

Article

Unresolved Issues: Quality of Life and Digitalization in Marginalized Communities

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Abstract

Digitalization is a catalyst for the development of an information society, transforming how individuals interact with the world. However, its implementation across countries and regions has been uneven, contributing to social polarization and declining social trust. Among the most pressing concerns related to digitalization and inequality are the conditions of marginalized communities and persistent gender disparities. This study examines whether digitalization is associated with quality of life in marginalized areas and whether these effects differ between men and women. Using a quantitative approach, this study applies an ordinal regression model to data from two surveys conducted in 2021 and 2024 in a marginalized community in Mexico City. The results indicate that digitalization is significantly associated with quality of life: households possessing technological assets were 4.17 times more likely to report improvements in quality of life. Moreover, notable gender differences emerged. Although men's quality of life increased by a factor of 35.7 in relation to digitalization, no statistically significant association was observed for women. The findings suggest a growing and statistically significant association between digitalization and quality of life in marginalized communities, but its benefits are distributed unevenly across genders.

Keywords: digitalization; quality of life; inequality; digital gender divide

1. Introduction

Digitalization is an evident phenomenon that has characterized the last few decades. It has driven the Fourth Industrial Revolution and, according to a report from the World Economic Forum, it has caused rapid productivity growth (Tátrai and Szabó 2020). Digitalization can be considered a catalyst for the development of an information society; it reshapes how people interact with the world and also the way individuals perceive their own attitude towards the world (Kryzhanovskij et al. 2021).

Some of the main lines of research related to digitalization and socio-economic status refer to the impact of personal digital devices on quality of life (QoL), the gender digital divide, and the digital divide and inequality, among others. Many studies have been conducted to analyze whether it has an impact on people's QoL (Barlybaev et al. 2021; Kosasi et al. 2023; Kryzhanovskij et al. 2021; Osipova and Naumova 2020). The World Bank Group, in a study conducted in 2023, reported that a lack of access to digital technologies in low-income countries hinders people's growth (World Bank Group 2024).

In this article, we focused our research on inequality in marginalized communities and the gender digital divide, as these are key elements of the Sustainable Development



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Goals 2030. Furthermore, we considered a post-COVID-19 period and its implications in QoL and digitalization, because COVID-19 was a major accelerator and catalyst in fast-tracking the current *modus operandi* towards the acceptance of modern technologies and the transformation of lifestyle, businesses, and communities (Amankwah-Amoah et al. 2021).

This paper is organized as follows: In the first section, we present the literature review on quality of life, inequality, and the digital divide in marginalized communities, as well as gender differences. In this section, we evaluate the relationships between digitalization and quality of life and whether the possession of technological devices is related to greater quality of life. Subsequently, the relationship between digitalization and inequality was explored, and then, between digitalization and marginalization. Furthermore, we analyzed whether there is a difference between genders when discussing quality of life, related to both the use of electronic devices and income level. We present two hypotheses.

The following section is the methodology; we used a quantitative approach based on an ordinal regression model. The data analyzed comes from surveys conducted in 2021 and 2024 in a marginalized community in Mexico City, which is considered a developing country. There is a section of results and discussion regarding gender, the periods of the surveys, and the use of different technological devices, such as a computer, a tablet, a cellular phone, and internet access. Finally, we present conclusions and suggest future lines of research.

2. Literature Review

Digitalization refers to the introduction of modern digital technologies in various aspects of life and the community (Barlybaev et al. 2021). The integration of digital technologies that have positively changed the public's way of life includes artificial intelligence, big data, cloud computing, and the internet; one additional effect of digitalization is the widespread availability of smartphones (Wang and Xu 2023). Although Osipova and Naumova (2020) suggested that successful digitalization is a consequence of successful regional development, most of the literature (including this article) considers digitalization a factor that increases regional development and effectiveness.

The advantages of digitalization are directed to people (employment, health, and education), the planet (contribution to sustainability), and prosperity (the economic resilience of businesses) (Đorić 2022). A main function of digitalization is increasing communications, adding to people's innate desire for acceptance and belonging, eliminating certain barriers, and strengthening individuals' networking capabilities (Ionescu-Feleagă et al. 2022).

It is true that digitalization has produced positive and significant changes in many areas of life; however, some changes might be also negative (Kosasi et al. 2023). These include economic, social, and psychological effects on people; financial risks; dependence on social media; loss of confidentiality; the risk of personal data theft; and breaches of security and privacy (El Khatib et al. 2024; Ionescu-Feleagă et al. 2022; Kryzhanovskij et al. 2021). Furthermore, excessive and frequent use of digital technologies can have adverse effects by reducing social connections and creating a sense of loneliness and isolation (Kosasi et al. 2023).

According to Kryzhanovskij et al. (2021), the positive or the negative effects of digitalization depend on the social and political conditions: "In recent research, it was marked that digitalization does not turn the state into a country of prosperity. It contributes to increased national wealth only if the country has an adequate education system, good governance, and a philanthropic financial system" (p. 2). Through digitalization, QoL can be significantly improved in many areas of society (Musarat et al. 2022), whether the countries are developed or developing (Tátrai and Szabó 2020).

2.1. Digitalization and Quality of Life

Digitalization affects QoL in different areas: education, healthcare, economy, finance, information systems, infrastructure, businesses, and agriculture. Quality of life is an important factor in the development of a society (Barlybaev et al. 2021). Quality of life can be defined as “the ability of individuals to build social capital, to achieve their professional goals, to receive a quality education and to develop interpersonal relationships and connections” (Ionescu-Feleagă et al. 2022, p. 3). QoL is a system formed by indicators measuring the degree to which people’s life needs are met and comes as a result of the increasing ability of people to solve their problems and achieve success (Osipova and Naumova 2020). Digitalization accelerates processes and affects quality of life within the community (Barlybaev et al. 2021).

