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Research Article

Digital Divide in Homeless Population: ML analysis of Technology Access and Usage Patterns in California, USA

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ABSTRACT

Digital technologies cannot be imagined without modern life, and they can afford several advantages, including better healthcare, education, economic growth, and a more civilized society. However, issues regarding the disparity in access continue to exist, particularly among low-income groups in the United States, such as the older group, disabled people, and homeless individuals who are disadvantaged in the digital world. Based on 421 homeless adults referred to permanent supportive housing in California, 94% had cell phones with almost half having a smartphone (mostly Android-based), and they frequently used their phone daily, including 76 per cent with text messaging and 51 per cent with the internet, though one in three said they had no recent connection to the internet. Latent dimensions of engagement were developed using machine-learned methods on principal component analysis and the k-means algorithm, and logistic regression, three discrete digital profiles, and predicates (including texting frequency) that did not decrease the possibility of daily internet use. The results suggest that mobile technology can be used as a useful channel of health interventions among this cohort. A stable internet connection, literacy education, and availability of inexpensive devices to bridge the digital divide is therefore essential in the process of integrating and well-being of homeless people.

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Keywords: Homelessness; Digital Divide; PCA; K-means Clustering; Logistic Regression.

Introduction

The digital divide is a significant issue in today's interconnected world, where access to digital platforms is crucial for accessing essential services, information, and opportunities. However, billions of people remain on the wrong side of the digital revolution [1]. To ensure global equity and fairness, a world with zero digital divide is necessary [2, 3]. Various countries are taking action by launching a global campaign titled "Zero Digital Divide" and setting up a global e-Quality center to ensure equitable access and participation in digital platforms [4].

The digital divide is not just about access to the internet or electronic devices; it exacerbates existing social, economic, and educational disparities. Governments, non-governmental organizations, and private sector stakeholders must collaborate to build infrastructure to connect remote and marginalized communities [5, 6]. Digital literacy is also essential for individuals to navigate the digital landscape effectively [7, 8]. Bridging the digital divide is not just about technology; it's a matter of justice [9, 10]. A world with zero digital divide is essential for equity and fairness, ensuring that every individual can fully participate in the opportunities and benefits of the digital age [5, 11, 12].

The digital divide, which affects over half of the global population, is a significant issue that persists even in high-income countries like the United States. Despite the majority of the population living in areas covered by 3G+ networks, 22% of Americans do not use mobile internet services [12]. Income is a key determinant of this divide, with lower-income Americans being less likely to adopt digital technology [13, 14]. Those who do are often smartphone-dependent, meaning they own a smartphone but lack fixed-line broadband. This is disproportionately the case for those in low-income households and those with less than a high school education [9, 15, 16].

For people experiencing homelessness, digital inclusion often hinges solely on smartphones, as fixed-line broadband is generally not feasible for those without permanent housing or who are unsheltered. Mobile technology can underpin and amplify access to critical information, tools, and services beneficial to social, economic, and emotional well-being. Addressing the barriers to digital inclusion faced by vulnerable people in the US is critical to achieving digital equity [15-19].

The digital divide is a significant issue affecting access to the Internet, particularly for women. It is primarily caused by factors such as the high cost of devices and services, limited access for low-income earners, insufficient knowledge and skills, and the challenges in implementing infrastructures that facilitate the adoption of Information and Communication Technologies (ICTs)[11]. The use gap refers to the lack of sufficient digital skills to use ICTs effectively, affecting everyday tasks like online doctor appointments and electronic banking[20]. Access gap is another significant issue, affecting certain population groups due to socioeconomic inequalities and lack of public funding for infrastructures. The generation gap, particularly among those aged 65-74, is also a significant issue, with nearly half of the population having low digital skills. The digital gender gap further exacerbates this issue, with women having limited access to ICT, resulting in fewer girls choosing STEM careers[21]. Despite equal internet access in Spain, the global gender gap is more pronounced in countries like Africa and the Arab States [22-27].

This research aims to provide a deeper knowledge of the use patterns that this population demonstrates in order to establish a technology-enabled society for those who are homeless. In order to achieve that goal, this study offers descriptive information on Internet and mobile phone usage as well as employment from a sample of homeless people. Next, we compare these results with data from an age-matched, large-scale population sample [28, 29].

