such as age, education level, occupation, internet use, e-commerce use, making financial transactions online, the number of people in the household, and region are found to be related to both men's and women's use of e-government services. Age, education level, occupation, e-commerce use, making financial transactions online, number of people in the household, and regional variables are found to be associated with women's use of e-government services during the COVID-19 pandemic period. On the other hand, age, education level, occupation, internet use, e-commerce use, making financial transactions online, number of people in the household, income level, and region are all found to be related to men's use of e-government services during the COVID-19 pandemic period. Detailed information on these gender differences in the significance and impact of the variables can be found in Appendix 1.

In the context of gender, one of the most interesting findings of the study is that while male administrators benefit more from e-government services than non-working men, this is not the case for women. Gender equality significantly impacts the development of e-government in sub-Saharan African countries [11]. Gender has a significant direct effect on the perception of e-government service usability [7]. In Jordan, gender positively influences the intention to use technology [16]. When women perceive e-participation as a tool for personal growth, they tend to use it more actively [66]. In Saudi Arabia, both men and women positively contribute trust in e-government, with this effect being more pronounced for women [8]. In Türkiye, men use e-government applications more than women [45]. Gender differences in the use of e-government in Indonesia are minimal, with an overall usage rate of 18.24 %. Specifically, 19.20 % of men and 17.28 % of women use e-government services [44]. Gender is not a significant factor in e-government use and support [14,51,52]. In Malawi, gender was not found to be a significant factor in the adoption of e-government services [7]. Gender positively influences both the intention to use and the performance expectation of mobile government (m-government) services [13]. Gender differences have little effect on digital participation [2].

In the study, the effect of the COVID-19 pandemic was most pronounced among men employed in non-qualifying positions. While these individuals use e-government services less than those who were unemployed prior to the COVID-19 pandemic, they use it more than those who were unemployed during the pandemic. During the COVID-19 pandemic, the e-government applications and word of mouth about COVID-19 positively affected online social presence [24]. E-government ensures the proper functioning of public administration during the COVID-19 pandemic [18].

In the study, it was found that women in all age groups (25–34, 35–44, 45–54, 55–64, 65+) both before COVID-19 and during the COVID-19 pandemic period benefited less from e-government services than women in the 15–24 age group. When analyzing the pre-COVID-19 period for men, it was determined that those aged 45 to 54 benefited less from e-government services than those aged 15 to 24. During the COVID-19 pandemic, one of the most noteworthy findings of the study is that men in the 25–34 and 35–44 age groups gained more from e-government services than men in the 15–24 age group. In China, for example, e-government use is correlated with age [51], and age has a direct impact on the perceived use of e-government services [7]. Moreover, age contributes positively to the intention to use mobile government services [13]. In sub-Saharan African countries, age has a significant effect on the development of e-government [11].

Interestingly, pre-techno individuals use e-government more frequently than post-techno individuals [39]. In Saudi Arabia, elderly individuals have a higher level of trust in e-government compared to younger individuals [8]. However, the effect of age on digital participation is minimal [2], and overall, the use of e-government tends decreases as age increases [52].

Compared to women with a bachelor's degree, those with a primary, secondary or high school diploma benefit less from e-government services. Similarly, men who have not completed primary, secondary, or high school are less likely to use e-government services compared to men with a bachelor's degree. Education's influence on e-government usage has been observed in various contexts. For instance, in China, e-government use correlates with the level of education in the population [51]. Education affects performance expectations, mobile self-efficacy, and the likelihood of using mobile government services [13]. Similarly, education has an important effect on e-government usage in Malaysia [30]. Lack of education negatively affects the use of e-government [52]. In contrast to the findings of this study, there is no relationship between education level and e-government use in Malawi [7].

6. Conclusion

Since the 1990s, an increasing number of countries have adopted digital platforms, including e-government services, leveraging ICTs extensively. These services play a crucial role in societies by offering various benefits such as time-saving, reducing corruption, providing efficient, low-cost, and rapid services, enhancing transparency, and fostering trust in the government. E-government applications save valuable time, a valuable resource, by minimizing bureaucratic hurdles and fatigue, and eliminating the need for citizens to make trips for offline transactions.

Amid isolation measures and the imperative of maintaining social distance, many countries have turned to e-government applications throughout the COVID-19 pandemic. These applications have played a pivotal role in disseminating information about COVID-19 and enabling individuals to report their test results online. Such advantages highlight the importance of e-government in helping states achieve their objectives in the 21st century, where access to information and knowledge transfer are paramount for social development.