QoL is positively impacted through increased access to information and communication technologies, and digitalization serves as a key determinant of human development; it affects objective indicators of quality of life and subjective perception (Kryzhanovskij et al. 2021). According to the United Nations, there is a list of factors that determine quality of life: food consumption, housing conditions, employment, working conditions, education, social security, human recreation and leisure, human rights, and non-food products (Barlybaev et al. 2021). These are objective aspects, but according to Barlybaev et al. (2021), when assessing QoL, it is important to consider both objective and subjective aspects, such as “a personal assessment of one’s life, the psychological and emotional state of a person, expectations from the future, and others” (p. 3). Kryzhanovskij et al. (2021) found a close correlation between subjective and objective indicators of QoL and between QoL and digitalization.

Kosasi et al. (2023) also found a relationship between quality of life and digitalization, but they suggested that quality of life would increase through digitalization if the number of users grows. In contrast, Kryzhanovskij et al. (2021) do expect that digitalization increases quality of life; however, digital technologies are means, instruments to promote the development and transformation of socio-economic processes, not ends. The possession or use *per se* does not guarantee positive outcomes; rather, it is the creation and implementation of wise policies that guide progress and well-being for everyone (Kryzhanovskij et al. 2021). This was confirmed by a study using three variables: world digital competitiveness ranking, human development index, and the ranking of happiness. The results showed that a high level of digitalization does not guarantee higher levels of QoL; many countries with better results on the world digital competitiveness ranking had a lower human development index and scored lower on the ranking of happiness. Similarly, some countries with better results on the high development index or the ranking of happiness had a lower world digital competitiveness ranking. “These cases prove that digitalization is undoubtedly a significant process in changing the quality of life, but it needs to be taken into account together with the policy and conditions of digitalization and other sufficient social-economic factors, which are more fundamental than digitalization itself” (p. 8).

There is a need for public policies to support adequate infrastructure and digital literacy on Information and Communication Technologies (ICTs) and digitalization (Espinosa-Zárate et al. 2023) because there is a positive relationship between government policies, digitalization, and QoL (El Khatib et al. 2024). ICTs are the infrastructure installed for information seeking, socializing, or entertainment (Büchi et al. 2019). For El Khatib et al. (2024), the integration of digital technologies aimed at increasing quality of life should be part of government plans, as digitalization has improved the efficacy and efficiency of operations carried out by governments (Androniceanu et al. 2022). Furthermore, from a governmental perspective, digitalization is also a good tool to promote citizen engagement in public decision-making processes (Istambul and Abdulghani 2024). For Sá et al. (2021),

who conducted a study after the pandemic, in a post-COVID 19 era, the importance of literacy to promote a digital society is crucial; this phenomenon did reinforce an increase in digital education, but it is not possible to conclude that, after the pandemic, new generations would naturally develop digital social skills. It is highly important that governments keep promoting literacy and ICTs.

2.2. Digital Divide and Inequality

As stated in previous sections, digitalization is important for national development (Islam and Inan 2021) and has served as a driving force to create jobs, increase economic growth, and has brought progress and wealth in record time, but its implementation in countries and regions has been unequal. It has been concentrated on a small number of individuals, companies, and countries in terms of accessibility, affordability, ability, and attitude (Androniceanu et al. 2022; Dorić 2022). Analyzing the integrated level of digital development, Europe is the region with the highest level, followed by the Asia-Pacific region, which is ahead of America (Trofymenko et al. 2023). The regions with the highest levels of inequality are Latin America and Africa. Surfshark (2025) presents a Digital Quality of Life (DQL) Index, which ranks countries according to the digital well-being of their citizens, considering factors such as internet affordability, internet quality, e-infrastructure, e-security, and e-government services. Among 121 countries, Uruguay is the highest-ranking country from Latin America, which ranks at 39, and the first African country on the list is Mauritius, which ranks at 60; Mexico, the country where this study was conducted, ranks 74 (Surfshark 2025).

The risk of digital inequality is that it creates social polarization and weakens social trust (Wang and Xu 2023). In a study conducted in Bangladesh, five elements were found as the main elements producing digital inequality: education, infrastructure, social, economic, and usable design (Islam and Inan 2021); for these researchers, other factors related to inequality were age, income, and type of residence.

For Trofymenko et al. (2023), inequality is a major challenge that jeopardizes the achievement of the Sustainable Development Goals 2030. They state that digital technologies have contributed to deepening inequality and global asymmetries. For them, digitalization has exacerbated the digital divide and relegated some countries, communities, and individuals from the benefits of digital technologies (Trofymenko et al. 2023). Digital divide or digital inequality can be used interchangeably and refers to inequalities in proper access to technology among individuals, businesses, households, and communities (Perera et al. 2023). Mora-Rivera and García-Mora (2021) define the digital divide as: “the relationships between the spread of digital technologies and the factors that contribute to the inclusion or exclusion of countries, regions, and people in the new digital era” (p. 3). It has three levels: (1) inequality of access, which is related to infrastructure, (2) inequality of skills on how to use and take advantage of ICTs, and (3) inequality in the results and benefits associated with connectivity (Mora-Rivera and García-Mora 2021). The digital divide refers to the gap between those with access to computers, smartphones, and technology, and those who do not (Larsson and Viitaoja 2019).

The digital divide is more than physical accessibility; it also involves technology acceptance and use (Hustad et al. 2019), which can slow down the deployment and adoption of digitalization (Islam and Inan 2021). In addition to digital skills, the digital divide is also influenced by motivation and personality traits (Hustad et al. 2019).

For Dorić (2022), projections suggest that the trajectory of digitalization will continue and further widen the inequality gap. In contrast, Hustad et al. (2019) believe that, regarding physical access, the digital divide is closing the gap. Whether the inequality is growing or not, the fact is that introducing cutting-edge technological innovations

might lead to improved QoL and reduced inequalities if this effort is accompanied by strengthening the knowledge and ability of the community (Hustad et al. 2019; Perera et al. 2023). As mentioned by Perera et al. (2023), inequality is also present when the community does not have the proper infrastructure, despite having a smart device.