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Literature review

Uneven patterns of access, or "digital divides," are a prominent aspect of cyberspace. An article states that the majority of pupils are Internet-savvy digital natives [30]. Second, it provides an overview of digital divides, including worldwide trends, disparities between rural and urban areas, inequalities in gender and ethnicity, and the function of smartphones [31, 32]. Teaching digital divides as a means of comprehending sociospatial inequality is justified in the third part. The article then provides six ways to help students understand this subject: mapping Internet users, speaking with a nonuser, talking about the contrasts between rural and metropolitan areas, going without the Internet, investigating ways to close the gap, and picturing a time before the Internet [33, 34]. Another article, "The Digital Divide: A Review and Future Research Agenda, "reviews the digital divide, a societal issue involving disparities in IT access and usage [35, 36]. It identifies factors affecting the divide, including sociodemographic, socioeconomic, personal elements, social support, type of technology, digital training, rights, infrastructure, and large-scale events. Education is the most significant factor [37, 38]. The review also identifies a new form of internet access and two potential levels of the digital divide: algorithmic awareness and data inequalities [39, 40]. The pandemic has exacerbated the digital divide, and the article suggests further development in organizations to address the issue [41].

Public libraries are the primary source of Internet access for millions of Americans who do not have access to a computer or broadband at home [42, 43]. The study explores the relationship between library computer use and digital home-lessness in the US, focusing on three themes: lifeline, negotiating access, and risky business. It highlights how individuals navigate complex settings without access to computers or broadband, shaping their digital lives and experiences. The study highlights the importance of usability, privacy, and security in negotiating access, and the diversity of insecure internet and computing practices due to low technological capital. It also highlights how digital homelessness limits social inclusion and reproduces socioeconomic inequality. The findings contribute to the digital divide [24]. A review of health and social science literature on the use of information technologies by homeless persons found that mobile phone ownership ranged from 44% to 62%, computer ownership from 24% to 40%, computer access and use from 47% to 55%, and internet use from 19% to 84% [44]. Homeless persons use technologies for various purposes, some of which are health-related [40]. Many homeless persons had access to information technologies, suggesting potential health benefits to developing programs linking them to healthcare through mobile phones and the Internet. Homeless persons experience high morbidity, high mortality rates, and inefficiencies in resource use [45]. The rapid proliferation of mobile phones presents opportunities for improving communication and retention in care [46-49].

A study investigates mobile phone usage among homeless individuals in downtown Los Angeles, focusing on usage patterns and connectivity challenges [50, 51]. It highlights the impact of access instability, which includes poverty, housing insecurity, and discrimination, on access to social services, information seeking, skills building, and social capital formation. The research, based on a survey of homeless adults and a participatory research intervention, found that reliable access to electrical power is a significant barrier to mobile use among marginalized populations [52]. This lack of access disrupts the expectation of constant reachability, limiting employment opportunities, access to healthcare, and personal support networks [53]. Another study in Oakland, California, aimed to understand the access to mobile phones, computers, and the internet among 350 homeless adults over 50 years [18, 54]. The study found that 87.5% of the participants completed the mobile phone and internet questionnaire. Most had feature phones, not smartphones, and did not hold annual contracts [51, 55]. Just over half had ever accessed the internet. Participants used phones and the internet to communicate with medical personnel, search for housing and employment, and contact their families. Those who regained housing were more likely to have mobile phone access. Those with ADL and executive function impairment were less likely to have mobile phones. Moderate to high-risk amphetamine use was associated with reduced access to mobile phones [56]. The study suggests that expanding access to these basic technologies could improve outcomes for older homeless adults [57-59].

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The digital divide in the United States is a significant issue that requires a shift in policy focus from disparities in access to computers and the Internet to the differential access and use of Internet information resources [60, 61]. This paper presents a model that identifies four interrelated elements: information delivery approaches, technology use contexts, social networks, and social policies and institutional mechanisms regulating technology access [62]. The model highlights the embeddedness of ICT use in people's daily lives and suggests policy concerns related to how ICTs may mitigate or exacerbate economic and political inequalities in the United States. The paper highlights the need for a more comprehensive understanding of the digital divide and its implications for policymakers and the wider community[63]. The Veterans Health Affairs supportive housing program in September 2020 provided video-enabled tablets and cell phones to 5127 Veterans. The initiative aimed to support their communication and healthcare engagement needs during the COVID-19 pandemic. The study found that in-person and video engagement increased by an average of 1.4 visits (8%) and 3.4 visits (125%) respectively, compared to the 6 months prior to device receipt. Tablet users had a substantially larger increase in video-based engagement (+3.2 visits [+110%] vs. +0.9 [+64%]). This suggests that providing video-enabled devices to Veterans in supportive housing programs may facilitate engagement in healthcare [64]. The VA's device distribution program offers a model for expanding access to health-related technology and telemedicine to individuals in supportive housing programs [51, 65, 66].