Understanding the demographic characteristics of e-government service users, including their gender, is essential for tailoring the content and improving the efficiency of these services. Moreover, defining user profiles allows for the implementation of incentive programs targeting groups that underutilize these applications, helping to identify system deficiencies.

The aim of this study is to illustrate how the significance and impact of variables in e-government service usage vary by gender and between the pre-COVID-19 and COVID-19 pandemic periods. By highlighting these differences, the study contributes to the existing literature, shedding light on the gender-specific factors influencing e-government service utilization over time.

Young people and men with higher levels of education gain the most from e-government services. This trend may stem from the slower adoption of technological advancements among elderly men, who are more accustomed to conventional methods. To address this, e-government applications should be tailored to attract older male demographics, ensuring effective ICT use within this segment. Additionally, individuals engaged in e-commerce and online financial transactions demonstrate more efficient utilization of e-government services. Furthermore, disparities between western and eastern provinces in e-government usage suggest that regional education level differences play a role. Addressing this requires informative campaigns outlining the benefits of e-government applications and providing incentives for individuals outside the western region.

The study offers practical recommendations for IT personnel, ministry employees, and researchers interested in boosting e-government service usage. These findings serve as valuable insights for informing economic and social development policies, optimizing resource allocation, and guiding future program designs. Ultimately, the study serves as a pioneering effort in identifying priority areas for enhancing e-government service adoption.

This study is not without limitations. Firstly, it relies on secondary data, meaning the variables required for statistical analysis are limited to those found in the data set. As a result, examining influencing factors is restricted to age, education level, occupation, e-commerce use, internet financial transaction status, household size, and region. This narrow focus may lead to an incomplete understanding of the determinants of e-government service usage, as broader potential factors such as economic status and cultural background are overlooked. Secondly, the study relied on individuals' self-reported responses, which might introduce bias into the data. This data collection method can affect the results' accuracy and reliability.

Role of the funding source

This research did not receive any grants from funding agencies in the public, commercial, or non-profit sectors.

Data availability statement

The Turkish Statistical Institute has established third-party restrictions for the data used in this study. Researchers who comply with the criteria for accessing confidential data can access the data through the Turkish Statistical Institute (bilgi@tuik.gov.tr). The authors of this paper did not have any special privileges to access the data.

CRediT authorship contribution statement

Hasan Serkan Oztaskin: Writing – review & editing, Writing – original draft, Methodology, Investigation. **Neslihan Iyit:** Writing – review & editing, Writing – original draft, Validation, Formal analysis. **Omer Alkan:** Writing – review & editing, Methodology, Formal analysis, Data curation, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix 1

Summary of variable effects for use of e-government services.

Variables	Pre-COVID-19 period		COVID-19 period	
	Women	Men	Women	Men
Age (reference category: 15-24)				
25-34	↓		↓	↑
35-44	↓		↓	↑
45-54	↓	↓	↓	
55-64	↓	↓	↓	↓
65+	↓	↓	↓	↓
Education level (reference category: bachelor's degree)				
No degree	↓	↓	↓	↓
Primary school	↓	↓	↓	↓
Secondary school	↓	↓	↓	↓
High school	↓	↓	↓	↓
Occupation (reference category: unemployed)				
Managers		↑		↑
Professionals	↑	↑	↑	↑
Technicians/assistant professionals	↑			
Staff working in office services	↑	↑	↑	↑
Service/salespersons	↑			
Qualified agriculture/ forestry/ aquaculture workers		↓	↓	
Craftsmen/workers in related businesses				↑
Plant-machine operators/ assemblers	↑		↑	↑
Employees in unqualified jobs		↓	↑	↑
Internet usage (reference category: between the last three months and 1 year)				
Within the last three months	↑	↑		↑
E-commerce usage (reference category: no)				
Yes	↑	↑	↑	↑
Financial transaction (reference category: no)				
Yes	↑	↑	↑	↑
Number of people in the household (reference category: 6 and above)				
1-3	↑		↑	↑
4-5		↑	↑	↑
Income level (reference category: 4th income level)				
1st income level (lowest)				↓
2nd income level				↓
3rd income level				↓
5th income level (highest)			↑	
Region (reference category: Eastern region)				
Western region	↑	↑	↑	↑
Middle region	↑	↑		

