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Bridging the Gap: Exploring Mobile Ownership Disparities among Vulnerable Population

Waqas Shair[1]

Rizwan Ul Hassan[2]

Javeria Khatoon[3]

Kanza Amjad[4]

Sumaira Nawaz[5]

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Abstract

The study explores the digital divide in vulnerable groups in Pakistan, assessing the impact of different vulnerabilities and analyzing the effect of various vulnerabilities on this divide. The study identifies key vulnerable groups, including women, economically disadvantaged individuals, and persons with disabilities. The study uses Pakistan Social and Living Standards Measurements (PSLM), 2019-20. The Logit model's aftermath suggests that females are 65.1% less likely to own a mobile phone than males. Poor individuals are 44.4% less likely to own a phone, and disabled individuals have 61.4% lower odds. The study shows that individuals with one vulnerability are 44% less likely to own a mobile phone vis-à-vis a person without vulnerability, with two vulnerabilities 70.1% less likely, and with three vulnerabilities 84.8% less likely. As vulnerabilities like poverty, disability, or marginalization increase, compounded barriers—financial, accessibility, and social—reduce mobile phone ownership. The research reveals that females who are simultaneously poor and disabled, as well as those who are either poor or disabled, are particularly susceptible to the digital divide. The findings emphasize compounded disadvantages, showing an intersectionality effect in mobile phone ownership. The conclusions of this research are crucial for formulating strategies to address and mitigate the digital divide within and among vulnerable communities.

[1]Minhaj University Lahore, Pakistan
Corresponding Author: waqas.eco@mul.edu.pk
[2]The Lahore ALMA, Lahore, Pakistan
[3]Independent Researcher, Pakistan
[4]Independent Researcher, Pakistan
[5]Independent Researcher, Pakistan

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1 Introduction

The digital divide refers to the unequal access and utilization of digital resources such as mobile phones, computers, and the Internet (Afzal et al., 2023). This divide is influenced by the availability, affordability, quality, and relevance of digital infrastructure and services (Reddick et al., 2020). The disparity in the utilisation of digital technology is related to the capability of an individual to perform and acquire digital skills (Youssef et al., 2022). Access to technology enhances personal and societal benefits, such as social capital, business innovation, and public service access (Khalil & Kenny, 2008). However, unequal access to information and communication technologies (ICTs) varies across regions and economies, driven by differing infrastructural, economic, and technological factors (Wang et al., 2021).

The diffusion of ICTs has been recognized as an essential factor in digitalization (Gupta et al., 2020; Wang et al., 2021). Digitalization entails using digital technologies to transform different aspects of society, such as the economy, education, health, government, and culture (Kurniawati, 2021). Digitalization is crucial because it not only contributes to the short-term growth of an economy (Yuan et al., 2021) but also accelerates the long-term path of economic development by fostering new job opportunities and markets, enhancing access to finance and boosting efficiency and transparency (Verma et al., 2023). Transitioning from a traditional economy to a knowledge economy requires bridging the digital gap to reap the digital dividend (Upadhyaya, 2024). To achieve this goal, it is necessary to identify the factors that contribute to the digital divide at an individual level.

Equitable digital diffusion requires access, utilization, and benefits from ICTs across all societies (Raihan et al., 2024). The lack of access, utilization, and benefits are classified into three levels of digital divide (Lythreatis et al., 2022). The first-level digital divide refers to access to technological resources across different groups. Cross-country access to digital technologies varies due to the availability, affordability, and quality of ICTs (Aleksandrova & Khabib, 2022).

However, access to digital technologies varies across individuals or households by demographic and socioeconomic characteristics such as age, education, income, gender, and ethnicity (Shair et al., 2023; Shair et al., 2022a; 2022b). The indicators of the first-level digital divide are the proportion of the population with mobile phone access (Vimalkumar et al., 2021), the percentage of internet access, the rate of broadband penetration, and the rate of internet usage. However, access to a mobile phone is relevant in a household or individual-level study (Quandt et al., 2020).

Mobile phone penetration is important from economic and social standpoints (Ahmad, 2020). It enables individuals to access information, services, and opportunities that are unavailable or costly. Mobile phone penetration as an indicator of digitalization contributes to economic growth and development by increasing productivity (Aleksandrova et al., 2022), efficiency, and innovation. It also helps reduce transaction costs, enhance market access, and create new business opportunities (Nguimkeu & Okou, 2021). In general, mobile phone penetration favors well-being, empowerment, and prosperity (Shair et al., 2023). However, the challenge of the digital divide remains intact due to the inequitable distribution of digital technology across the country.

