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Digital health and social inequality: Population-based evidence from MyHealth platform use in Catalonia

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ABSTRACT

Objectives: The rapid expansion of digital health technologies during and after the COVID-19 pandemic has reshaped how individuals access healthcare services. While these innovations promise greater efficiency and reach, questions remain about their equitable uptake across different population groups. This study investigates the adoption and sustained use of MyHealth, a digital health platform introduced by the Catalan National Health System in 2015 and widely integrated into primary care delivery.
Methods: Drawing on longitudinal administrative data covering around 80% of the Catalan population (9.46 million individuals) and over 727 million healthcare records from 2015 to 2023, we analyse patterns of digital engagement using survival analysis and microeconometric modelling.
Results: Our findings reveal persistent inequalities in both initial adoption and long-term usage. Engagement is higher among women, Spanish nationals, and individuals from higher-income areas. At the same time, older adults, migrants, and rural residents are significantly less likely to adopt or sustain use of the platform. These disparities were particularly pronounced during the pandemic's peak, when digital health use surged. Concentration indices confirm a clear pro-wealth bias in digital health engagement, challenging the assumption that digitalisation automatically enhances equity. Despite the platform's wide availability and integration into the healthcare system, structural barriers, including digital literacy, cultural and linguistic accessibility, and infrastructure, continue to shape patterns of use.
Conclusions: This study presents one of the first comprehensive, large-scale assessments of digital health inequality in Europe. It highlights the need for targeted, evidence-based policies to ensure that digital health transformation supports rather than undermines equity goals in healthcare access and delivery.

Introduction

The COVID-19 pandemic accelerated the global rollout of digital health platforms, transforming the way patients access healthcare and communicate with healthcare providers. From virtual consultations to mobile portals, these tools were often introduced as universal solutions to ensure continuity, safety, and access to care [1]. Emerging evidence suggests that digital health innovations may reinforce rather than reduce pre-existing inequalities in healthcare systems [2]. Despite widespread availability, digital health services continue to reflect and strengthen structural inequalities, with lower-income groups, older adults, migrants, rural residents, and those with limited digital skills at greater risk of exclusion [3–5]. Furthermore, only 55.6 % of EU adults possess at least basic digital skills, far below the 2030 target of 80 %. Adults with lower levels of education and manual occupations are most at risk of digital exclusion [6].

Several national health systems have promoted patient portals and digital services, reporting widespread uptake during the pandemic. For example, the NHS App in England experienced a surge in downloads following the introduction of the COVID Pass [7], while Scandinavian countries, such as Sweden and Denmark, saw substantial increases in digital consultations and access to health records [8]. However, most studies in this field rely on self-reported data or selected populations [9, 10]. Few provide population-level analyses using administrative records, and even fewer examine sustained use over time or explore how digital engagement intersects with broader patterns of social inequality

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[11].

This study addresses the gap in population-based analyses using administrative datasets by examining the adoption and long-term use of MyHealth, a patient-facing digital platform launched by the Catalan National Health System in 2015 and integrated with the asynchronous consultation tool eConsulta in 2018. Using longitudinal administrative data from 9.46 million individuals and over 727 million healthcare interactions between 2015 and 2023, this study offers the first population-level analysis of digital health engagement over nearly a decade within a universal health system. We examine how sociodemographic, economic, and geographic factors influence both access to and continued use of digital services, applying survival analysis, microeconometric techniques, and measures of inequality.

This study makes a novel contribution by providing the first population-level, longitudinal analysis of digital health engagement within a universal health system over nearly a decade. By integrating survival analysis with microeconometric models and inequality indices, we offer a comprehensive assessment of who adopts and sustains digital health usage—and who is left behind. Longitudinal data from the NHS App reveal widening deprivation gaps, with the most deprived quintiles showing 20–30 % lower retention at 5 years than affluent groups [12]. Our work goes beyond snapshots of digital access to trace long-term engagement patterns across demographic, socioeconomic, and geographic dimensions. Cross-national studies (e.g., Portugal's digital divide) confirm these patterns are structural, not contextual [13]. These insights challenge optimistic assumptions about digital health levelling inequalities and underscore the need for targeted policy strategies that address structural barriers to equitable access. We expose how barriers, such as financial toxicity (e.g., device/data costs), and algorithmic bias in AI tools perpetuate exclusion [14], and demonstrate that 'access' alone cannot overcome embedded inequities without co-designed interventions.

Policymakers should prioritise targeted interventions—such as improving digital literacy, offering multilingual support, and investing in infrastructure in rural and low-income areas—to ensure that digital health platforms promote, rather than exacerbate, healthcare equity.

Data

This study draws on population-level administrative data covering 9.46 million individuals registered in the Catalan public health system between 2015 and 2023. The dataset includes longitudinal, individual-level records of healthcare usage, demographic characteristics, and pharmaceutical benefits, allowing us to track inequality trends over time and across population subgroups. All variables were harmonised and validated by the Catalan Health Quality and Assessment Agency (AQuAS) for research purposes. Catalonia's public health system provides universal healthcare to approximately 7.9 million residents as of 2023, within a shared digital infrastructure for clinical information exchange introduced in 2008. eConsulta, an asynchronous teleconsultation tool launched in 2015 and used by over 92 % of primary care teams, was integrated into MyHealth in 2018. MyHealth enables users to manage appointments, renew prescriptions, access nursing services, and view personal health records, test results, and vaccination history.