References

[1] B. Zhang, Y. Zhu, Comparing attitudes towards adoption of e-government between urban users and rural users: an empirical study in Chongqing municipality, China, Behav. Inf. Technol. 40 (11) (2021) 1154–1168.
[2] M. Dodel, F. Aguirre, Digital inequalities' impact on progressive stages of e-government development. Proceedings of the 11th International Conference on Theory and Practice of Electronic Governance, 2018, pp. 459–463. April 4 - 6, 2018 2018 Galway, Ireland.
[3] T. Kaya, et al., Citizen attitudes towards e-government services: comparison of northern and southern Nicosia municipalities, International Journal of Public Administration in the Digital Age (IJPADA) 7 (1) (2020) 17–32.
[4] P.W. Ziba, J. Kang, 'Factors affecting the intention to adopt e-government services in Malawi and the role played by donors', Inf. Dev. 36 (3) (2020) 369–389.
[5] E. Elgohary, R. Abdelazyz, The impact of employees' resistance to change on implementing e-government systems: an empirical study in Egypt, Electron. J. Inf. Syst. Dev. Ctries. 86 (6) (2020) e12139.
[6] S. Balaskas, A. Panagiotarou, M. Rigou, The influence of trustworthiness and technology acceptance factors on the usage of e-government services during COVID-19: a case study of post COVID-19 Greece, Adm. Sci. 12 (4) (2022).
[7] I.K. Mensah, J. Mi, Exploring the impact of demographic factors on E-government services adoption, Inf. Resour. Manag. J. 31 (3) (2018) 1–16.
[8] L. Alzahrani, W. Al-Karaghouli, V. Weerakkody, Investigating the impact of citizens' trust toward the successful adoption of e-government: a multigroup analysis of gender, age, and internet experience, Inf. Syst. Manag. 35 (2) (2018) 124–146.
[9] D. Rosenberg, Immigrants' disadvantage online: understanding the effects of immigration status, gender and country of origin on the e-government use in Israel, Digital Policy, Regulation and Governance 23 (1) (2020) 45–58.
[10] Ö. Alkan, Ş. Ünver, Türkiye'de e-devlet hizmetlerinin kullanımını etkileyen faktörlerin analizi (Analysis of the factors affecting the use of e-government services in Turkey), Atatürk Üniversitesi İktisadi ve İdari Bilimler Dergisi 34 (4) (2020) 1431–1453.
[11] S.F. Verkijika, L. De Wet, E-government development in Sub-Saharan Africa (SSA): relationship with macro level indices and possible implications. *2016 IST-Africa Week Conference,* 2016, IEEE, 2016, pp. 1–10.
[12] D. Rosenberg, 'Use of e-government services in a deeply divided society: a test and an extension of the social inequality hypotheses', New Media Soc. 21 (2) (2019) 464–482.
[13] I.K. Mensah, G. Zeng, C. Luo, The effect of gender, age, and education on the adoption of mobile government services, Int. J. Semantic Web Inf. Syst. 16 (3) (2020) 35–52.
[14] Y.-T. Choi, S. Park, Understanding gender inequality in central e-government: a Korean case study, Govern. Inf. Q. 30 (3) (2013) 300–309.
[15] E. Abu-Shanab, N. Al-Jamal, Exploring the gender digital divide in Jordan, Gend. Technol. Dev. 19 (1) (2015) 91–113.
[16] E.A. Abu-Shanab, Gender and age: moderators or predictors of e-government acceptance? Int. J. E-Adoption (IJEA) 7 (1) (2015) 32–51.
[17] N. Mat Dawi, et al., Attitude toward protective behavior engagement during COVID-19 pandemic in Malaysia: the role of e-government and social media, Front. Public Health 9 (2021) 1–8.
[18] S. Hodzic, D. Ravselj, D.J. Alibegovic, 'E-Government effectiveness and efficiency in EU-28 and COVID-19', Central European Public Administration Review 19 (1) (2021) 159–180.
[19] T.T.T. Nguyen, Citizens' intentions to use e-government during the COVID-19 pandemic: integrating the technology acceptance model and perceived risk theory, Kybernetes 52 (7) (2023) 2329–2346.
[20] F. Almehmadi, Developing an information management strategy for e-government in Saudi Arabia, Int. J. Adv. Comput. Sci. Appl. 11 (11) (2020) 643–653.
[21] A.Y. Ar, A. Abbas, 'Public-private ICT-based collaboration initiative during the COVID-19 pandemic: the case of ehsaas emergency cash program in Pakistan', Braz. Arch. Biol. Technol. 64 (2021) 1–8.