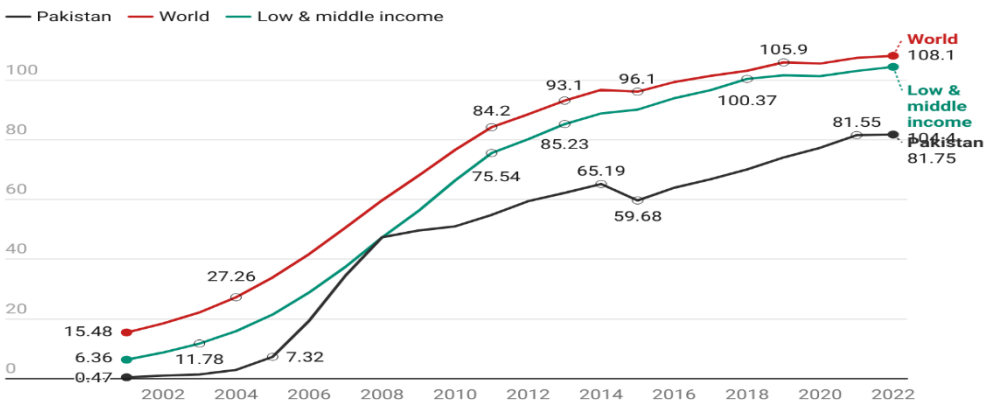

Figure 1: The dynamic pattern of mobile subscription per 100 (Source: World Bank)

Figure 1 illustrates the increase in mobile phone subscriptions per 100 people in Pakistan, low and middle-income countries, and globally from 2001 to 2022. Pakistan's subscription rates have experienced significant growth over the past decade, starting from almost zero in 2001 and reaching nearly 82 subscriptions per 100 people by around 2022. This remarkable increase represents a 37 percent growth over the last decade. This increase can be attributed to the liberalization of the telecom sector in the early 2000s. Moreover, affordability, innovations, and the growing demand for communication and information fueled this increment. Despite Pakistan's efforts to increase mobile phone penetration, it still lags behind the global average and the levels seen in lower and middle-income countries (Feroz et al., 2020). Mobile phone usage has reached a global penetration rate of 108 per 100 people, while low and middle-income countries have a rate of 104 per 100 individuals in 2022. The importance of mobile phone penetration emerges as (Waverman et al., 2005) found that mobile penetration significantly increases GDP per capita growth by 0.8 to 1.2 percentage points.

Pakistan is making significant progress in addressing the digital divide by enhancing digital infrastructure, implementing effective regulations, and establishing institutions. Although efforts have been put forth to promote a digital-friendly environment, current indicators of digitalization need to meet expectations. Pakistan Social and Living Standard Measurement (PSLM) found that 93 percent of households have a mobile phone (Ubaid et al., 2024). However, in the case of individuals aged 10 years or above, 45 percent own mobile phones (Choudrie et al., 2020). The lower digital adoption among individuals can be attributed to different disparities across various segments of society.

The literature on the digital divide reveals that various factors contribute to disparities in ICT access and utilization. Geographically, urban areas tend to have better ICT access, reducing the digital divide compared to rural areas (Salemink et al., 2017). Education emerges as a critical element in bridging the digital divide. Educated individuals are more likely to adopt ICT (Szeles, 2018). However, studies like those by Shair et al. (2023) suggest that even less literate users can effectively engage with mobile technology through memory and social assistance. Age also plays a role, with older individuals typically slower to adopt new technologies, although once familiar, they may utilize more devices (Salajan et al., 2010). The digital divide also varies with factors like gender, profession, and community networks, each influencing ICT engagement in distinct ways (Srinuan & Bohlin, 2011).

This research aims to estimate and compare the extent of the digital divide among vulnerable populations, specifically focusing on mobile phone ownership. It identifies key vulnerable groups, including women, economically disadvantaged individuals, and persons with disabilities. The research has a threefold objective to enhance the existing scholarly dialogue.

Firstly, it estimates and compares the digital divide among these vulnerable populations. Secondly, it investigates the effects of having one or several vulnerabilities on the digital divide. Thirdly, it analyzes the impact of various categories of vulnerabilities on the digital divide. The findings from this research are crucial for formulating strategies to address and mitigate the digital divide within and among vulnerable communities.