Policy analytics uses new data sources like mobile smartphones, Internet of Everything devices, and electronic payment cards to inform and direct public policy. However, those without these devices may be digitally invisible if their daily actions are not captured. An exploratory study of homeless individuals in Phoenix, Arizona, and nonhomeless, digitally connected university students revealed that they interact differently with the physical environment and technology. Homeless individuals and university students experience significant differences in individual temperatures relative to outdoor conditions, potentially leading to differentiated health risks and outcomes. Additionally, homeless individuals have fewer opportunities to benefit from digital services and a lower likelihood of generating digital data that might influence policy analytics [43]. Failing to account for these differences may result in biased policy analytics and misdirected policy interventions [51, 67].

In the United States, digital inequalities disproportionately affect marginalized populations, including formerly incarcerated persons (FIPs) [68]. These individuals face challenges such as advanced aging, disability, low incomes, education, gender-based marginalization, and race and ethnicity. The digital rehabilitation model, supported by Reisdorf and Rikard, aims to help FIPs navigate the digital society post-incarceration. However, lack of access to ICTs and the Internet during incarceration deprives FIPs of the necessary digital skills to navigate economic, social, cultural, personal, and health fields [69, 70]. Policies addressing digital rehabilitation should increase limited internet access and provide comprehensive digital skills training for FIPs [71].

The New Tech for Youth Sessions is a curriculum designed for homeless young people aged 13-25, focusing on developing life skills in digital media and promoting self-worth through positive communication with adults and peer support [38]. The curriculum incorporates a community technology center into a multi-purpose drop-in for homeless youth, guiding them through integrated activities related to finding employment. The study found that digital media instruction can create life-affirming experiences, strengthening relationships between youth and drop-in staff. The curriculum's principles, class processes, and social structure support the learning environment [72, 73]. Lessons learned from the program include the need for providing access to digital media, the potential benefits of access, the design of a community technology curriculum for improving self-worth, and the potential for youth-adult relationships to be fostered [74-76]. Mobile City and Aug City have implemented different approaches to provide access to local government support and services [77]. Aug City used a bottom-up infrastructure-based model, involving non-state involvement, while Mobile City used a centrally planned model with state service custodians [78]. A case study approach was used to examine these two urban areas in the UK. The study revealed that existing information needs and barriers, such as literacy, technology skills, and socioemotional conditions, hinder the direct access model for socially

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excluded communities. It is crucial to address these issues before implementing new MICT initiatives to ensure the success and benefit of the targeted communities and individuals [79, 80].
The digital divide is an overwhelming event for homeless people not only in the US but all over the world [81]. The literature review describes what the digital divide is, how it affects the homeless population, and some of the statistical evidence of the digital divide and homelessness in people all over the world. This paper has a prospect of better understanding the patterns of use that this demographic exhibits to create a technology-based society for individuals experiencing homelessness. To that purpose, this study provides descriptive data from a sample of homeless individuals regarding Internet and cell phone access and employment. Then, we contrast these outcomes with the data from a broad population sample that was age-matched [82].

Materials and methods

A study involving 421 homeless adults moving into permanent supportive housing (PSH) in Los Angeles or Long Beach, CA, was conducted. The participants were referred directly from 26 housing/service provider agencies or recruited during building lease-up events. Eligibility requirements included being 39+, moving in without minor children, and completing interviews in English or Spanish. The study aimed to detect changes in HIV risk behavior over time in PSH by minimizing variability due to developmental life stages or current parenting status. Interviews were conducted from August 2014 to October 2015, assessing various topics, including technology use. Participants were paid $20 and study protocols were approved by the authors' University's Institutional Review Board.

Table 1: Demographic characteristics and technology use among homeless adults.

Transition to permanent supporting housing (n=421)	
Demographic characteristics	(%)
Age	**20-60**
Gander	
Male	71.5(301)
Female	27.9(117)
Transgender	0.6(3)
Race/ethnicity	
Black	56.0(265)
White	24.3(102)
Others	19.7(54)
Internet use	
Daily	55(232)
Weekly	39(164)
Rarely	6(25)
Device ownership	
Cellphone	3.8 (16)
Smartphone	91.45 (385)
Computer	4.45 (20)

Demographics included age, gender, race/ethnicity, education, and income. Place of stay questions were adapted from prior research with homeless persons, and literal homelessness was defined as staying in temporary/emergency shelters, outside, abandoned buildings, garages, sheds, indoor public places,

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vehicles, or public transportation. Measures regarding smartphone and cell phone usage activities were adapted from the survey.