[22] I.K. Mensah, et al., Drivers of egovernment adoption amidst COVID-19 pandemic: the Information Adoption Model (IAM) approach, Inf. Dev. (2021) 02666669211010872.
[23] T.S. Amosun, et al., Does e-government help shape citizens' engagement during the COVID-19 crisis? a study of mediational effects of how citizens perceive the government, Online Inf. Rev. (2021) 1–21.
[24] A. Yasir, et al., Modeling impact of word of mouth and E-government on online social presence during COVID-19 outbreak: a multi-mediation approach, Int. J. Environ. Res. Publ. Health 17 (8) (2020) 2954.
[25] A.A.R.N. Avotra, et al., Examining the impact of e-government on corporate social responsibility performance: the mediating effect of mandatory corporate social responsibility policy, corruption, and information and communication technologies development during the COVID era, Front. Psychol. 12 (2021) 737100.
[26] L.F. Rodriguez-Hevía, J. Navío-Marco, L.M. Ruiz-Gómez, Citizens' involvement in E-government in the European Union: the rising importance of the digital skills, Sustainability 12 (17) (2020) 6807.
[27] G.P. Dias, Determinants of e-government implementation at the local level: an empirical model, Online Inf. Rev. 44 (7) (2020) 1307–1326.
[28] I.K. Mensah, P. Vera, J. Mi, 'Factors determining the use of e-government services: an empirical study on Russian students in China', Int. J. E-Adoption (IJEA) 10 (2) (2018) 1–19.
[29] K.A. Al Mansoori, J. Sarabdeen, A.L. Tchantchane, Investigating Emirati citizens' adoption of e-government services in Abu Dhabi using modified UTAUT model, Inf. Technol. People 31 (2) (2018) 455–481.
[30] A. Sulaiman, et al., Snapshot of e-government applıcations acceptance among the urban poor communities and its relationship with age, gender, education and income in Malaysia, JATI-Journal of Southeast Asian Studies 24 (2) (2019) 19–31.
[31] V. Venkatesh, T.A. Sykes, S. Venkatraman, Understanding e-Government portal use in rural India: role of demographic and personality characteristics, Inf. Syst. J. 24 (3) (2014) 249–269.
[32] R. Pérez-Morote, C. Pontones-Rosa, M. Núñez-Chicharro, The effects of e-government evaluation, trust and the digital divide in the levels of e-government use in European countries, Technol. Forecast. Soc. Change 154 (2020) 119973 1–11997314.
[33] S.H. Bostanci, S. Yildirim, F. Erdogan, A review on e-government portal's services within hospital information system during covid-19 pandemic, Konuralp Tip Dergisi 14 (2022) 271–279.
[34] B. El Hajj, G. Karadas, P. Zargar, How E-government can help societies during a crisis: implications of UTAUT model in Lebanon, Sustainability 15 (6) (2023).
[35] S. Nookhao, S. Kiattisin, 'Achieving a successful e-government: determinants of behavioral intention from Thai citizens' perspective', Heliyon 9 (8) (2023) e18944.
[36] M. Kurfalı, et al., Adoption of e-government services in Turkey, Comput. Hum. Behav. 66 (2017) 168–178.
[37] G. İskender, S. Özkan, Analysis of success factors in e-government transformation in Turkey: are these factors really the causes of success? Inf. Dev. 31 (4) (2015) 323–332.
[38] A. Şişman, F.A. Sesli, Z. Alkış, E-government concept and e-government applications in Turkey, Afr. J. Bus. Manag. 3 (11) (2009) 644–653.
[39] S. Ersoz, E. Demir Askeroğlu, Generations X, Y, Z and their perception of e-government services: case of Turkey, Online J. Commun. Media Technol. 10 (1) (2020) e202002.
[40] M. Yıldız, A. Saylam, 'E-government discourses: an inductive analysis', Govern. Inf. Q. 30 (2) (2013) 141–153.
[41] M. Yildiz, C. Babaoğlu, M.A. Demircioğlu, E-government education in Turkish public administration graduate programs: past, present, and future, J. Publ. Aff. Educ. 22 (2) (2016) 287–302.
[42] L. Alzahrani, W. Al-Karaghouli, V. Weerakkody, Analysing the critical factors influencing trust in e-government adoption from citizens' perspective: a systematic review and a conceptual framework, Int. Bus. Rev. 26 (1) (2017) 164–175.
[43] S. Saxena, Perception of corruption in e-government services post-launch of "Digital India": role of demographic variables, Digital Policy, Regulation and Governance 20 (2) (2018) 163–177.