2 Research Methodology

2.1 Data source

The study uses Pakistan Social and Living Standards Measurements (PSLM), 2019-20, the twelfth round of surveys initiated in 2004. The data is available at the official website of the Pakistan Bureau of Statistics and can be accessed by anyone (Pakistan Bureau of Statistics, 2020). The current round of PSLM district-level surveys covered 176,790 households. The current study's examination is based on a sample of 633,770 individuals who are 10 years old or above.

2.2 Econometric model

In this study, we explore the impact of vulnerability on the digital divide. In the study, the dependent variable is dichotomous, which follows 'yes' if an individual owns a mobile phone and 'no' otherwise. Economic literature often recommends the Logit model in binary responses to estimate the likelihood that specific covariates will occur (Khan et al., 2023; Kwak et al., 2023). The general form will be as follows:

$$Y_i = \alpha_0 + \alpha_1 female_i + \alpha_2 poor_i + \alpha_3 disabled_i + \alpha_4 education_i + \alpha_5 employment_i + \alpha_6 age_i + \alpha_7 urban_i + \varepsilon_i \quad (1)$$

$$Y_i = \beta_0 + \sum_{j=1}^{4} \beta_{j1}\, extent_{ji} + \beta_2 education_i + \beta_3 employment_i + \beta_4 age_i + \beta_5 urban_i + \varepsilon_i \quad (2)$$

$$Y_i = \gamma_0 + \sum_{k=1}^{9} \gamma_{k1}\, extent_{ki} + \gamma_2 education_i + \gamma_3 employment_i + \gamma_4 age_i + \gamma_5 urban_i + \varepsilon_i \quad (3)$$

Where $i = 1, 2, \ldots., nth$, and Y_iThe outcomes of the digital divide are coded as one if the individual owns a mobile device and 0 otherwise. Education, employment, age, and urban are control variables. Equation 1 is related to the first objective, which is to compare the digital divide across vulnerable populations like females, poor, and disabled people.

Equation 2 is associated with the second objective to quantify the impact of the extent of vulnerability on the digital divide. In equation 2, $j = 1, 2, 3, 4$which indicated the four outcomes of the extent of vulnerability. On the other hand, equation 3 is related to the third objective, which is to compare the impact of distinct vulnerability on the digital divide. In equation 3, $k = 1, 2, \ldots \ldots, 9$which indicated the nine distinct outcomes of the vulnerability. Table 1 further describes the covariates and dependent variables.

Table 1: Definition of variables

Variables	Description
Outcome variables:	
Mobile ownership	A binary variable coded one if the individual responded to the ownership of a personal mobile or smartphone and zero otherwise.
Key variables:	
Gender	A binary variable coded one if an individual is female, zero otherwise.
Income	A binary variable is coded as one if an individual is poor and zero otherwise. We obtained household income by summing up the household's labor and non-labor income. After obtaining household income, we get quantiles and coded 1 for quantiles 1 and 2. In short, the lower and lower-middle-income class is a poor category.
Disability	A binary variable coded one if the individual responded with functional limitations in seeing, hearing, walking, remembering, self-care, or speaking and zero otherwise.
Extent of vulnerability	An ordinal categorical variable is coded as 0 for no vulnerabilities, 1 for female, poor, or disabled individuals, 2 for those experiencing two vulnerabilities, and 3 for individuals experiencing all three vulnerabilities.
Vulnerabilities	A multinomial categorical variable is divided into eight distinct vulnerability categories: female, poor, disabled, poor female, poor, disabled female, poor, disabled female, and none of these vulnerabilities.
Control variables:	
Age	Age is in year old.
Education	Education is a discrete variable that consists of years of education.
Urban	A binary variable coded 1 for individuals from urban areas and zero otherwise.
Labour participation	A binary variable coded 1 for an employed individual and zero otherwise.

3 Descriptive analysis

The descriptive analysis of the variables used in the study is presented in Table 2. The variable owning a mobile device indicates that the dataset includes 633,770 observations with a mean of 0.439, suggesting that approximately 43.9% of the sampled population owns a mobile device. In the sample, about 49% of the population sampled are females. The mean value of the variable poor is 0.335, meaning that 33.5% of the population is considered poor. In the study, 8% of the population are disabled.

The key variable, the extent of vulnerability, categorizes the population based on the number of vulnerabilities (female, poor, or disabled) they experience. 30.3% of the population does not experience any of the listed vulnerabilities. The largest group, 46.8% of the population, experienced one of the vulnerabilities. 20.9% of the population experiences two vulnerabilities. Only 2% of the population experiences all three vulnerabilities.