Results and discussion

Homelessness has started to rise again in recent years and remains a serious problem in the United States. Point-in-time (PIT) counts from 2019 indicated that more than 560,000 people were experiencing homelessness across the country[83], with 37% being 'unsheltered'. Rates of homelessness vary, but they tend to be highest in California, Hawaii, New York, and Oregon. Unsheltered homelessness is particularly acute on the West Coast, with California having nearly nine times as many people experiencing it as California. Figure 1 explains the difference in homelessness for the world and in California.

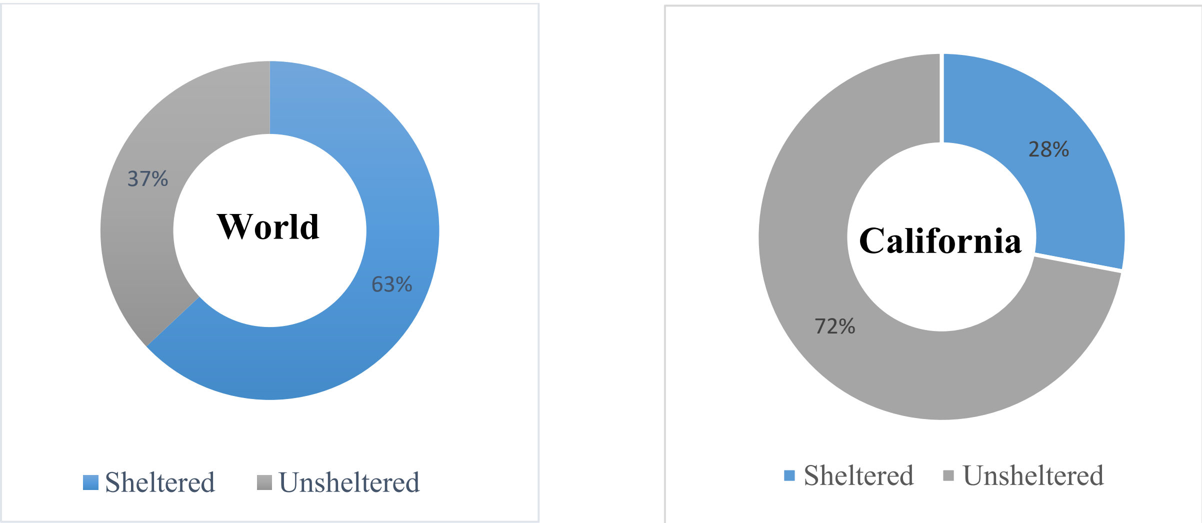

Figure 1: Homelessness in the world and California.

The study reveals that the majority of homeless adults in the study are male, predominantly Black or White, with an average income of $594/month. The most common places of stay are temporary shelters (42%), transitional living programs (21%), and outdoors (17%). The average lifetime literal homelessness duration is 6 years, and 77% reported past 3-month literal homelessness. The majority of respondents own a cell phone, with 56% reporting 2+ phones in the past 3 months. Most of them (91.45%) currently own smartphones. Daily cell phone use is reported by 55%, and 76% reported text messaging in the past 3 months. Other common past 3-month phone activities include internet use (51%), listening to music (50%), downloading apps (38%), and email (38%). Daily internet use is reported by 39%, while 33% reported no past 3-month internet access.
The study focuses on the technology use of homeless adults in California, specifically those aged 20-60. The data is compared to publicly available data from the Pew Research Center for the same age group. The results show that homeless respondents report slightly higher rates of current cell phone ownership than the general population, at 95.55%. Smartphone ownership, text messaging, and app downloading rates were similar between homeless and same-age Pew Research Center respondents. Homeless respondents had slightly higher rates of accessing the Internet on cell phones (49 and 45%) and slightly lower rates of checking email (38%) compared to the general population data. There was a larger gap between the groups in listening to music on cell phones (48%) in the study compared to 26% in the general population.
The study's limitations include its focus on a cohort of homeless adults moving into Public Housing Shelters (PSH), which is not necessarily representative of all homeless adults in Los Angeles. The study

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also does not accurately assess differences between participants and those who refused. Additionally, the data comes from California, a dense, urban area with the largest population of homeless persons in the U.S.A., and excludes persons under 39 and those moving into PSH with minor children.