The dataset includes detailed usage records from MyHealth, enabling analysis of digital health engagement over time and across population groups. The analysis is limited to patient-initiated interactions recorded in the MyHealth platform; professional-initiated messages, which were introduced later and expanded after 2020, are not included in the available data. The platform collects detailed administrative and behavioural data, including users' age, gender, morbidity level (GMA – *Grupos de Morbilidad Ajustados*), nationality, pharmacy co-payment level (a proxy for income), number of logins, and health area. We also include the variable navigation type, which indicates the channel the user used to access the platform (e.g., mobile application, desktop or tablet web browser). This enables us to investigate whether digital engagement patterns vary by access modality. This dataset allows in-depth analysis of digital health access and engagement across diverse population subgroups. We assessed rurality at the municipality level using IDESCAT's urbanisation dataset, based on OECD guidelines for population density and distribution [15]. In fact, Rurality is measured using the RULA indicator, an index developed by IDESCAT based on population density and settlement patterns, which classifies municipalities along a rural–urban continuum. Primary care centres were mapped to municipalities, and income was proxied using IDESCAT's 2021 tax base data. Since 69.4 % of municipalities were fully rural and 24 % were fully urban, we constructed rurality measures based on population density deciles. To complement this, we used 2013 tax data from 1112 Catalan postcodes to calculate average municipal income and generate income deciles. Aggregate municipal income and the corresponding income deciles are used to construct contextual socioeconomic rankings at the municipal level and are employed in the computation of concentration indices and related inequality analyses, where individual digital health usage is ranked by area-level income.

Empirical methods

To examine inequalities in digital health engagement, we employ an integrated empirical strategy that combines three complementary methods. First, we use logistic regression models to identify the individual and contextual determinants of initial adoption of the MyHealth platform. Second, survival analysis techniques—Kaplan-Meier estimates and Cox proportional hazards models—are applied to track long-term user retention. Finally, we compute concentration indices with Erreygers' correction to quantify the degree of socioeconomic inequality in digital service use over time. This multi-method approach allows us to analyse not only whether individuals access digital services, but also how long they remain engaged and how equitably these services are used across the population.

All empirical analyses are based on individual-level administrative data covering 9.46 million individuals observed between 2015 and 2023. The data structure allows us to implement each empirical approach in a manner consistent with its underlying assumptions. Specifically, survival models rely on exact dates of first and last platform use to construct time-to-event outcomes; adoption models use a cross-sectional indicator of ever use over the study period; and inequality analyses are based on annual measures of digital activity ranked by socioeconomic position.

We use survival analysis to assess MyHealth retention, applying Kaplan-Meier curves and Cox proportional hazards models to examine usage over time across demographic groups. Quarterly data and key covariates were included to capture patterns of persistence and identify factors linked to continued use or attrition. The Kaplan-Meier method estimates the survival function S(t), representing the probability of continued MyHealth usage beyond time *t*. The survival function is calculated as in Eq. (1):

$$S(t) = \prod_{i:t_i<t}\left(1-\frac{d_i}{n_i}\right) \tag{1}$$

where t_i represents the observed time points, d_i is the number of users who stopped using MyHealth (events) at time t_i, and n_i is the number of users still using MyHealth (at risk) just before time t_i. This non-parametric approach visually depicts user retention over time, enabling us to compare retention rates across demographic groups. The Cox proportional hazards model assesses the impact of multiple covariates on the hazard function *h(t)*, which represents the instantaneous risk of discontinuing MyHealth usage at time *t*. The model is defined as in Eq. (2). We tested the proportional hazards assumption using Schoenfeld residuals and detected only minor violations. To assess the robustness of our findings, we estimated alternative specifications

Table 1
Descriptive statistics by users and non-users of MyHealth.

	Population (9,459,051)	Not MyHealth users (3,722,504)	MyHealth users (5,736,547)	MyHealth users (non-delegated 5,086,737)
Navigations by individual	9.783 (22.37) [0.0-2,245.0]		16.132 (26.89)	13.830 (23.71)
No. Access to eConsulta	2.674 (7.62) [0.0-937.0]		4.409 (9.39)	3.659 (8.08)
No. Access to eConsulta docs	0.756 (2.20) [0.0-903.0]		1.246 (2.72)	1.077 (2.48)
Dummy for eConsulta	0.413 (0.49) [0.0-1.0]		0.680 (0.47)	0.650 (0.48)
Dummy for eConsulta docs	0.263 (0.44) [0.0-1.0]		0.434 (0.50)	0.403 (0.49)
Individual is a woman	0.504 (0.50) [0.0-1.0]	0.477 (0.50)	0.521 (0.50)	0.497 (0.50)
Individual age	46.079 (24.43) [0.5-122.5]	41.254 (30.27)	49.210 (19.10)	49.711 (20.06)
Individual age (excluding non-adults)	52.755 (20.41) [18.5-122.5]	58.301 (23.81)	50.345 (18.22)	
Max level of GMA (comorbidity)	33.114 (36.89) [0.0-462.4]	32.813 (42.58)	33.310 (32.67)	34.015 (33.88)
Drug copayment level				
Exempted	0.036 (0.19) [0.0-1.0]	0.048 (0.21)	0.028 (0.17)	0.029 (0.17)
10% copayment	0.181 (0.38) [0.0-1.0]	0.217 (0.41)	0.157 (0.36)	0.175 (0.38)
40% copayment	0.552 (0.50) [0.0-1.0]	0.587 (0.49)	0.530 (0.50)	0.522 (0.50)
50% copayment	0.201 (0.40) [0.0-1.0]	0.124 (0.33)	0.250 (0.43)	0.239 (0.43)
60% copayment	0.007 (0.08) [0.0-1.0]	0.004 (0.07)	0.009 (0.09)	0.009 (0.10)
Mutual	0.023 (0.15) [0.0-1.0]	0.020 (0.14)	0.025 (0.16)	0.026 (0.16)
Monthly limit Pharmacy				
No limit	0.819 (0.39) [0.0-1.0]	0.783 (0.41)	0.842 (0.36)	0.824 (0.38)
Up to 8.23	0.133 (0.34) [0.0-1.0]	0.175 (0.38)	0.106 (0.31)	0.118 (0.32)
Up to 18.52	0.047 (0.21) [0.0-1.0]	0.041 (0.20)	0.051 (0.22)	0.057 (0.23)
Up to 61.75	0.001 (0.03) [0.0-1.0]	0.001 (0.02)	0.001 (0.03)	0.001 (0.04)
Nationality				
Spain	0.722 (0.45) [0.0-1.0]	0.567 (0.50)	0.822 (0.38)	0.819 (0.39)
Europe	0.029 (0.17) [0.0-1.0]	0.035 (0.18)	0.026 (0.16)	0.026 (0.16)
East Europe	0.031 (0.17) [0.0-1.0]	0.049 (0.22)	0.019 (0.14)	0.019 (0.14)
Maghreb	0.045 (0.21) [0.0-1.0]	0.078 (0.27)	0.023 (0.15)	0.023 (0.15)
North America	0.003 (0.06) [0.0-1.0]	0.004 (0.06)	0.003 (0.05)	0.003 (0.05)
South America	0.064 (0.25) [0.0-1.0]	0.080 (0.27)	0.054 (0.23)	0.055 (0.23)
Central/Caribbean America	0.019 (0.14) [0.0-1.0]	0.026 (0.16)	0.015 (0.12)	0.016 (0.12)
East Asia	0.009 (0.09) [0.0-1.0]	0.011 (0.11)	0.007 (0.08)	0.007 (0.08)
South-East Asia & Oceania	0.002 (0.05) [0.0-1.0]	0.003 (0.05)	0.002 (0.05)	0.002 (0.05)
South-Asia	0.017 (0.13) [0.0-1.0]	0.030 (0.17)	0.009 (0.10)	0.010 (0.10)
Central-West Asia	0.013 (0.11) [0.0-1.0]	0.026 (0.16)	0.004 (0.07)	0.005 (0.07)
Middle East	0.003 (0.06) [0.0-1.0]	0.005 (0.07)	0.002 (0.05)	0.002 (0.05)
East/Central/South Africa	0.001 (0.04) [0.0-1.0]	0.002 (0.05)	0.001 (0.03)	0.001 (0.03)
Not identified	0.040 (0.20) [0.0-1.0]	0.083 (0.28)	0.012 (0.11)	0.013 (0.11)