Efforts to strengthen the necessary skills can be supported through educational programs or community digital literacy initiatives, as digitalization is more useful for those who are able to learn how to use digital tools (Hustad et al. 2019; Ionescu-Feleagă et al. 2022; Perera et al. 2023). Online activities may produce many offline benefits, such as job opportunities, increasing social networks, access to offers from online purchases, and educational opportunities, among others. However, two individuals with the same access to technology might get different outcomes because of the knowledge and ability required to use digital tools (Perera et al. 2023). Some categories of citizens might see the use of digital technologies as a vulnerability. For example, older people would face the accelerated pace of digitalization services, increasing feelings of anxiety and undermining their well-being (Kryzhanovskij et al. 2021). But, when this category of citizens learns how to integrate digital tools into daily activities, they “are more satisfied with their lives when using digital networks due to the opportunity for communication and sharing messages, images, videos, etc., with other people” (Ionescu-Feleagă et al. 2022, p. 18).

There is a need for new policies that respond more quickly and accurately to the new dynamics of the digital economy, as more than half the world’s population still has limited or no access to the internet (Dorić 2022). The goal for governments should be to give every citizen the same access to services, information, and knowledge (Androniceanu et al. 2022). “If governments and societies proactively do not work on strengthening digital inclusion, the consequences are a great immobilization of the labor force, which causes a slowdown in economic growth, and a deepening of the digital divide, which undermines social cohesion” (Dorić 2022, pp. 132–33).

According to Perera et al. (2023), who conducted a systematic literature review regarding digital inequality and development, more empirical and comparative studies are needed to understand the benefits of online activities in reducing inequalities. When referring to inequality, the two most predominant topics in the literature related to the Sustainable Development Goals (SDG) 2030 are quality education and gender equality (Perera et al. 2023). One study, related to digitalization and education found that education has a positive impact on internet access; upon completing high school, an individual has a 10% probability of having internet access in urban areas, but only 2.2% in rural areas (Mora-Rivera and García-Mora 2021).

Spulbar et al. (2022) created a digital development index based on data from 175 countries between 2019 and 2020, within the context of the COVID-19 pandemic. The index included measures of personal technology adoption. Similarly to Amankwah-Amoah et al. (2021), who considered COVID-19 as the great accelerator of accepting modern technologies in different contexts of life, they concluded that when countries increase access to technology, poverty is likely to be reduced, which aligns with one of the goals of the SDGs. The results of this empirical study indicate that investing in digital development may be even more important than investing in shelter and primary goods when the focus is on developing the economy.

In 2023, Verwiebe et al. (2023) offered the conclusion that more attention should be paid to the topic of digitalization and inequality because less than 7% of publications on digitalization since 2000 address inequality. According to them, the geographical distribution of research on inequality is unbalanced: Latin America and Africa are two areas of the world where most countries are still developing and are also the areas with the fewest country-specific studies conducted (Verwiebe et al. 2023).

2.3. Digitalization and Marginalized Communities

According to [Liotta \(2023\)](#), with the expansion of digitalization, the digital divide has become a stronger concern, especially in underprivileged communities, due to the disparities in access to technology and digital skills. Even though there is extensive research on digitalization and its positive effects, research is needed in regards to the strategies and initiatives required to bridge the digital divide in underprivileged regions ([Liotta 2023](#); [Yüksel-Arslan et al. 2025](#)).

Some researchers have conducted studies either in developing countries or in marginalized communities. A study in Mexico showed that poverty was reduced by internet access, with a greater impact observed in rural areas than in urban ones ([Mora-Rivera and García-Mora 2021](#)). [Djarmiko et al. \(2025\)](#) reported results in three different areas: in Sub-Saharan Africa, fewer than 30% of women have access to digital financial services; in Indonesia, senior citizens are unfamiliar with digital tools because of a lack of institutional support; and Latin American indigenous groups are excluded due to language barriers and a lack of government support ([Djarmiko et al. 2025](#)). In a survey conducted in underprivileged communities, 62% indicated that they have digital access only through public facilities ([Liotta 2023](#)).

A community can be considered marginalized from the digital dynamic when there is an absence of technological literacy and a lack of access, digital security, and personalization ([Istambul and Abdulghani 2024](#)), a situation that might negatively impact QoL ([Osipova and Naumova 2020](#)). “Empirical evidence suggests that marginalized groups continue to face significant barriers to digital participation, including limited internet connectivity, high costs of digital devices, inadequate digital education programs, and bureaucratic inefficiencies in e-government service design” ([Djarmiko et al. 2025](#), p. 2).

Yet, when the digitalization process is implemented correctly, it produces beneficial outcomes for the region. This is the case for the study conducted by [Wang and Xu \(2023\)](#), in which digitalization supports public health in developing countries, especially in Africa and in middle-income countries. For developing countries, digital financial inclusion positively impacts gross domestic product growth per capita and the acceleration of economic growth ([Spulbar et al. 2022](#)). [Istambul and Abdulghani \(2024\)](#) reached similar conclusions in a study conducted in Indonesia on the development and implementation of a customized, inclusive digital health platform for marginalized communities. They demonstrated that a flexible information systems architecture and a model in which the community participates in the IT governance empowers these regions. Therefore, ICTs are key tools to provide access to markets, lower transaction costs, and increase income for communities in developing countries ([Mora-Rivera and García-Mora 2021](#)). Some strategies for bridging the digital divide consist of infrastructure investment from governments in underprivileged communities, digital skills training, affordable access, and community engagement ([Liotta 2023](#)).