Explanatory Analysis of Technology-use Relationships

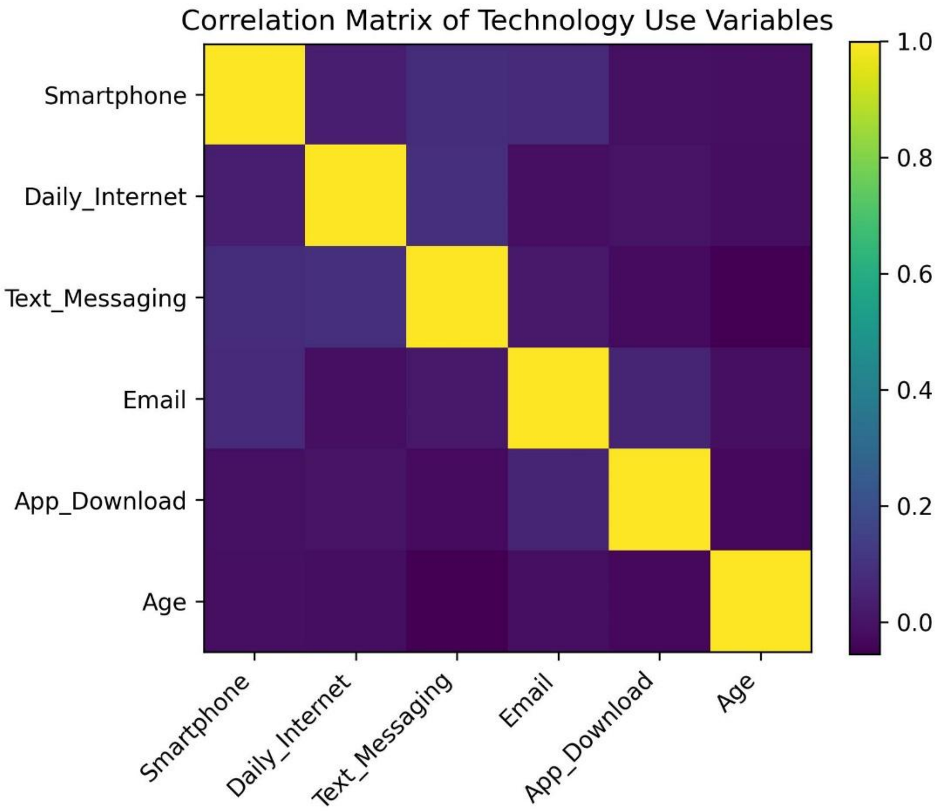

Figure 2: Correlation Matrix of Variables of Technology Use.

Figure 2 shows the pairwise correlations between age and technology-related behaviors. The positive relation between daily Internet use and text messaging ($r = 0.092$), smartphone ownership and text messaging ($r = 0.082$), and smartphone ownership and email ($r = 0.075$) is relevant and gives the strongest positive correlation. The relationship between age and all the analyzed behaviors (e.g., Age vs. text messaging $r = 0.055$; Age vs. daily Internet use $r = 0.017$) is also weak, which is indicative of insignificant age-patterning in the age bracket 20 to 60 years old. In general, the numbers of the correlations are small. In general, the percentage of the explanations by each variable is low, which justifies the further multivariate machine-learn analysis consisting of PCA, clustering, and predictive-modeling.

Dimensionality Reduction and Latent Digital Engagement

A two-dimensional framework of a principal component analysis (PCA) projection shown in Figure 3, summarizes the variables of technology-use, into two latent dimensions. Principal component 1 explains 19.51 percent of the total variance and principal component 2 explains 17.82 percent of the total variance, and the total variance explained by the two is 37.33 percent. The loadings indicate that the dominant element in component 1 is general engagement, reflected in the highest magnitudes, namely text messaging (0.603) or the Smartphone ownership (0.517) or daily Internet use (0.433). On the contrary, component 2 represents a pattern of a service-oriented one, where email (0.626) and app

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download (0.600) have the greatest magnitudes. The wide scatter of the points on the plot promotes heterogeneous digital behaviour profiles and legitimises application of segmentation analyses through clustering.