Another key variable is vulnerability categories, representing individuals with no vulnerabilities and comprising 30.3% of the population. Individuals are classified as economically disadvantaged, constituting 14.4% of the population. Individuals with disabilities make up 4.2% of the population. Female individuals comprise 2.1% of the population. Individuals who are both female and disabled constitute 28.2% of the population. Poor females make up 15% of the population.

Poor individuals with disabilities constitute 3.8% of the population. Individuals who are poor, disabled, and female make up 2% of the population. Individuals living in urban areas constitute 30.7% of the population. The population's average age is approximately 31.31 years, with a standard deviation of 16.674 years, ranging from 10 to 99 years. The average years of education in the population is about 4.91 years, with a significant variation (standard deviation of 5.011 years), ranging from 0 to 21 years. The proportion of the population engaged in the labour force is 36.9%.

Table 2: Descriptive statistics

Variable	Observation	Mean	Std. dev.	Min	Max
Mobile own	633,770	0.439	0.496	0	1
Female	633,762	0.49	0.5	0	1
Poor	633,762	0.335	0.499	0	1
Disabled	633,762	0.08	0.406	0	1
The extent of Vulnerability:					
None vulnerability	633,762	0.303	0.46	0	1
One vulnerability	633,762	0.468	0.499	0	1
Two vulnerabilities	633,762	0.209	0.407	0	1
Three vulnerabilities	633,762	0.02	0.139	0	1
Vulnerability categories:					
None	633,762	0.303	0.46	0	1
Poor	633,762	0.144	0.351	0	1
Disabled	633,762	0.042	0.2	0	1
Female	633,762	0.021	0.144	0	1
Disabled female	633,762	0.282	0.45	0	1
Poor female	633,762	0.15	0.357	0	1
Poor disabled	633,762	0.038	0.191	0	1
Poor, disabled female	633,762	0.02	0.139	0	1
Urban	633,770	0.307	0.461	0	1
Age	633,762	31.309	16.674	10	99
Education	633,767	4.907	5.011	0	21
Labour participation	633,770	0.369	0.483	0	1

Figure 2a also presents some descriptive stylized facts on the digital divide and marginalized communities. The segment of the donut represents individuals who own a mobile phone, accounting for 45% of the population in the dataset. The individuals who do not own a mobile phone make up 55% of the population. It shows that most of the population does not own a mobile phone. Across the marginalized communities, the largest segment who own a mobile phone is disabled individuals, constituting 41% of the total mobile phone ownership within these communities, as shown in Figure 2b. The next segment represents individuals classified as poor who own a mobile phone, making up 34%. The lightest segment represents females who own a mobile phone, accounting for 25% of the mobile phone ownership in the dataset. Figure 2b visually compares mobile phone ownership among different vulnerable groups. It highlights that disabled individuals have the highest rate of mobile phone ownership among the groups considered, followed by people experiencing poverty and then females.

The donut chart in Figure 2c depicts the distribution of mobile phone ownership across the extent of vulnerability. This segment represents individuals with no vulnerabilities who own a mobile phone, making up 47% of the total mobile ownership in the dataset. It's colored the lightest, indicating the highest proportion. The next segment indicates that 28% of mobile phone owners have one vulnerability. This segment covers 15% of the total, shown in a deeper shade, representing those with two vulnerabilities. Individuals with all three vulnerabilities account for 10% of mobile ownership. The chart effectively displays a gradient of decreasing mobile phone ownership with increasing vulnerability. Individuals with no vulnerabilities have the highest percentage of mobile ownership, which decreases as the number of vulnerabilities increases.

The bar chart in Figure 2d depicts the distribution of mobile phone ownership across the classified vulnerability. The top bar represents individuals with no classified vulnerabilities who own a mobile phone, making up 67% of this group. Disabled individuals owning a mobile phone closely follow at 66%. Poor individuals owning mobile phones show a slightly lower percentage at 59%. Female individuals owning a mobile phone make up over half of the female population in this dataset. 27% of females who are disabled own a mobile phone. 21% of the poor disabled own a

mobile phone. 17% of poor females own a mobile phone. The lowest bar represents females who are both poor and disabled, with only 15% owning mobile phones. The chart distinctly shows how different vulnerabilities impact mobile phone ownership. Individuals with no vulnerabilities have the highest ownership rates, indicating fewer barriers to access. The compounded impact of multiple vulnerabilities (such as being poor, female, and disabled) results in significantly lower mobile phone ownership, as seen in the drastic drop for categories combining these vulnerabilities.