Note: Values are reported as means, with standard deviations in parentheses. GMA represents comorbidity status through "Grupos de Morbilidad Ajustados". Drug copayment level refers to the TSI classification based on income brackets established by the Spanish National Health System. Delegated access refers to MyHealth access performed by a proxy user (e.g., a parent or caregiver) on behalf of the patient. Nationality categories are defined using geographical groupings based on country of origin.

incorporating time interactions. These produced qualitatively similar results, suggesting that the main conclusions are not sensitive to potential time-varying effects. This supports the appropriateness of the Cox model for our analysis. Moreover, our specification focused solely on baseline covariates, omitting time-varying ones, a limitation that is now explicitly acknowledged in the manuscript. Hazard ratios should therefore be interpreted as reflecting differences in the risk of disengagement over time attributable to baseline characteristics.

$$h(t / X) = h_0(t) \cdot \exp\left(\beta_1 X_1 + \beta_2 X_2 + \ldots + \beta_p X_p\right) \quad (2)$$

where $h(t|X)$ is the hazard at time t for a user with covariates X, $h_0(t)$ is the baseline hazard function, representing the hazard when all covariates are zero, $X_1, X_2, \ldots, X_p$ are the covariates (e.g., age, gender, copayment level). The βs are the coefficients representing the effect of each covariate on the hazard.

The Cox model quantifies how demographic and socioeconomic factors influence MyHealth retention, revealing which groups are more likely to continue using the platform. Combined with Kaplan-Meier estimates, this approach allows us to (i) track usage over time, (ii) identify key predictors of retention or dropout, and (iii) compare patterns across groups. The model estimates differences in time-to-disengagement across baseline covariates, capturing differential retention patterns without requiring time-varying predictors. We define disengagement as the first full quarter without any digital activity on MyHealth following initial adoption, provided it is not followed by re-engagement. Time-at-risk begins with the first recorded use of the platform and ends with disengagement or censorship. Individuals who remained active through the final quarter of observation (Q4 2023), or who re-engaged after a temporary lapse, were treated as right censored.

We employed microeconometric analysis to examine the determinants of MyHealth usage, controlling for all covariates simultaneously. This comprehensive approach, as specified in Eq. (3), enables us to identify the key factors influencing the adoption of digital health access.

$$y_i = \alpha_0 + z'_i \varphi + \alpha_i \quad (3)$$

Our adoption of the digital health access Eq. (3) features utilisation (y) as the dependent variable across individuals (i = 1,…n), with a random error term capturing unobserved individual characteristics. Although the dependent variable is binary, we estimate the adoption equation using a linear probability model (OLS), which facilitates coefficient interpretation and is commonly used in large administrative datasets. As a robustness check, we also estimated logit models; the results are qualitatively similar in terms of sign, magnitude, and statistical significance. The corresponding logit estimates are reported in the Appendix (Table A1).

We analyse three main dependent variables derived from MyHealth usage records. The first outcome is MyHealth adoption, defined as a binary indicator equal to 1 if an individual accessed the MyHealth platform at least once during the study period and 0 otherwise. The second outcome, sustained use, is analysed through time-to-disengagement in the survival models, where disengagement is defined as the first full quarter without any MyHealth activity following initial adoption. The third outcome captures digital health utilisation and refers to observed MyHealth activity, including access to eConsulta and eDocuments, as reported in Table 1.