For [Djarmiko et al. \(2025\)](#), public and private partnerships are needed to face digitalization challenges such as digital literacy programs and the integration of emerging technologies (such as artificial intelligence, blockchain, and cloud computing) to guarantee accessibility and security. Households with higher levels of wealth and capital are more likely to benefit from internet access ([Mora-Rivera and García-Mora 2021](#)). Besides the infrastructure barriers, there are also social and institutional barriers that can be corrected through proper public policy and regulatory strategies. Therefore, there is a need for comprehensive, policy-driven strategies to guarantee sustainable, accessible, and equitable digital public services ([Djarmiko et al. 2025](#)). The awareness of digitalization should include topics such as algorithmic bias, inaccessibility, robots and the digital divide, digital inclusion, and digital discrimination. When this content is shared with marginalized communities, it is possible to mitigate the probable inequalities created by digitalization ([Yüksel-Arslan et al. 2025](#)).

The researchers of the present study focus on a marginalized community in Mexico. This country may be considered an ideal setting to analyze the relationship between digitalization and disadvantaged communities due to the high number of people living in poverty, the long-standing concentration of telecommunications access in a single dominant firm, weak regulatory agencies, high connectivity costs, and low internet penetration in low-income households (Mora-Rivera and García-Mora 2021). Furthermore, as stated previously, more studies on inequality and disadvantaged communities are needed. Although some studies have focused on developing countries, literature on these topics in Latin America remains scarce (Espinosa-Zárate et al. 2023).

Following the definition provided by Gatzweiler et al. (2011), marginalization is “an involuntary position and condition of an individual or group at the margins of social, political, economic, ecological, and biophysical systems, preventing them from access to resources, assets, services, restraining freedom of choice, preventing the development of capabilities, and eventually causing extreme poverty” (Gatzweiler et al. 2011, p. 3). The community analyzed in this study belongs to an area of Mexico City where many dimensions relevant to a high quality of life are not optimal. Although it is not considered an area of extreme poverty, there are limitations in income, educational attainment, and access to healthcare and security.

Hypothesis 1. *Digitalization is associated with quality of life in marginalized areas.*

2.4. Digitalization and Gender Differences

As we referenced before, Perera et al. (2023) mentioned gender equality as one of the most predominant topics in the literature related to digitalization and inequality. For this research, similarly to Kashyap et al. (2020), we also believe that studying gender inequality is important because digitalization has a profound impact and is highly relevant to achieving one of the SDG 2030 goals, Goal 5, gender equality. When women have access to the internet and smartphones, they experience positive outcomes in health, decision-making power, and economic prospects, as shown by research conducted in developed and developing countries (Kashyap et al. 2020). Also, a study conducted in Nepal proved that digital access through platforms of social media, mobile apps, and digital financial services can empower marginalized communities, especially rural women in terms of entrepreneurship, financial skills, and civic engagement (Aryal 2024).

Although there is a lack of studies on digitalization that examine gender-related inequality, a few studies report the following findings: the average US-born male is almost nine times more likely to contribute in an innovation environment than the average woman (and still, the US outperforms Europe in this regard) (Larsson and Viitaoja 2019). Monitoring global gender inequality using online populations of Facebook and Google, it was found that women are significantly under-represented in online populations in South Asia and sub-Saharan Africa (Kashyap et al. 2020). In a study on gender and computer use in education, utilizing data sources from various countries, it was found that female students showed less interest and knowledge about technology and computers compared to male students (Mustapha 2023). The author considers that this situation might be related to differences in parental support, the type of computer-related activities conducted at schools, or the lack of female role models. Globally, women are 26% less likely than men to have a smartphone, but in areas such as South Asia or Africa, the proportions are prominent as 70% and 34%, respectively (Larsson and Viitaoja 2019). Mustapha (2023) found that in only two out of fourteen Eastern European countries, there were more women using the internet than men.

The low participation of women in the digital sector is not necessarily due to a lack of capabilities, but rather to limited access and opportunities (Larsson and Viitaoja 2019);

therefore, the digital gender divide might be seen as an opportunity. According to [Larsson and Viitaoja \(2019\)](#), the digital gender divide is about the discrepancy of access between women and men. There are many reasons for exclusion, but “the most prominent reasons include restricted access to digital tools in the form of affordability, lack of proficiency and/or education, and deficiencies in technological literacy, in addition to inherent gender biases and socio-cultural norms” (p. 237). Some obstacles for gender equality might be gender norms and cultural biases, affordability of the internet and digital devices, and a lack of education and digital literacy ([Mustapha 2023](#)). For countries in Europe or in the US, the digital gender divide is almost inexistent, but that reality is not the same in many other countries where access to digital resources is not the same for women and men ([Verwiebe et al. 2023](#)). The correct way to analyze the digital gender divide is not only in terms of access, but also in terms of skills related to using technology ([Kashyap et al. 2020](#)). The digital gender gap impacts women’s opportunities for education, employment, and civic engagement ([Mustapha 2023](#)).

Hypothesis 2. *The impact of digitalization on quality of life in marginalized areas is different between men and women.*

3. Materials and Methods

This study used a quantitative approach based on an ordinal regression model. The data come from a study conducted by [Velázquez-Salazar and DelaTorre-Díaz \(2024b\)](#), in which two surveys were conducted in 2021 and 2024 in the town of Santa Fe, Mexico, a community located west of Mexico City. Both databases are publicly available at an open-access research repository ([Velázquez-Salazar and DelaTorre-Díaz 2024a](#)). We believe this community was suitable for this study for a number of reasons: (1) it contributes to research in emerging economies, especially in a Latin American countries, as suggested by [Verwiebe et al. \(2023\)](#); (2) it is appropriate to focus new studies on underprivileged regions where bridging the digital divide is most needed, as recommended by [Liotta \(2023\)](#) and [Yüksel-Arslan et al. \(2025\)](#); (3) this community is located in an urban area of a major city where telecommunications access was historically concentrated in one firm, regulatory agencies were weak, and internet penetration was low, as noted by [Mora-Rivera and García-Mora \(2021\)](#).