[44] K. Ariansyah, et al., Digital inclusion for all? A gender-disaggregated analysis of e-government service use in Indonesia, Transforming Gov. People, Process Policy 17 (4) (2023) 655–672.
[45] A. Acilar, Exploring the gender digital divide in E-government use in a developing country, International Journal of Public Administration in the Digital Age 7 (4) (2020) 1–15.
[46] S. Saxena, Factors influencing perceptions on corruption in public service delivery via e-government platform, Foresight 19 (6) (2017) 628–646.
[47] O.M. Okunola, J. Rowley, F. Johnson, The multi-dimensional digital divide: perspectives from an e-government portal in Nigeria, Govern. Inf. Q. 34 (2) (2017) 329–339.
[48] D. Rosenberg, Ethnic perspective in e-government use and trust in government: a test of social inequality approaches, New Media Soc. 23 (6) (2021) 1660–1680.
[49] M.A. Ali, M.R. Hoque, K. Alam, An empirical investigation of the relationship between e-government development and the digital economy: the case of Asian countries, J. Knowl. Manag. 22 (5) (2018) 1176–1200.
[50] A. Yera, et al., Characterization of e-Government adoption in Europe, PLoS One 15 (4) (2020) e0231585.
[51] L. Ma, Digital divide and citizen use of e-government in China's municipalities, International Journal of Public Administration in the Digital Age (IJPADA) 5 (3) (2018) 16–31.
[52] R. Gauld, S. Goldfinch, S. Horsburgh, 'Do they want it? Do they use it? The 'Demand-Side'of e-Government in Australia and New Zealand', Govern. Inf. Q. 27 (2) (2010) 177–186.
[53] TÜİK, Hanehalkı bilişim teknolojileri Kullanım Araştırması, Available at: https://www.tuik.gov.tr/Kurumsal/Mikro_Veri#, 2019.
[54] E. Bayrakçeken, Ö. Alkan, H. Abar, Psychological help-seeking status for living with mental health conditions in Türkiye: using a multivariate probit model, Healthcare 11 (21) (2023).
[55] E. Güney, et al., Gender differences in psychological help-seeking attitudes: a case in Türkiye, Front. Psychol. 15 (2024).
[56] A. Akgül, O. Çevik, İstatistiksel Analiz Teknikleri: SPSS'te İşletme Yönetimi Uygulamaları, Emek Ofset Ltd, Ankara, 2003.
[57] A. Agresti, An Introduction to Categorical Data Analysis, John Wiley and Sons Inc, New York, 1996.
[58] K. Özdamar, Paket programlar ile istatistiksel veri analizi-1: SPSS-MINITAB, Eskişehir: Kaan Kitabevi (1999).
[59] W. Mendenhall, T. Sincich, N.S. Boudreau, A Second Course in Statistics: Regression Analysis, New Jersey: Prentice Hall, Upper Saddle River, NJ, 2003.
[60] H. Özer, *Nitel Değişkenli Ekonometrik Modeller: Teori ve Bir Uygulama.* Ankara: Nobel Yayın Dağıtım, 2004.
[61] S. Ünver, Ö. Alkan, E. Oktay, Physical intimate partner violence against pregnant women in Türkiye: a population based study, Sage Open 14 (2) (2024).
[62] Ö. Alkan, E. Güney, Investigation of factors that affect the frequency of alcohol use of employees in Turkey, J. Subst. Use 26 (5) (2021) 468–474.
[63] G. Lazaroiu, et al., The economics of deep and machine learning-based algorithms for COVID-19 prediction, detection, and diagnosis shaping the organizational management of hospitals, Oeconomia Copernicana 15 (1) (2024) 27–58.
[64] M.S. Nemteanu, et al., Predicting job satisfaction and work engagement behavior in the covid-19 pandemic: a conservation of resources theory approach, E & M Ekonomie a Management 25 (2) (2022) 23–40.
[65] M.S. Nemteanu, V. Dinu, D.C. Dabija, Job insecurity, job instability, and job satisfaction in the context of the COVID-19 pandemic, Journal of Competitiveness 13 (2) (2021) 65–82.
[66] S. Kim, J. Lee, Gender and e-participation in local governance: citizen e-participation values and social ties, Int. J. Publ. Adm. 42 (13) (2019) 1073–1083.