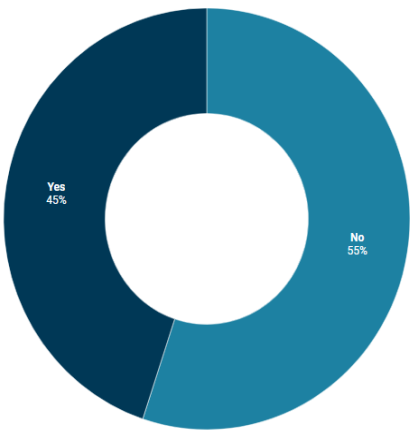

Figure 2a: Distribution of individiauls own a mobile phone

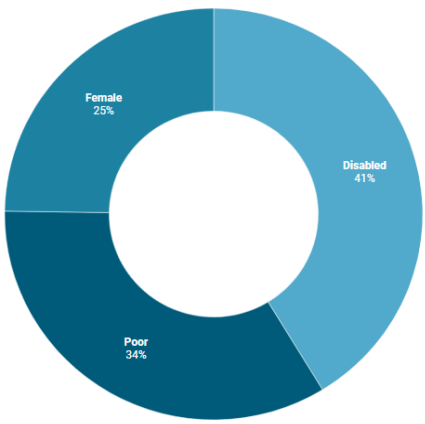

Figure 2b: Distribution of mobile phone ownership across vulnerable communities

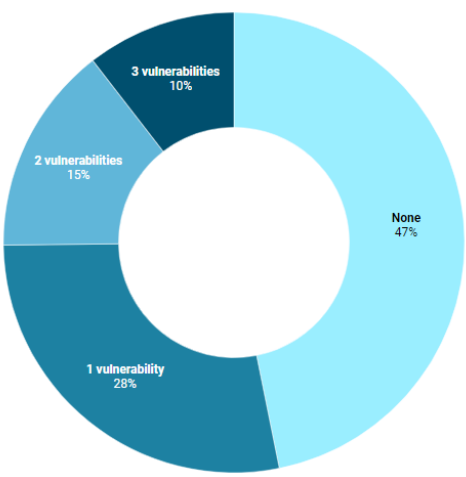

Figure 2c: Distribution of mobile phone ownership across the extent of vulnerability

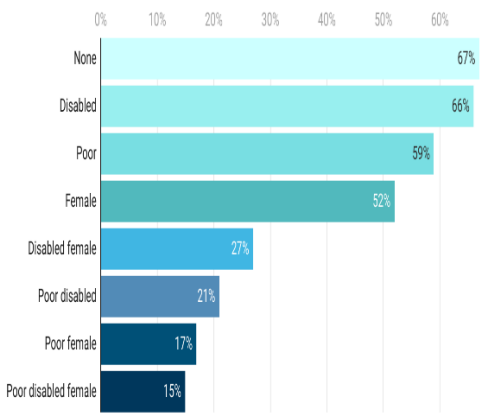

Figure 2d: Distribution of mobile phone ownership across the classified vulnerability

4 Results and Discussion

The estimates of the Logistic regression model are presented in Table 2. The results of logistic regression models comprise odds ratios, where the dependent variable is mobile phone ownership. The results are reported for five different models, with the control variables including urban status, age, education, and labor participation. It depicts that being urban is associated with higher odds of owning a mobile phone across all models, as shown in Figure 3a. For instance, in model 1, the

odds of urban residents owning a mobile phone are about 1.567 times that of non-urban residents, holding all else constant. It implies that an individual from an urban area has 57 percent more likelihood of owning a mobile phone than a person from a rural area. This effect is consistently positive and statistically significant across all models, suggesting a robust association between urban residence and mobile phone ownership. Urban areas often have superior telecommunications infrastructure, higher incomes, and a denser, more lucrative market, leading to greater mobile phone ownership (Gillwald et al., 2010). Enhanced accessibility to digital services, higher education levels, and targeted marketing further boost technology adoption, justifying a higher likelihood of urban residents owning mobile phones than rural dwellers.

A one-year increase in age is associated with a slight increase in the odds of owning a mobile phone. In model 1, each additional year of age increases the likelihood of owning a mobile phone by 5.7%. Across models, the effect of age slightly decreases but remains positive and statistically significant, indicating that older individuals are generally more likely to own a mobile phone, albeit the effect is small.