The following covariates are included in Eq. (3). Sex is a binary indicator equal to one for women and zero for men. Age is included as a categorical variable using the following age groups: 18–30, 30–40, 40–50, 50–60, 60–70, 70–80, and 80+. Nationality is captured through a set of categorical indicators distinguishing Spanish nationals from major groups of foreign origin. Socioeconomic position is proxied using pharmacy copayment levels, defined as categorical indicators corresponding to the official copayment brackets established by the Spanish National Health System. Following previous studies using Spanish administrative health data [16], pharmacy copayment categories have been used to capture socioeconomic differences in healthcare and pharmaceutical utilisation. Health status is measured as the maximum level of comorbidity observed over the study period, according to the GMA classification. Municipality fixed effects are included to account for unobserved area-level heterogeneity, and standard errors are clustered at the ABS level.

Next, we examine socioeconomic and geographic gradients in MyHealth utilisation using concentration indices. These indices assess whether digital health use is disproportionately concentrated along a socioeconomic gradient, with socioeconomic position proxied by pharmacy copayment levels. Following [17], the concentration index is computed as the covariance between MyHealth usage and the fractional rank of individuals based on this socioeconomic proxy.

Because MyHealth usage is measured as a binary outcome, standard concentration indices are not directly comparable. We therefore apply the Erreygers correction [18], which adjusts for the bounded nature of binary variables and satisfies the mirror property. As a robustness check, we also compute concentration indices using the alternative formulation proposed by [19], obtaining results that are qualitatively similar.

Concentration indices are estimated annually from 2015 to 2023 to capture the evolution of socioeconomic gradients in digital health use. In addition to overall estimates, indices are computed separately for selected demographic subgroups (sex, age groups, and nationality) to explore heterogeneity in these gradients. Sensitivity analyses using alternative weighting parameters are reported in the Results section.

Results

Descriptive statistics of myhealth usage

Table 1 summarises the population’s average characteristics and highlights differences between MyHealth users and non-users. Users were more likely to be female (52.1 %) and, on average, older than non-users (49.2 years versus 41.3). The data also focus on consultations conducted directly by patients, excluding those conducted via delegated access. These findings highlight the role of age and sex in shaping MyHealth usage patterns, while subsequent sections examine other demographic and contextual factors.

User engagement with MyHealth fluctuated substantially throughout the study period. As illustrated in Figure A1 in the Appendix, usage rose gradually until a sharp peak in 2020, coinciding with the onset of the COVID-19 pandemic. The number of patient-initiated consultations tripled between early 2019 and late 2020, with the highest activity recorded in September 2020.

To better understand patterns of digital health adoption, Figures A2 and A3 in the Appendix present heat maps of MyHealth and eConsulta usage by demographic and geographic characteristics. Fig. 2A indicates that usage was highest among individuals aged 50–70, particularly among women, who consistently recorded higher activity rates than men across all age groups. Engagement peaked among those with a 50 % co-payment level, generally associated with higher-income individuals, although the pattern was not strictly monotonic: in 2021, users with a 60 % co-payment level recorded the highest MyHealth usage, while in 2023, individuals with a 10 % co-payment level ranked second in eConsulta activity. Notably, the age group with the highest MyHealth engagement shifted from 50 to 60 in 2021 to 60–70 in 2023. Figure A3 shows that eConsulta usage, while lower overall, peaked among users aged 40–60 and declined following the pandemic. Women, Spanish nationals, and individuals from other European countries displayed higher uptake, especially in urban areas such as Barcelona and Camp de Tarragona.

In contrast, older adults, individuals from Central and Western Asia, and rural residents exhibited significantly lower engagement with MyHealth. Figure A4 explores how MyHealth usage relates to primary care utilisation. Before the COVID-19 pandemic, users had fewer visits to general practitioners and specialists compared to non-users. However, after the pandemic, this pattern reversed: MyHealth users registered more visits to both types of care. Figure A4.a shows how eConsulta usage varied across demographic groups, while A4.b depicts its temporal evolution.

Survival analysis

Kaplan-Meier curves illustrate the probability of continued MyHealth usage over time (see Fig. 1). Starting at 1 (100 %), the declining curves indicate user attrition over time. For instance, if the women's curve shows 0.8 and the men's 0.7 in quarter four, 80 % of women and 70 % of men remain active users. Similarly, for age groups, if at quarter six, the curves show 0.9 for ages 20–30, 0.85 for 30–40, and 0.8 for 40–50, this indicates higher retention rates among younger users. These curves facilitate a direct comparison of MyHealth retention patterns across demographic groups. Table 2 presents hazard ratios illustrating user retention patterns, with ratios above 1 indicating higher continued usage compared to the reference groups. The reference age category differs by specification, as indicated in the notes to Table 2. A hazard ratio below 1 indicates a lower instantaneous risk of disengaging, i.e., longer expected retention, for a given subgroup. Women exhibited stronger retention than men, with a 20 % higher retention rate among adults. Additionally, individuals with drug copayments (particularly 50–60 %) showed higher sustained usage compared to those exempted. In the adult population, hazard ratios indicate a 41–47 % higher likelihood of continued usage for the 50 % and 60 % copayment groups. All non-Spanish nationals exhibited lower retention rates than Spanish users, with individuals from other European countries showing the smallest differences. Lower retention was observed among users from Latin America, North Africa, and South and East Asia, consistent with the patterns reported in Table 2.

Fig. 1 visualises these patterns across gender and age groups. Elderly segments of the population used less than younger adults. These results were confirmed after using only the adult and non-delegated populations. Specifically, for non-delegated access, individuals aged 70–80 and those aged 80+ had 12 % and 28 % lower likelihood of accessing MyHealth, respectively.