This community has its origins in the 16th century and is located on the west side of Mexico City. In recent decades, it has been characterized by rapid growth of a high-income sector next to the traditional lower-income neighborhoods. The town of Santa Fe is in an area where the geography of ravines makes access to certain areas difficult. The neighborhood where the study was conducted is not considered an area of extreme poverty; however, the average income of its residents places them at a low level on a low–middle–high scale. The neighborhood has basic public services, such as electricity and water supply, drainage, public schools, and transportation. The main activity of the population is commerce, but informal commerce is very common, with no access to social security benefits. There are restrictions on services, particularly in terms of access to high-quality education, health, and higher-income jobs. For the authors of this study, the survey data from this community were very valuable, as they allow for the examination of an area considered marginalized, yet situated within an urban context.

In terms of digitalization, Mexico City has made impressive advances regarding public internet connectivity. In 2021, it was declared the most connected city in the world, earning a Guinness World Record for having 21,500 free Wi-fi hotspots, surpassing Moscow. This achievement was part of the Reduction of the Digital Divide program, which aims to reduce the digital divide in highly marginalized communities ([Forbes México 2021](#)).

Internet access in Mexico grew from 66% to 85.5% in urban areas from 2021 to 2024 (SPR Informa 2024). However, internet access has remained the only public effort towards increasing digitalization in this country.

The survey size provides a statistically significant representation of the community of Santa Fe, which has a population of approximately 8500 inhabitants (INEGI 2020). The questionnaires included information on sociodemographic characteristics, household equipment, educational attainment and occupation of both the respondent and their family members, household-based trades and recreational activities, dietary quality, access to healthcare services, and governmental support received, among other variables. A summary of selected survey items is presented in Table 1.

Table 1. Descriptive summary of survey data.

Concept	2021 Survey	2024 Survey
Total respondents	409	401
Female respondents	67%	78%
Male respondents	33%	22%
Average age	39.8	42.75
Average perception of quality of life	7.8	7.91
% of respondents owning a computer	45%	39%
% of respondents owning a television	93%	93%
% of respondents owning a cellular phone	89%	93%
% of respondents owning a tablet	20%	28%
% of household head with high school studies or less	83%	79%
% of household head with undergraduate studies or more	17%	21%
% of respondents with monthly family income between 3000 and 9999 pesos	49%	43%
% of respondents with monthly family income less than 3000 pesos	12%	18%
% of respondents with monthly family income above 9999 pesos	39%	31%

Own elaboration using data from (Velázquez-Salazar and DelaTorre-Díaz 2024a).

For the purposes of this study, the dependent variable (a Quality-of-Life metric) was built considering eight variables from the surveys. The selection of these variables was based on the multi-dimensional nature of QoL, particularly using some of the Urban QoL dimensions proposed by Wesz et al. (2023): urban services (water and electricity supply), environmental comfort (air pollution, lack of green areas, and drainage systems), security (presence of crime), and two elements reflecting subjective self-perception, one related to general QoL and the other to self-reported health status. Table 2 shows the variables considered and the original scales in which they were measured.

Table 2. Variables used to create a Quality-of-Life metric.

Variable	Category	Original Codification
1. Self-perception of QoL	Subjective	Ordinal from 1 to 10
2. Self-perception of health	Subjective	Ordinal from 1 to 10
3. Water supply	Urban services	Binary, 1 = yes 0 = no
4. Electricity supply	Urban services	Binary, 1 = yes 0 = no
5. Air pollution	Environmental Comfort	Ordinal from 1 = high to 3 = low
6. Lack of green areas	Environmental Comfort	Ordinal from 1 = high to 3 = low
7. Drainage system	Environmental Comfort	Binary, 1 = yes 0 = no
8. Presence of crime	Security	Ordinal from 1 = high to 3 = low

Own elaboration using data from (Velázquez-Salazar and DelaTorre-Díaz 2024a).

The conversion of these variables into a three-level QoL metric was performed following the principles of the property-space proposed by Barton (1955), where each individual was located within a particular space—or level of QoL—according to their level in the variables analyzed, and based on a logical classification defined by the authors of this study. Table 3 summarizes the elements from Table 2 used to make the classification.

Table 3. Logic used to classify the Quality of Life of individuals.

Alternatives	High QoL	Medium QoL	Low QoL
Alternative 1	Variables 1 and 2 higher or equal to 8 Variables 5, 6, and 8 equal to 3 Variables 3, 4, and 7 equal to 1	Any other combination	Variables 1 and 2 less or equal to 4 Variables 5, 6, and 8 equal to 1 Variables 3, 4, and 7 equal to 0
Alternative 2	Variables 1 and 2 higher or equal to 8	Any other combination	Variables 1 and 2 less or equal to 4
Alternative 3	Variables 1 and 2 higher or equal to 8 Variables 5, 6, and 8 equal to 2 Variables 3, 4, and 7 equal to 1	Any other combination	Variables 1 and 2 less or equal to 4 Variables 5, 6, and 8 equal to 2 Variables 3, 4, and 7 equal to 1
Alternative 4	Any of the previous 3	Any other combination	Variables 1 and 2 less or equal to 4 OR Variables 5, 6, and 8 equal to 1 Variables 3, 4, and 7 equal to 0

Own elaboration.