As individuals age, they typically gain financial stability, increasing their capacity to afford mobile phones. Growing social and professional needs, greater appreciation for technological conveniences, and heightened health and safety considerations also contribute to this trend. Older adults often become more comfortable with technology over time, and their evolving life stages necessitate communication tools like mobile phones for themselves and family (Mwin & Kritzinger, 2016). This slight yet consistent increase in mobile phone ownership with age is statistically significant across various models.

Higher levels of education are strongly associated with increased odds of owning a mobile phone. In model 1, each additional year of education increases the likelihood of owing a mobile phone by 20 per cent. The effect of education is quite strong and consistent across all models, indicating a significant positive relationship between education and mobile phone ownership.

Higher educational levels correlate with greater mobile phone ownership due to increased income potential, technological literacy, and professional demands often requiring digital connectivity. Educated individuals also have broader social networks and better consumer information, which enhance their ability to access and use mobile phones effectively (Nishijima et al., 2017). This consistent relationship across models underscores education's significant influence on technology adoption and usage.

Labor participation is associated with a significant increase in the likelihood of owning a mobile phone. In model 1, those participating in labor have odds of owning a mobile phone that is 6.586 times higher than those not participating in labor. Labor participation significantly increases the likelihood of owning a mobile phone, primarily due to financial resources from employment enabling the purchase and maintenance of phones. Work often necessitates mobile phones for communication, task coordination, and professional networking, particularly in mobile or remote roles (Penard et al., 2012).

Employers may also provide phones or subsidies, enhancing accessibility. Moreover, employment empowers individuals with information access and career development opportunities through mobile technology. This consistent relationship across various models indicates a fundamental connection between employment and mobile phone ownership, highlighting the role of work in boosting technology adoption.

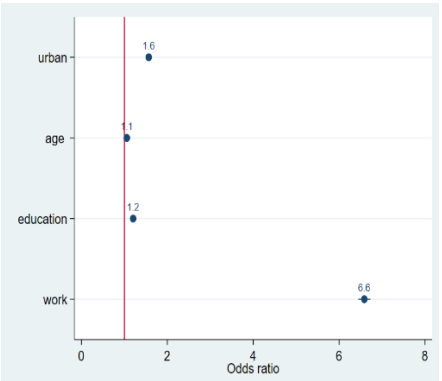

Figure 3a: Coefficient plot of the control variables

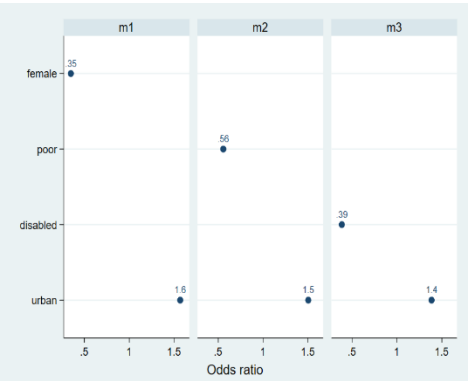

Figure 3b: Coefficient plot of the key variables

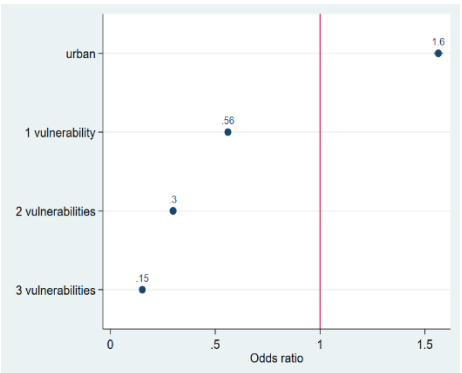

Figure 3c: Coefficient plot of the extent of vulnerability

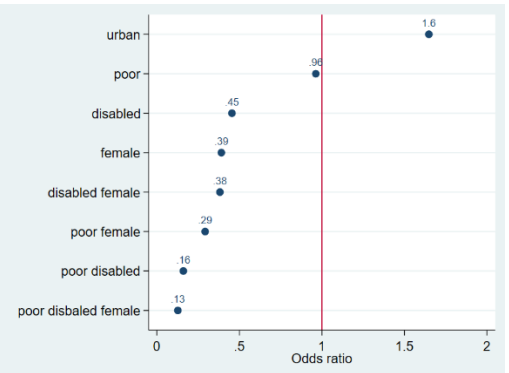

Figure 3d: Coefficient plot of the distinct vulnerabilities

Regarding the first objective of the study, we estimated three distinct models for each vulnerable group to avoid the overlapping of one vulnerable group with the others, as shown in Figure 3b. For instance, in model 1, there are only those females who are not disabled or not poor to obtain a fair and true coefficient. In model 1, the odds ratio for being female is 0.349, statistically significant, suggesting that females are about 65.1% less likely than males to own a mobile phone, holding other factors constant.