Our results indicated higher use among women across all populations. Furthermore, higher copayment levels were associated with greater use of MyHealth and eConsulta. We confirmed that individuals from all nationalities used less than Spanish individuals. Age correlated positively with usage; however, we observed the opposite trend when restricted to the adult population, except for eDocuments utilisation. Finally, the higher the comorbidity, the greater the utilisation, irrespective of the population. Table 3 presents our findings across multiple specifications: columns (1–3) examine MyHealth use, eConsulta (only consultations are required), and eDocuments (only documentation is needed), respectively, for the entire population; column (4) focuses on

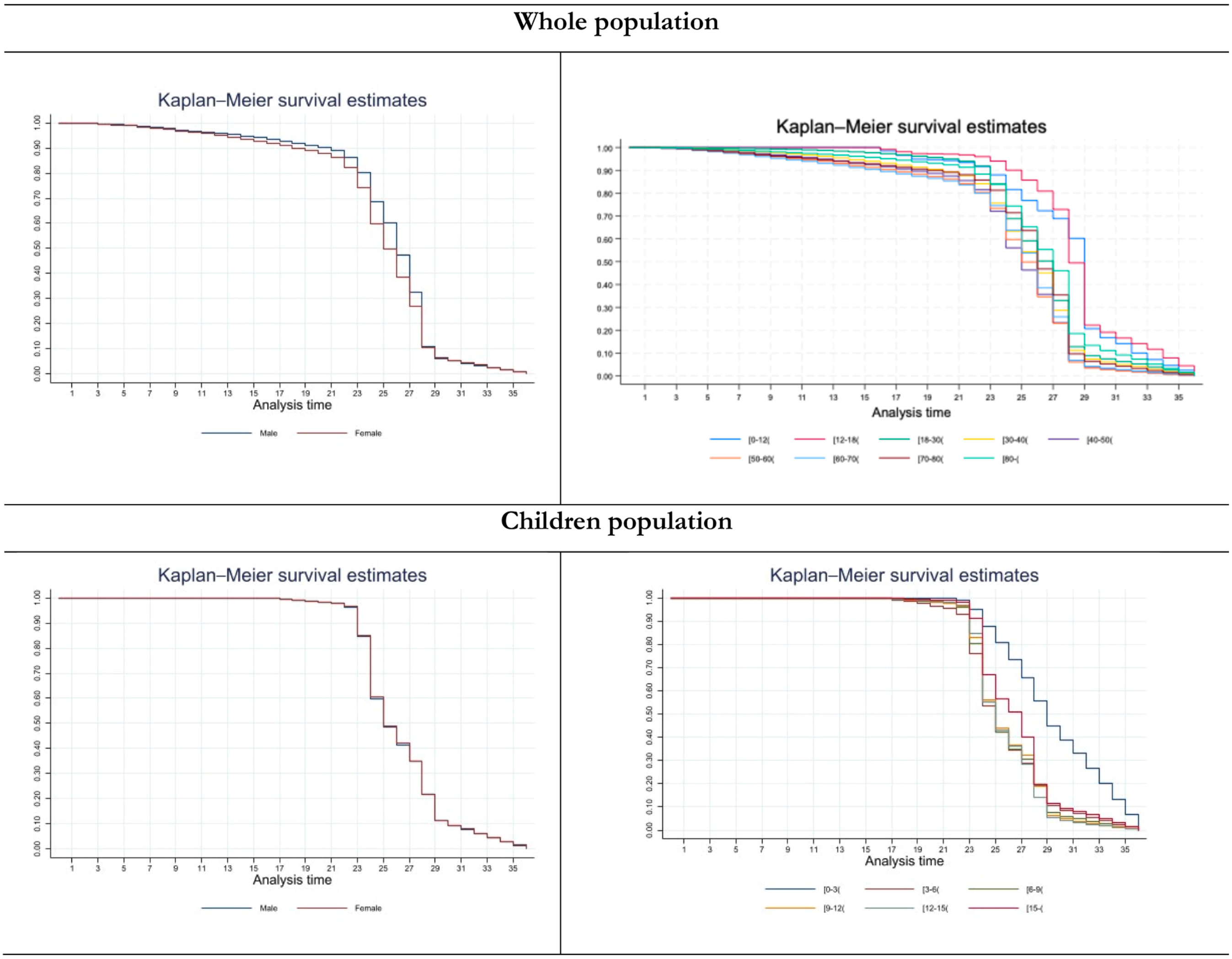

Fig. 1. Survival graphs for sex and age boundaries: access to MyHealth.
Note: Kaplan-Meier survival curves showing time to first use of the MyHealth platform, stratified by sociodemographic variables. Periods correspond to calendar quarters. Observations are censored at the end of follow-up or death.

adult users; and columns (5–6) specifically analyse non-delegated usage among adults. Our results indicated higher use among women across all populations. Additionally, higher copayments were associated with greater use of MyHealth and eConsulta. We confirmed that individuals of all nationalities used less than Spanish individuals. Age correlated positively with usage; however, we observed the opposite trend when restricted to the adult population, except for eDocuments utilisation. Finally, the higher the comorbidity, the greater the utilisation, irrespective of the population.

Inequities in the utilisation of this digital health platform

The concentration indices, illustrated in Fig. 2, highlight the evolving trends in inequality. The baseline index of 0.087 increased steadily, reaching a peak of 0.150 in 2022 before decreasing to 0.077 in 2023. We have added 95 % confidence intervals for all concentration indices. Although we do not conduct formal statistical tests across years, the reported confidence intervals provide information on the precision of the estimates over time. The estimated concentration indices suggest a moderate but consistent pro-rich gradient in digital health usage. The Wagstaff index produced a marginally higher value of 0.105. Further analyses employing weighted indices (β=1.5 and β=5) provided additional insights: higher β values, which emphasise income distribution extremes, yielded an index of 0.104, whereas lower β values, which focus on middle-income groups, yielded an index of 0.063. In addition to the overall concentration indices, we estimate indices separately for key demographic subgroups (e.g., age, sex, and country of origin) to explore heterogeneity in socioeconomic gradients, without aiming to explain the underlying sources of inequality. Within each subgroup, individuals are ranked by the same socioeconomic proxy (pharmacy copayment level), so the resulting indices capture socioeconomic inequality in digital health use within each group rather than differences across groups.