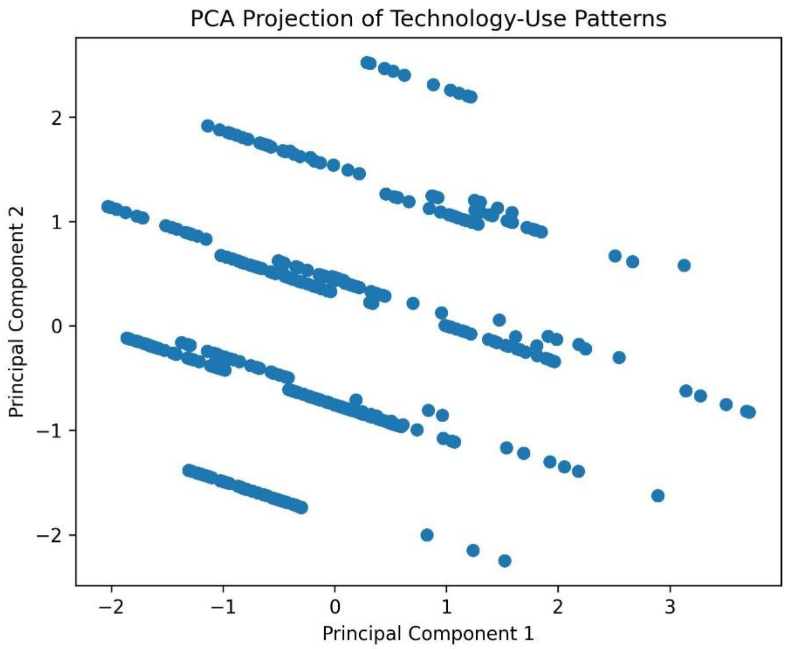

Figure 3: PCA Projection of Patterns of Technology use.

Unsupervised Segment of Digital Engagement

Figure 4: Digital Profiles K-Means (with numbers) Clustering.

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Figure 4 uses the k-means clustering algorithm (k3) on the PCA based space and the three behavioral clusters are observed. Cluster 0 includes 153 participants (36.3 percentage of the sample); Cluster 1 includes 181 (43.0 percentage of the sample); Cluster 2 includes 87 participants (20.7 percentage of the sample). The cluster means represent discrete profiles: Cluster 1 has more connectivity with mean values of daily Internet use (0.624), text messaging (0.956), and smartphone ownership (0.983); Cluster 0 is more dense with relation to device ownership and platform activity with means of email (0.725), application download (0.680), and smartphone ownership (1.000) but with relatively lower daily Internet use (0.203); and Cluster 2 portrays a less affluent picture since it has higher

Predictive Modelling for Daily Internet Usage

An interpretable logistic regression model was summarized in Figure 5 to predict the daily use of the Internet. The highest positive coefficient is text messaging ($\beta = 0.416;\ 1.516$) then the smartphone ownership ($\beta = 0.177;\ 1.194$), which means that active communicators through phones are more likely to have a daily Internet use, and smartphone owners are more likely to engage in a daily use of Internet. The other predictors e.g. email, downloading apps, and age show weak effects; email (0.063; OR 0.939), downloading apps (0.014; OR 1.014) and age (0.002; OR 0.998). The concept of model discrimination is a small scale one, and the operating characteristic curve of the receiver is an area of 0.549 and an accuracy of 0.625. These results indicate that even the everyday use of the Internet can be described in part by the evident behavior, and it may involve structural elements, namely Wi-Fi availability, data costs, and the dependability of data charges.

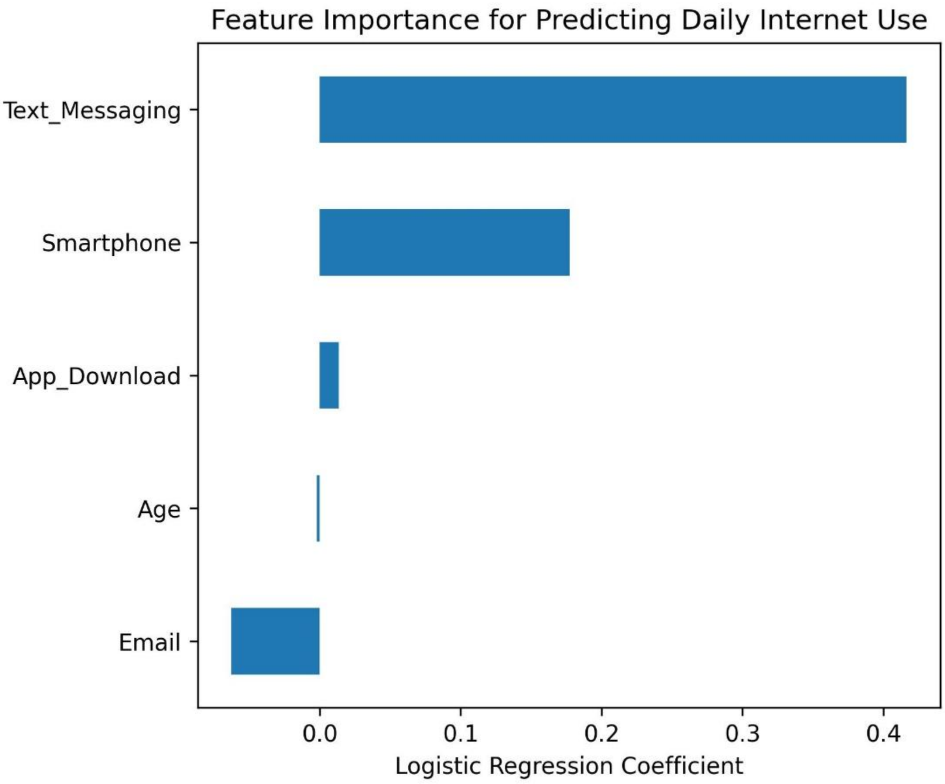

Figure 5: Logistic Feature Regression Importance of Daily Internet Use.