This significant difference indicates a disparity in mobile phone ownership between genders. Women are less likely to own mobile phones primarily due to economic constraints, cultural norms, and gender roles that restrict their access and affordability (Chabossou et al., 2009). Educational disparities also play a role, limiting women's technology use and literacy. Additionally, privacy and safety concerns and policy and regulatory barriers can prevent women from owning mobile devices. Addressing these factors through targeted interventions and policies is critical to closing the gender gap in mobile technology access.

The odds ratio for being poor is 0.556, also statistically significant. This suggests that individuals classified as poor have about 44.4% lower odds of owning a mobile phone compared to those who are not poor. The statistical significance of this relationship highlights economic factors as a barrier to mobile phone ownership. Poor individuals have lower odds of owning a mobile phone primarily due to financial constraints, prioritizing basic needs over technology. Limited access to reliable

mobile services and fewer opportunities for credit and financing also pose significant barriers (Avilés et al., 2016). Furthermore, lower education and digital literacy levels reduce the perceived benefits of mobile ownership, while social norms may discourage technology investment. Addressing these challenges requires strategies that improve infrastructure, enhance affordable access to devices and services, and provide education on the benefits of digital technology.

The odds ratio for being disabled is 0.386, significantly lower than 1, indicating that disabled individuals have 61.4% lower odds of owning a mobile phone than those who are not disabled. This points to a significant disadvantage in mobile phone ownership for individuals with disabilities. Disabled individuals have lower odds of owning a mobile phone due to several barriers: Many mobile devices are not designed with accessibility for various impairments in mind. Additionally, higher living costs for specialized care and equipment can restrict financial resources for mobile phones. Employment challenges due to discrimination and physical limitations further reduce income. Social isolation and lower educational opportunities decrease exposure to and the perceived need for technology (Forenbacher et al., 2019). The lack of market focus on adaptive technology exacerbates these issues. Addressing these requires enhancing accessibility, developing adaptive technologies, and improving supportive policies.

Regarding the second objective of the study, the model results, as shown in Table 3 and Figure 3c, show the odds ratios for individuals with different levels of vulnerability compared to the base category of "No vulnerability." The odds ratio is 0.560. This suggests that individuals with one vulnerability are about 44% less likely to own a mobile phone than those with no vulnerabilities. The odds ratio is 0.299, meaning that individuals with two vulnerabilities are about 70.1% less likely to own a mobile phone than those with no vulnerabilities. The odds ratio is 0.152, indicating that individuals with three vulnerabilities are about 84.8% less likely to own a mobile phone than those with no vulnerabilities.

In summary, as the number of vulnerabilities increases, the likelihood of mobile phone ownership decreases significantly. The findings show that an increase in vulnerabilities—such as poverty, disability, or marginalization—reduces the likelihood of owning a mobile phone. Each added vulnerability compounds barriers, including financial constraints, accessibility issues, social and systemic hurdles, and the need to prioritize basic needs over technology. As vulnerabilities accumulate, individuals face increasing challenges in affording, accessing, and using mobile phones, limiting their access to empowerment opportunities. This highlights the need for targeted interventions addressing multiple vulnerabilities' individual and combined effects.

Regarding the third objective of the study, the odds ratio of 0.963 suggests that individuals categorized as poor are slightly less likely (approximately 3.7%) to own a mobile phone compared to those who are non-female, non-disabled, and non-poor, as shown in Table 3 and Figure 3d. The odds ratio of 0.455 indicates that disabled individuals have about 54.5% lower odds of owning a mobile phone than the reference group. The odds ratio of 0.391 means that females have approximately 60.9% lower odds of owning a mobile phone than the reference group. The odds ratio of 0.382 suggests that females who are disabled have about 61.8% lower odds of owning a mobile phone compared to the reference group.

The odds ratio of 0.292 indicates that poor females have about 70.8% lower odds of owning a mobile phone compared to the reference group. The odds ratio of 0.160 suggests that poor and disabled individuals have about 84% lower odds of owning a mobile phone compared to the reference group. The odds ratio of 0.127 indicates that females who are both poor and disabled have about 87.3% lower odds of owning a mobile phone compared to the reference group. In summary, this model highlights significant disparities in mobile phone ownership, with compounded disadvantages apparent for those who are poor, female, and/or disabled, especially for those who belong to all three categories simultaneously. The more vulnerabilities a group faces,

the less likely they are to own a mobile phone, indicating a clear intersectionality effect.