Fig. 3 shows concentration indices across rural deciles using the RULA indicator. Results reveal a positive correlation between MyHealth usage and both income and population density—less rural municipalities (higher population density) and wealthier ones exhibit higher levels of MyHealth adoption.

Discussion and conclusions

This study provides empirical evidence that digital health platforms can simultaneously broaden access and reinforce existing inequalities within a universal healthcare system. Specifically, we find rapid expansion in MyHealth adoption during the COVID-19 period and higher uptake among women and individuals with greater healthcare needs, alongside persistently higher adoption, retention, and usage

Table 2
Cox parallel hazards ratios (HR) estimation results: access to MyHealth.

	Whole population	Adult population	Adult population non-delegated
Individual is a woman	1.187 (0.001)***	1.199 (0.001)***	1.150 (0.001)***
Age boundaries			
[12-18)	0.940 (0.003)***		
[18-30)	1.749 (0.005)***		
[30-40)	2.140 (0.006)***	1.226 (0.002)***	1.163 (0.002)***
[40-50)	2.355 (0.007)***	1.341 (0.002)***	1.202 (0.002)***
[50-60)	2.212 (0.006)***	1.257 (0.002)***	1.214 (0.002)***
[60-70)	1.959 (0.006)***	1.114 (0.002)***	1.123 (0.002)***
[70-80)	1.539 (0.005)***	0.878 (0.002)***	0.883 (0.002)***
[80-)	1.244 (0.004)***	0.713 (0.002)***	0.716 (0.002)***
Drug copayment level			
10% copayment	1.545 (0.043)***	1.556 (0.042)***	1.569 (0.043)***
40% copayment	1.158 (0.003)***	1.159 (0.003)***	1.163 (0.003)***
50% copayment	1.447 (0.003)***	1.468 (0.003)***	1.460 (0.003)***
60% copayment	1.410 (0.006)***	1.414 (0.006)***	1.414 (0.006)***
Mutual	1.275 (0.004)***	1.278 (0.004)***	1.279 (0.004)***
Monthly limit Pharmacy			
Up to 8.23	0.774 (0.021)***	0.772 (0.021)***	0.773 (0.021)***
Up to 18.52	0.954 (0.026)*	0.952 (0.026)*	0.948 (0.026)*
Up to 61.75	1.196 (0.014)***	1.192 (0.014)***	1.201 (0.014)***
Nationality			
Maghreb	0.742 (0.002)***	0.746 (0.002)***	0.760 (0.002)***
South America	0.635 (0.002)***	0.637 (0.002)***	0.643 (0.002)***
East Europe	0.615 (0.001)***	0.614 (0.001)***	0.615 (0.001)***
Europe	0.647 (0.004)***	0.651 (0.004)***	0.665 (0.005)***
East Asia	0.598 (0.001)***	0.601 (0.001)***	0.608 (0.001)***
South-Asia	0.558 (0.001)***	0.558 (0.001)***	0.570 (0.001)***
Central-West Asia	0.584 (0.002)***	0.574 (0.002)***	0.577 (0.002)***
Central/Caribbean America	0.609 (0.003)***	0.606 (0.003)***	0.619 (0.004)***
Middle East	0.556 (0.002)***	0.559 (0.002)***	0.569 (0.002)***
North America	0.566 (0.002)***	0.566 (0.002)***	0.573 (0.002)***
South-East Asia & Oceania	0.586 (0.004)***	0.588 (0.004)***	0.593 (0.004)***
East/Central/South Africa	0.577 (0.007)***	0.579 (0.007)***	0.586 (0.007)***
Not identified	0.858 (0.002)***	0.820 (0.004)***	0.825 (0.004)***
N (Individuals*quarters)	140181288	135,094,646	134,806,633
Log-likelihood ratio	-82,608,243	-79,273,440	-74,928,548
LR chi2	659,362.43 (0.00)	569,941.73 (0.00)	486,199.86 (0.00)

Note: Robust standard errors. Municipality fixed effects are included in all specifications but are not reported in the table for brevity. Age is included as a categorical variable. The reference age group is 0–17 in the full-sample specification and 18–30 in the adult-only specifications. Sex is coded with men as the reference category. Nationality uses the Spanish nationality as the reference group. Drug copayment level refers to the TSI classification based on income brackets established by the Spanish National Health System, with copayment-exempt individuals as the reference category. GMA represents comorbidity status through "Grupos de Morbilidad Ajustados", with the lowest morbidity group as the reference category. Significance levels: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

among individuals with higher copayment levels, Spanish nationality, and residents of less rural areas.

The rapid expansion of the MyHealth platform during the COVID-19 pandemic increased population coverage, yet access and retention remain deeply unequal. This surge likely reflects both immediate responses to the initial lockdowns and the broader reorganisation of healthcare delivery. Although the peak occurred after the initial wave, sustained public health concerns, digital transformation policies, and the reopening of schools may have jointly driven the spike. This pattern confirms that external shocks, such as pandemics, can accelerate the adoption of digital health tools, even beyond the strictest phases of crisis response. The sharp increase at the end of 2020 coincides with several events: the intensification of the pandemic, the roll-out of the COVID-19 vaccination campaign, and the introduction of professional-initiated messages. Additionally, the platform's use for administrative purposes, such as requesting travel certificates, may have further contributed to this uptick in activity.