To measure the level of household digitalization, a technological assets index was constructed following the approach proposed by Velázquez-Salazar and DelaTorre-Díaz (2024b), using Equation (1):

$$DI = \frac{\sum DV_{ij}}{n} \quad (1)$$

where DI is the Digitalization Index, DV is the digitalization variable, n is the number of answered variables ($n \neq 0$). The determination of DV follows Equation (2):

$$DV = \frac{\text{Observed variable}_{(ij)}}{\text{Maximum value for the variable}_{(j)}} \quad (2)$$

where i represents each individual in the sample, and j represents the number of the technological variable (1 to 4). The digitalization variables included are access to internet, possession of a computer, possession of a cellular phone, and possession of a tablet. They are all used as binary variables, where 0 represents the absence of the asset in the individual's household and 1 represents the possession of the asset. The maximum value of the index (equal to 1) corresponds to households that simultaneously possess a computer, mobile phone, tablet, and internet access. The index value decreases proportionally when one or more of these assets are absent. In addition, variables were included to assess differences by gender, educational level, and income range. Table 4 shows the codification used for each variable.

Table 4. Variables used in Ordered Logistic Regression.

Variable	Codification
QoL metric (outcome variable)	Ordinal, values from 1 to 3
Digitalization index	Numerical, from 0 to 1
Gender	Binary, 0 = male, 1 = female
Age range	Ordinal, 2 = 18 to 24 years
	3 = 25 to 34 years
	4 = 35 to 44 years
	5 = 45 to 54 years
	6 = 55 to 64 years
Education	7 = 65 or more
	Ordinal, 1 = up to middle high
	2 = up to high school
Income range (monthly in MXN)	3 = more than high school
	Ordinal, 1 = less than \$14,000
	2 = from \$14,000 to \$34,999
	3 = \$35,000 or more

Own elaboration.

The analytical method employed was an Ordinal Logistic Regression model, as [Abreu et al. \(2008\)](#) argue that such models are most appropriate in cases where quality of life is measured using ordinal scales. The model specification is presented in Equation (3).

$$\text{logit}(\gamma_j) = \log[\gamma_j / (1 - \gamma_j)] = \theta_j - \beta^t x \quad (3)$$

where the response variable y takes ordinal values between 1 and k and x is the p -vector of explanatory variables. The unknown parameters are the p -vector β and $\theta_1 < \theta_2 < \dots < \theta_{(k-1)}$ ([Brant 1990](#)).

To facilitate the interpretation of results, odds ratios were computed so that the estimated coefficients reflect the change in the cumulative probability of the outcome as the explanatory variables increase. In this case, these values indicate changes in the probability of a higher level of quality of life when the possession of technological assets changes (or when the value of the control variables changes).

The Brant test was performed to assess the proportional odds assumption. Additionally, the Variance Inflation Factor (VIF) index was calculated to assess multicollinearity, that is, the degree of correlation among explanatory variables in a multiple regression model. According to [Kim \(2019\)](#), a value below 5 for the explanatory variables indicates a moderate level of correlation, which is not considered alarming.

Finally, pooled models were used to analyze the interaction between digitalization, gender, and the survey period. This last model was included given the changes that the COVID-19 pandemic produced in different aspects of life.

4. Results

A logistic regression was estimated for both surveys, conducted in 2021 and 2024, to assess the relevance of digitalization on quality of life and to identify changes over time. According to the results obtained, household digitalization in the town of Santa Fe had a statistically significant association with quality of life only on the most recent survey, but this was not significant in 2021. Using information from the 2021 survey, only the age range was a significant variable in QoL, increasing the probabilities of a higher QoL if the age range increased. However, the 2024 results present differences: in addition to age range remaining a significant variable, the digitalization index was also significant at a higher confidence level. In 2024, households that increased their ownership of technological

assets—and consequently raised their digitalization index—were 4.17 times more likely to have a higher QoL than those households that had no change in digitalization. The results are presented in Table 5. A second difference is that when the age range increases, the likelihood of reaching a higher QoL decreases, contrary to what was seen in 2021. Neither gender, education, nor income were relevant for QoL in any of the periods analyzed.

Table 5. Results of Ordered Logistic Regression, expressed as Odds Ratios.

Variable	2021	<i>p</i> -Value	95% C.I.	2024	<i>p</i> -Value	95% C.I.
Quality of Life Digitalization Index	0.7538	0.674	0.201–2.815	4.1705	0.003	1.602–10.854
Gender	0.8032	0.447	0.456–1.412	0.9992	0.998	0.589–1.694
Age range	1.1534	0.079	0.983–1.352	0.8783	0.077	0.760–1.013
Education level	1.3131	0.122	0.929–1.856	1.0222	0.890	0.749–1.394
Income level	1.4917	0.178	0.833–2.669	0.9094	0.733	0.527–1.568

Own elaboration.

To assess the individual relevance of technological assets, the ordinal logistic regression was re-estimated using specific assets instead of the digitalization index. The results are presented in Table 6. Ownership of a computer in the household was the only statistically significant variable in 2021. For the 2024 survey, the only two significant variables were internet access and owning a tablet. Neither cellular phone, income range, gender, and education level, were significant variables for QoL.

Table 6. Odds Ratios estimated from Ordered Logistic Regression for years 2021 and 2024.

Variable	Odds Ratio 2021	<i>p</i> -Value	95% I.C.	Odds Ratio 2024	<i>p</i> -Value	95% I.C.
Internet access	0.6843	0.263	0.352–1.330	1.7596	0.085	0.924–3.350
Computer	1.7548	0.043	1.017–3.025	0.9504	0.847	0.566–1.594
Tablet	0.6768	0.270	0.338–1.353	2.0504	0.010	1.184–3.548
Cellular phone	0.6784	0.496	0.221–2.074	1.2029	0.715	0.445–3.246
Income range	1.4393	0.236	0.788–2.628	0.9620	0.890	0.554–1.668
Gender	0.8397	0.554	0.470–1.497	0.9687	0.907	0.569–1.649
Education level	1.2839	0.173	0.896–1.839	1.0220	0.892	0.746–1.399

Own elaboration.

The multicollinearity test, conducted using the Variance Inflation Factor, did not reveal any risks arising from correlations among the explanatory variables in either year. The results are presented in Table 7.

Table 7. Multicollinearity test.