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After the analysis, the final results were expressed below.

Access to the Internet for the homeless population:

Access to mobile phones: Homeless individuals often have access to mobile phones, obtained through the Federal Communications Commission's Lifeline program. A research pilot from the Bay Area found that 74% of homeless participants own a mobile phone, with 95.55% owning a smartphone. This is echoed by USC Annenberg's 'Connecting Skid Row' project and other findings on homeless sub-populations. However, homeless populations face challenges with retaining their devices due to loss, theft, or other factors. Device turnover is high, with over half of participants reporting having at least two different devices during a three-month period. The transient nature of homelessness makes possessions particularly vulnerable to theft, with 40% having their phone stolen more than once. A lack of reliable access to devices and the internet can have significant repercussions on caseworkers' and service providers' ability to contact individuals experiencing homelessness. For example, a client who received a referral to a subsidized housing program could no longer be contacted by the phone number she had listed, and the California Housing Authority's website warns that applicants for rental assistance programs may have to wait 4 to 9 years before their name will reach the top of the list.

Figure 6: Digital divide proficiency.

Access to charging and storage facilities: Phones are often lost or stolen due to lack of secure charging stations or storage spaces. Homeless individuals face challenges in charging devices, with 37% of older homeless adults lacking active mobile service due to lack of charging locations. Over 40% of chronically homeless individuals find it difficult to charge their phones. Accessible power outlets are often disabled to discourage charging in public places, and peers experiencing homelessness may not be familiar with adjusting device settings to reduce battery consumption.

Access to Wi-Fi: California offers free Wi-Fi in some outdoor public spaces, parks, libraries, and recreational centers, but these networks may not be accessible to certain people due to location or circumstances. Public libraries have 30-minute increments, leading to privacy concerns and limited access for some users. Local non-profits may offer drop-in centers with Wi-Fi access, but they are often closed on evenings and weekends when homeless individuals need to complete tasks like housing searches. In California, Wi-Fi at shelters is not yet standard, with estimates suggesting it is available at just over half of adult shelters. However, solutions like ShelterTech's Shelter Connect program are beginning to shift, outfitting 16 shelters and transitional housing facilities with free Wi-Fi, benefiting over 1,000 residents per night and 3,000 people annually. In December 2019, ShelterTech collaborated with the City of San Francisco to deliver Wi-Fi to the Star Hotel, providing high-speed internet connectivity to residents. Additional joint projects are expected in 2020 to provide high-speed internet access at no charge to those most in need.

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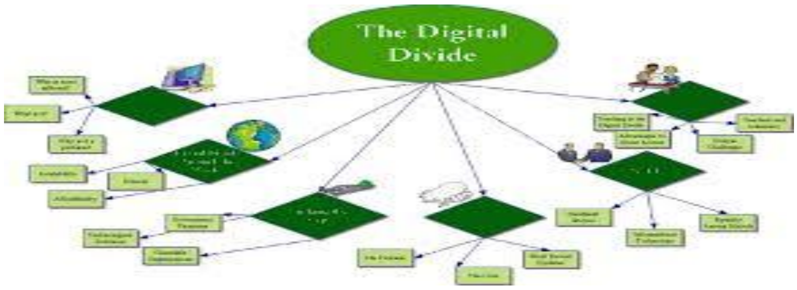

Figure 7: Digital affordability.

Digital inclusion is significantly impacted by the affordability of devices and data, particularly for low-income and vulnerable populations, such as those experiencing homelessness. The prohibitive costs of these devices and data can significantly impact access and usage, particularly for smartphone-dependent individuals who often need to cancel or suspend their services due to financial hardship. Federal and state Lifeline programs offer discounted bundled monthly voice and broadband plans, but the data offered is limited. Most Lifeline plans provide significantly less than the average monthly data usage for US citizens under the age of 45 of approximately 4.6 GB. These data limitations are particularly acute for people experiencing homelessness, who may be sharing devices and/or data plans. Beyond subsidized programs, some individuals experiencing homelessness purchase affordable devices, prepaid cards, or pay-as-you-go plans to reload when financially able. Some may share a phone and the cost with friends, while others find apps that offer more data in exchange for watching videos or ads. Affordability is particularly challenging for young people experiencing homelessness, especially those estranged from their families, who are often on a family plan. This creates an extra burden on these individuals, who must independently navigate the process of getting an individual phone plan.