Our findings confirm and extend prior research documenting digital divides in patient portal use across Europe [5,8], leveraging longitudinal administrative data to track real-world engagement over time and quantify inequality using retention metrics and concentration indices. Consistently, women, wealthier individuals, and Spanish nationals are more likely to adopt and retain MyHealth use, while older adults, migrants, and rural residents remain underrepresented. These disparities persisted before, during, and after the COVID-19 pandemic reached its peak. While the primary aim of this study was to characterise patterns of adoption and sustained use, our results also provide indirect insights into how digital engagement may interact with traditional healthcare demand. We refine our understanding of user behaviour observed in the initial descriptive statistics by applying survival analysis techniques. This approach provides a more nuanced view of how demographic factors influence adoption and sustained engagement with MyHealth over time. These insights are crucial for evaluating the long-term effectiveness of digital health interventions and informing strategies to enhance user retention across diverse population segments. Notably, we observe that MyHealth users initially had fewer GP and specialist visits than non-users, but this trend reversed after the COVID-19 pandemic, suggesting that digital adoption may have facilitated more active engagement with health services. This shift suggests that digital platform use does not inherently substitute in-person services; instead, it may reflect greater overall engagement with the health system. These findings are consistent with a complementary model in which digital tools facilitate or encourage contact, particularly during times of heightened health concerns. However, without a formal causal design, we cannot conclusively determine whether digital access increases or accompanies changes in demand. Further research using

Table 3
OLS estimation for the utilisation of MyHealth.

	(1) MyHealth utilisation	(2) eConsulta utilisation	(3) eDocuments utilisation	(4) MyHealth utilisation for adult population	(5) eConsulta utilisation for adult population and non-delegated	(6) eDocuments utilisation for adult population and non-delegated
Individual is a woman	0.025 (0.001)*	0.066 (0.001)*	0.051 (0.001)*	0.038 (0.001)***	0.066 (0.001)***	0.050 (0.001)***
Individual age	0.006 (0.000)*	0.004 (0.000)*	0.003 (0.000)*	-0.003 (0.000)***	-0.003 (0.000)***	0.003 (0.000)***
Individual passed away	-0.661 (0.002)*	-0.469 (0.004)*	-0.283 (0.003)*	-0.558 (0.003)***	-0.115 (0.002)***	-0.018 (0.002)***
Max level of GMA (comorbidity)	0.001 (0.000)*	0.002 (0.000)*	0.001 (0.000)*	0.002 (0.000)***	0.002 (0.000)***	0.001 (0.000)***
Drug copayment level (ref. exempted)						
10% copayment	-0.342 (0.008)*	-0.239 (0.007)*	-0.141 (0.005)*	-0.077 (0.007)***	0.020 (0.016)	0.075 (0.014)***
40% copayment	0.162 (0.003)*	0.165 (0.003)*	0.123 (0.002)*	0.136 (0.003)***	0.091 (0.002)***	0.071 (0.002)***
50% copayment	0.231 (0.004)*	0.239 (0.003)*	0.203 (0.003)*	0.254 (0.004)***	0.151 (0.002)***	0.160 (0.002)***
60% copayment	0.220 (0.005)*	0.176 (0.005)*	0.167 (0.004)*	0.255 (0.005)***	0.084 (0.005)***	0.137 (0.005)***
Mutual	0.137 (0.004)*	0.092 (0.004)*	0.128 (0.003)*	0.154 (0.004)***	0.035 (0.003)***	0.140 (0.003)***
Monthly limit Pharmacy (ref. no limit)						
Up to 8.23	0.183 (0.007)*	0.085 (0.006)*	0.032 (0.005)*	0.060 (0.007)***	-0.026 (0.016)*	-0.052 (0.014)***
Up to 18.52	0.300 (0.007)*	0.188 (0.007)*	0.103 (0.005)*	0.188 (0.007)***	0.041 (0.016)**	0.012 (0.014)
Up to 61.75	-0.160 (0.006)*	-0.152 (0.007)*	-0.148 (0.005)*	-0.028 (0.006)***	0.001 (0.008)	-0.024 (0.007)***
Nationality (ref. Spanish)						
Europe	-0.175 (0.004)*	-0.119 (0.003)*	-0.079 (0.002)*	-0.236 (0.003)***	-0.004 (0.002)*	-0.011 (0.003)***
East Europe	-0.306 (0.004)*	-0.245 (0.003)*	-0.177 (0.002)*	-0.368 (0.004)***	-0.106 (0.002)***	-0.115 (0.003)***
Maghreb	-0.332 (0.003)*	-0.276 (0.002)*	-0.211 (0.002)*	-0.406 (0.004)***	-0.183 (0.003)***	-0.222 (0.002)***
North America	-0.198 (0.006)*	-0.168 (0.004)*	-0.101 (0.003)*	-0.257 (0.005)***	-0.068 (0.005)***	-0.024 (0.005)***
South America	-0.195 (0.003)*	-0.179 (0.002)*	-0.166 (0.002)*	-0.266 (0.003)***	-0.104 (0.003)***	-0.163 (0.002)***
Central/Caribbean America	-0.207 (0.003)*	-0.212 (0.002)*	-0.204 (0.002)*	-0.296 (0.004)***	-0.163 (0.003)***	-0.237 (0.003)***
East Asia	-0.216 (0.005)*	-0.297 (0.004)*	-0.219 (0.002)*	-0.248 (0.005)***	-0.319 (0.004)***	-0.245 (0.004)***
South-East Asia & Oceania	-0.146 (0.006)*	-0.207 (0.006)*	-0.186 (0.007)*	-0.196 (0.009)***	-0.202 (0.010)***	-0.210 (0.013)***
South-Asia	-0.341 (0.006)*	-0.303 (0.006)*	-0.236 (0.005)*	-0.433 (0.007)***	-0.222 (0.006)***	-0.267 (0.007)***
Central-West Asia	-0.434 (0.006)*	-0.342 (0.004)*	-0.244 (0.003)*	-0.549 (0.006)***	-0.253 (0.005)***	-0.260 (0.004)***
Middle East	-0.321 (0.006)*	-0.269 (0.005)*	-0.202 (0.004)*	-0.380 (0.007)***	-0.136 (0.005)***	-0.157 (0.006)***
East/Central/South Africa	-0.356 (0.007)*	-0.293 (0.006)*	-0.214 (0.004)*	-0.466 (0.007)***	-0.156 (0.010)***	-0.174 (0.009)***
Not identified	-0.378 (0.003)*	-0.336 (0.003)*	-0.219 (0.002)*	-0.235 (0.005)***	-0.083 (0.004)***	-0.079 (0.004)***
N	9,459,051	9,459,051	9,459,051	7,984,152	4,915,803	4,488,278
R2	0.2472	0.1704	0.1130	0.2617	0.0511	0.0447