Disparities in mobile phone ownership arise from multiple factors. Financial constraints make it harder for poor individuals, especially those also facing disability or gender-based inequalities, to afford phones and ongoing costs. Disabled individuals may struggle with accessibility or affording specialized devices, while women often face cultural and financial barriers limiting their access. The intersection of these vulnerabilities compounds the challenges, with multiple disadvantages intensifying exclusion. Additionally, individuals with numerous challenges prioritize essential needs over technology, explaining the significant drop in ownership odds as vulnerabilities accumulate. This reflects the intersectionality of barriers to mobile phone access.

Table 2: Odd ratio of the Logit model

	(1)	**(2)**	**(3)**	**(4)**	**(5)**
VARIABLES	model 1	model 2	model 3	model 4	model 5
Urban	1.567***	1.503***	1.385***	1.564***	1.648***
	(0.0146)	(0.0147)	(0.0170)	(0.0113)	(0.0121)
Age	1.057***	1.042***	1.042***	1.041***	1.045***
	(0.000358)	(0.000300)	(0.000408)	(0.000225)	(0.000250)
Education	1.204***	1.217***	1.244***	1.189***	1.192***
	(0.00118)	(0.00130)	(0.00173)	(0.000906)	(0.000921)
Labour participation	6.586***	13.66***	16.22***	8.835***	6.861***
	(0.0718)	(0.128)	(0.210)	(0.0658)	(0.0547)
female	0.349***				
	(0.00351)				
poor		0.556***			
		(0.00503)			
disabled			0.386***		
			(0.00672)		
No vulnerability (base)					
One vulnerability				0.560***	
				(0.00438)	
Two vulnerability				0.299***	
				(0.00315)	
Three vulnerability				0.152***	
Non-female, non-disabled, non-poor (reference category)					
Poor					0.963***
					(0.00981)
Disabled					0.455***
					(0.00811)
Female					0.391***
					(0.00864)
Disabled female					0.382***
					(0.00351)
Poor female					0.292***
					(0.00342)
Poor disabled					0.160***
					(0.00322)
Poor disabled female					0.127***
					(0.00370)
Constant	0.0455***	0.0429***	0.0359***	0.0617***	0.0609***
	(0.000654)	(0.000613)	(0.000647)	(0.000689)	(0.000701)
Pseudo R2	0.3544	0.3774	0.3862	0.3308	0.3401
Observations	371,135	404,222	242,701	633,762	633,762

Standard errors Eform in parentheses, *** p<0.01, ** p<0.05, * p<0.1

4.1 Conclusion

This research examines the digital divide in mobile phone ownership among vulnerable groups, including women, the economically disadvantaged, and persons with disabilities. It aims to

estimate, compare, and analyze the effects of multiple vulnerabilities on the digital divide. The aftermaths of the Logit model regarding the study's first objective suggest that females are 65.1% less likely to own a mobile phone than males. Poor individuals are 44.4% less likely to own a phone, and disabled individuals have 61.4% lower odds. About the second objective of the study, the study shows that individuals with one vulnerability are 44% less likely to own a mobile phone vis-à-vis a person without vulnerability, with two vulnerabilities 70.1% less likely, and with three vulnerabilities 84.8% less likely.

As vulnerabilities like poverty, disability, or marginalization increase, compounded barriers—financial, accessibility, and social—reduce mobile phone ownership. Related to the third objective, the study finds that females who are disabled experience a 61.8% reduction in the likelihood of owning a mobile phone, and poor females have a 70.8% lower likelihood. Poor and disabled individuals face an 84% lower likelihood, and females who are both poor and disabled have the highest reduction, with an 87.3% lower likelihood of owning a mobile phone. The findings emphasize compounded disadvantages, showing an intersectionality effect in mobile phone ownership.

The study's findings reveal significant gaps in mobile phone ownership among different genders, income levels, and people with disabilities. To address this digital divide, it is essential to implement policies that promote gender equality, increase economic opportunities, and enhance support for the disabled. Special attention is needed for individuals facing multiple vulnerabilities, particularly impoverished disabled individuals who are at a greater risk of exclusion. Recommendations include the introduction of subsidy schemes and establishing community support networks that facilitate access to mobile technologies. Further, it is recommended that policies be advocated for to ensure gender equity in technology access, empower women, and secure their ownership rights. These measures should be designed to eliminate obstacles, foster equity, and increase mobile phone ownership among vulnerable groups.

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