Strategies to bridge the digital divide:

The digital world is a rapidly evolving landscape, and bridging the digital divide requires a multifaceted approach. The OECD has issued recommendations for G20 countries to help less developed countries overcome the digital divide, while international organizations like the UN and UNESCO are working towards a Sustainable Development Goal (SDG) or through initiatives to increase population involvement in the digital world. National and regional governments have implemented digital literacy projects, such as the Spanish government's National Digital Skills Plan and the Andalusian Government's Guadalinfo centers.

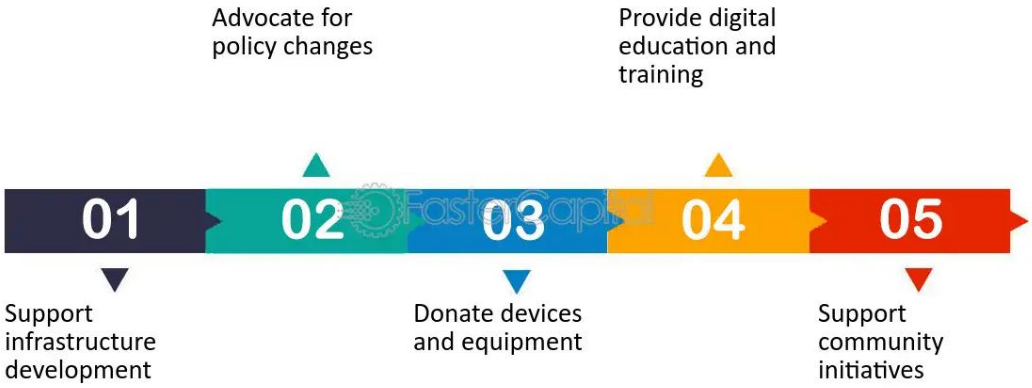

Figure 8: Strategies to bridge the digital divide.

The private sector has also contributed to facilitating access to technology, such as the Employment and Technology Campus, which trains unemployed single mothers in new technologies and includes online activities for their children. Repsol's Foundation has provided the necessary equipment for online training for both mothers and their children.

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Conclusion

The current study analyzing trends of digital technology access and use among homeless individuals living in California found significant possibilities and also current constraints to digital inclusivity. The results show that the majority of the sampled population owns mobile phones and smartphones, which implies that the availability of devices is not the major impediment to technology-based service provision. As a result, interventions utilising mobile platforms to deliver healthcare and housing navigation as well as social support seem operationally viable to this group. However, device and telephone number turnover remains a serious problem, which may negatively impact on the continuity of engagement and care.

Analytical procedures that involve machine-learning allowed the integration of analysis processes beyond simple descriptive statistics. The dimensionality -reduction and clustering analyses have revealed significant heterogeneity in technology -use patterns, outlining unique digital-engagement patterns of homeless adults. As an additional finding, predictive modelling indicated that the behavioural predictors like text messaging frequency and Smartphone use have a stronger relationship with daily internet use than the demographic factors such as age. These findings suggest that strategies of digital inclusiveness must emphasize more on supporting the active as well as functional use of technology rather than just increasing access.

Even with the high smartphone ownership rates, internet access and the use of computers or tablets are not widespread with substantial limitations due to structural issues that includes affordability of data and inconsistency in accessibility of Wi-Fi and lack of officially recognized and subsidized charging stations. Policy makers and housing providers need to focus more on home-based stable internet connections, digital literacy training, and a sustained technical support in permanent supportive housing opportunities as such. Lastly, technology-based interventions should be able to address the overlapping vulnerabilities of homeless people, such as health problems in younger age, cognitive impairment, and traumatized backgrounds. Streamlined, user-friendly technology development and long-term support are acquired so that to provide a level playing field in digital participation.

Overall, the combination of conventional survey methods with exploratory machine-learning research will provide a more careful understanding of the digital divide between homeless adults and justify the creation of focused and evidence-based policies of digital inclusiveness. There are some limitations to the research, as the machine-learning analyses were conducted using a synthetic dataset based on the reported proportions and sample size, ensuring the privacy of the participants. Therefore, it is necessary to understand the results as illustrative rather than inferential.

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