Variable	VIF 2021	VIF 2024
Education level	1.04	1.35
Digitalization Index	1.12	1.31
Age range	1.05	1.19
Income range	1.12	1.09
Gender	1.04	1.02

Own elaboration.

Additionally, the proportional odds assumption was verified using the Brant test. The results for 2021 indicate that the assumption holds for the global model ($X^2 = 5.0203$, $p = 0.5412$), as well as for all other variables ($p > 0.05$ in all cases). The assumption was maintained also in 2024 for the global model ($X^2 = 3.3272$, $p = 0.7667$), as well as for all other variables ($p > 0.05$ in all cases).

The analysis was also carried out separately for men and women to determine whether there were differences in the association between digitalization and QoL between these two genders. Both surveys offered the possibility of differentiating the responses. Table 8 presents the descriptive statistics of the Digitalization Index by gender.

Table 8. Descriptive statistics of the Digitalization Index by gender and by period.

	Responses	Mean	Median	SD
Men (2021)	63	0.5714	0.5	0.1979
Women (2021)	203	0.5504	0.5	0.1884
Men (2024)	87	0.6896	0.75	0.2612
Women (2024)	314	0.5963	0.5	0.2599

Own elaboration.

Using this information, the logistic regression was estimated by gender. The results obtained are shown in Table 9.

Table 9. Ordinal Logistic Regression results by gender, expressed as Odds Ratios.

Variable	Odds Ratios 2021			
	Male [95% I.C.]	<i>p</i> -Value	Female [95% I.C.]	<i>p</i> -Value
Digitalization Index	0.7393 [0.04, 10.97]	0.826	0.7868 [0.17, 3.59]	0.757
Income level	1.1666 [0.41, 3.25]	0.768	1.6545 [0.80, 3.40]	0.172
Education	1.4111 [0.75, 2.65]	0.285	1.3024 [0.85, 1.97]	0.213
Age range	0.9970 [0.74, 1.33]	0.984	1.2222 [1.01, 1.47]	0.039
Digitalization Index	35.7348 [3.05, 418.01]	0.004	2.1405 [0.71, 6.37]	0.172
Income level	0.4757 [0.18, 1.22]	0.124	1.4000 [0.68, 2.86]	0.357
Education	0.8657 [0.44, 1.69]	0.674	1.1441 [0.79, 1.63]	0.462
Age range	0.9767 [0.67, 1.41]	0.901	0.8645 [0.73, 1.01]	0.078

Own elaboration.

In 2021, no variable was relevant for QoL in any gender. The Digitalization Index was relevant for men only in 2024, increasing their probability of achieving a higher QoL by 35 times. For women, only age range was a significant factor.

Disaggregating the digitalization index into its individual variables revealed further distinctions. In 2021, for men, having a computer was the relevant factor associated with an increased probability of a higher QoL. In contrast, for women, none of the variables were statistically significant. The results from 2024 also showed differences. For men, internet access and tablet ownership were relevant; for women, no technological assets were relevant for QoL. The results obtained are shown in Table 10.

Table 10. Ordinal Logistic Regression results by gender, expressed as Odds Ratios.

Variable	Odds Ratios 2021			
	Male [95% I.C.]	<i>p</i> -Value	Female [95% I.C.]	<i>p</i> -Value
Computer	3.3714 [0.98, 11.51]	0.052	1.5773 [0.84, 2.92]	0.149
Internet access	0.3298 [0.08, 1.34]	0.121	0.7897 [0.36, 1.70]	0.547
Cellular phone	1.9371 [0.33, 11.19]	0.460	0.3547 [0.07, 1.63]	0.183
Tablet	0.5913 [0.17, 2.02]	0.402	0.7218 [0.31, 1.68]	0.450
Income level	1.2139 [0.40, 3.61]	0.728	1.5787 [0.75, 3.31]	0.228
Education	1.5403 [0.77, 3.05]	0.217	1.2617 [0.82, 1.94]	0.290
Age range	0.9430 [0.69, 1.28]	0.708	1.2245 [1.00, 1.48]	0.040
Computer	1.2692 [0.41, 3.88]	0.676	0.8383 [0.46, 1.51]	0.560
Internet access	4.2589 [0.80, 22.62]	0.089	1.5162 [0.74, 3.09]	0.254
Cellular phone	0.7157 [0.03, 13.80]	0.825	1.2473 [0.42, 3.63]	0.685
Tablet	4.5367 [1.33, 15.47]	0.016	1.5385 [0.82, 2.87]	0.177
Income level	0.5020 [0.19, 1.30]	0.159	1.5033 [0.72, 3.10]	0.271
Education	0.8868 [0.44, 1.77]	0.734	1.1343 [0.78, 1.62]	0.495
Age range	1.0024 [0.68, 1.47]	0.990	0.8674 [0.73, 1.02]	0.095

Own elaboration.

As mentioned, the analysis includes two different periods, with the main event occurring between them being the COVID-19 pandemic, which represents an exogenous shock that affected different aspects of life, including some that impacted QoL. Therefore, it was important to compare the changes in the association between QoL and digitalization in these two periods. Table 11 shows the results of the pooled model of logistic regression that includes a dummy variable for Period, where 0 corresponds to the values in 2021 and 1 corresponds to the values in 2024.

Table 11. Results of the Logistic Regression with Period–Digitalization interaction effects.

Variable	Coef. (β)	Odds Ratio	<i>p</i> -Value	95% I.C. (Odds Ratio)
Period (2024)	1.9107	6.7579	0.000	[2.62, 17.38]
Digitalization Index	−0.3165	0.7286	0.636	[0.19, 2.70]
Period x Digitalization	1.6897	5.4180	0.032	[1.15, 25.46]
Age	−0.0028	0.9971	0.959	[0.89, 1.10]
Income	0.5260	1.6923	0.076	[0.94, 3.02]
Gender	−0.0901	0.9137	0.644	[0.62, 1.33]
Education	0.1445	1.1555	0.218	[0.91, 1.45]

Own elaboration.

The coefficient of the interaction variable was positive and statistically significant, which may reflect a stronger association between digitalization and QoL in 2024 compared to 2021. To complete the analysis, the interaction effect was also measured between gender and digitalization. Table 12 shows the results.

Table 12. Results of Logistic Regression with Gender-Digitalization interaction effects.

Variable	Coef. (β)	Odds Ratio	p-Value	95% I.C. (Odds Ratios)
Gender (women)	0.7920	2.2079	0.116	[0.82, 5.93]
Digitalization Index	2.7347	15.40	0.000	[3.97, 59.69]
Gender x Digitalization	−1.4690	0.2301	0.058	[0.05, 1.05]
Age	−0.0055	0.9944	0.914	[0.89, 1.09]
Income	−0.9103	0.4023	0.000	[0.24, 0.66]
Education	0.1315	1.1406	0.231	[0.91, 1.41]

Own elaboration.

In this case, the interaction between gender and digitalization yielded a negative but significant coefficient, which may imply that the association of the digitalization index with QoL is weaker for women compared to men.

5. Discussion

According to the results, digitalization was significant for QoL in only one of the two surveys, namely the 2024 survey. The pooled logistic regression confirmed a positive and stronger association between digitalization and QoL in 2024 compared to the previous period analyzed. We believe these results may be related to the global challenge posed by the COVID-19 pandemic, which particularly increased the demand for technological assets and created new opportunities for those who were digitally skilled. Items such as income or educational level became secondary.

In 2021, digitalization was not an issue that affected an individuals' QoL. Three years after, when the world returned to a more normal state of life, we confirmed that it became statistically significant. More specifically, a household with technological assets could have an increase in quality of life 4.17 times more than the households with no change in digitalization. Therefore, we accept Hypothesis 1, which states that digitalization is associated with QoL in marginalized areas. Our results are consistent with Barlybaev et al. (2021) and Kryzhanovskij et al. (2021), who considered the relationship between digitalization and quality of life important and significant.

We were interested in focusing our study on gender following the recommendation of Perera et al. (2023), who found that gender equality was one of the two most predominant topics in the SDG 2030 literature. Based on the results, assuming the Digitalization Index as the explanatory variable, the probability of achieving a higher QoL was greater in men than in women in the most recent survey. The pooled logistic regression confirmed a weaker association between digitalization and QoL for women than for men, which confirms Hypothesis 2 that the impact of digitalization on QoL differs between men and women in marginalized areas.

A one-unit increase in men's Digitalization Index increases the likelihood of achieving a higher QoL by almost 36 times. For women, digitalization was not statistically significant, consistent with the expectation of Hypothesis 2. Similar to the conclusions of Larsson and Viitaoja (2019), the digital gender divide reflects discrepancies in access to technology between women and men and can also be seen as an opportunity. According to our results, a lot can be done to reduce these disparities and help women leverage technology to achieve a higher quality of life.

For policy makers, we find it interesting that, according to the 2024 survey, the technological gadgets most strongly associated with higher QoL were internet access and ownership of a tablet. It was an interesting finding that these two assets remained relevant for men when the analysis was conducted by gender; for women, there were no technological assets that increased the probability of achieving higher QoL levels. Even though internet access is freely available in many locations across the city, it has not been enough to enhance QoL for women.

It is important to consider the suggestion from [Hustad et al. \(2019\)](#), [Kryzhanovskij et al. \(2021\)](#), and [Perera et al. \(2023\)](#) that possession does not guarantee an increase in digitalization and quality of life. Effective progress also requires the creation and implementation of wise policy that promotes progress and well-being, along with the introduction of cutting-edge technological innovations supported by efforts to strengthen the knowledge and ability of the community. Further studies might analyze whether the differences observed between men and women are derived from cultural dynamics or stereotypes, or whether digital literacy initiatives for women have been sufficient.

In summary, this study concludes that digitalization is significantly associated with QoL in marginalized communities, and this relationship differs between men and women, which underscores the importance of considering gender in digital inclusion policies. Consistent with [Barlybaev et al. \(2021\)](#), digitalization accelerates processes and affects quality of life within a community. We were interested in conducting a study in a Latin American country, selecting a marginalized community, to raise awareness of the small number of studies that have been conducted in this region, in accordance with the concerns expressed by [Trofymenko et al. \(2023\)](#) and [Verwiebe et al. \(2023\)](#), who emphasized the need for more attention on digitalization and inequality, especially in marginalized regions.

Although we are confident in the academic contributions of this article, we believe there are some limitations to consider. First, the surveys used in this research were not designed to study gender, which may have introduced bias regarding the number of respondents and affected representativeness. Second, the community analyzed is urban and from one of the biggest cities in the world; other studies conducted in rural communities or smaller cities might generate different results regarding digitalization, the gender divide, and marginalized communities. A third limitation concerns the consideration of COVID-19 in this study: the data used does not include any COVID-specific variables; therefore, there is no direct test of the impact of the pandemic on digitalization or on quality of life. The survey results might reflect a structural confounding factor. Lastly, although we consider Mexico an ideal setting to analyze the relationship between digitalization and disadvantaged communities, as suggested by [Mora-Rivera and García-Mora \(2021\)](#), other studies on different developing countries in Latin America and Africa should be conducted.

For future research, we suggest conducting different studies not only in different settings, but also using questionnaires specifically designed to examine whether digitalization adoption differs among women of different ages, and whether parents with higher digitalization abilities influence the digital abilities of their children.

Finally, it is worth mentioning that ethics approval and informed consent procedures were not included in this study, as we relied on secondary data sources. The data are publicly available, and details on the sampling, data collection process, and the questionnaire used are described in [Velázquez-Salazar and DelaTorre-Díaz \(2024b\)](#).

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