Note: We report coefficients and standard deviations. Significance levels: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$. Age is included as a categorical variable, with 18–30 as the reference age group. Sex is coded with men as the reference category. Nationality uses the Spanish nationality as the reference group. Drug copayment level refers to the TSI classification based on income brackets established by the Spanish National Health System, with copayment-exempt individuals as the reference category. GMA represents comorbidity status through "Grupos de Morbilidad Ajustados", with the lowest morbidity group as the reference category.

quasi-experimental or longitudinal causal methods would be needed to more precisely evaluate substitution versus complementarity effects. Our concentration indices results highlight the need for targeted strategies to reduce digital exclusion among socioeconomically disadvantaged groups. These concentration magnitudes are in line with, or slightly higher than, values observed in previous studies of health service use in high-income settings, including specialist consultations or diagnostic procedures.

Finally, it is essential to acknowledge that the digital platform evolved over the study period, with eConsulta being progressively integrated into the MyHealth app. Improvements in first-time registration and easier access mechanisms have facilitated increased uptake, independently of user characteristics or policy changes. Although our analyses focused on patterns of adoption and usage among specific population groups, future research should more systematically assess how technological improvements and user interface changes may influence digital health inequalities.

A key limitation of our analysis relates to the use of drug copayment levels as a proxy for socioeconomic status. While this measure is officially determined and widely used in the Spanish healthcare system, it relies on broad income brackets, which may obscure finer gradients of socioeconomic variation. In particular, very few individuals fall into the highest copayment categories, which may inflate observed differences or generate a statistical association that overstates the proper socioeconomic gradient. In fact, eligibility for reduced or zero copayment depends not only on income thresholds but also on specific entitlements (e.g. disability, pensioner status, or chronic illness), meaning that copayment categories do not map perfectly onto economic disadvantage. In addition, the "Mutual" category refers to civil servants covered by separate insurance schemes and does not reflect income. This potential artefact should be considered when interpreting the strength and shape of observed inequalities. Future studies with access to granular income data would allow a more precise characterisation of these disparities. Another significant limitation is the lack of population-level measures of digital literacy. Although we observe persistent inequalities in platform use by age, nationality, and income proxies, we cannot determine to what extent differences in digital competence drive these patterns. Digital literacy is a crucial determinant of the ability to navigate health technologies, and its omission constitutes an unmeasured confounder in our analysis. Without direct indicators, we may be underestimating or misattributing part of the observed disparities. Future studies integrating digital skill assessments or proxies from other administrative sources could help disentangle these effects more precisely. Finally, a key limitation of our survival analysis is that it only accounts for baseline covariates. We do not include time-varying covariates, which may capture dynamic changes in user behaviour or health status. Future work could explore models that incorporate these dynamics to refine our understanding of sustained digital engagement.

While differences in usage across demographic groups are apparent, these patterns may reflect underlying systemic factors, such as economic

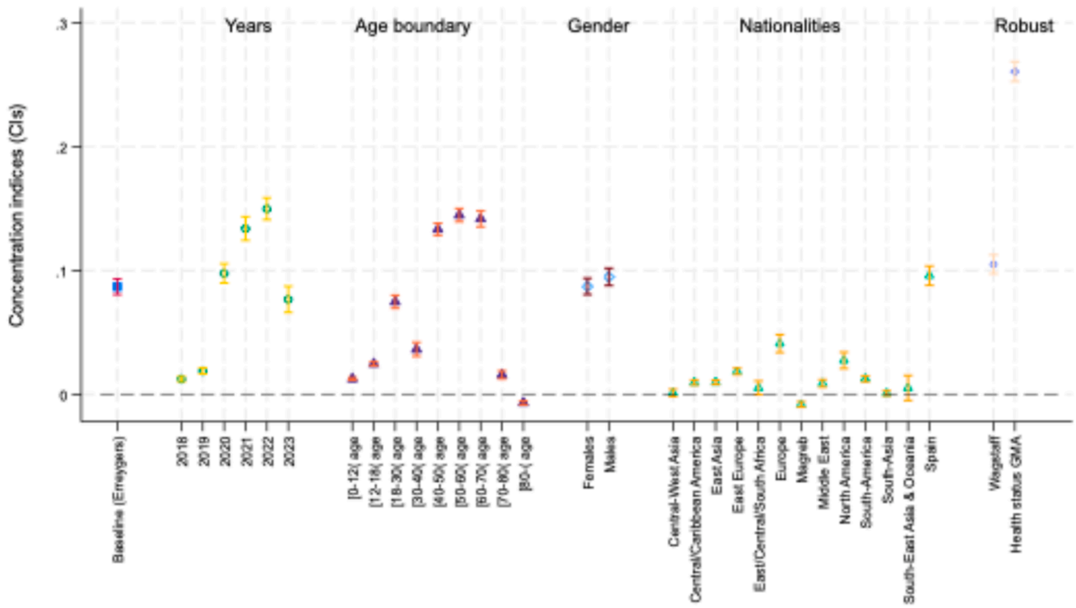

Fig. 2. Concentration indexes for MyHealth utilisation.
Note: Concentration indices calculated using the Erreygers-corrected method. Socioeconomic status is proxied using income deciles based on TSI levels, and rurality is measured using deciles of the RULA index. Detailed descriptions of the variables are provided in the Data section.

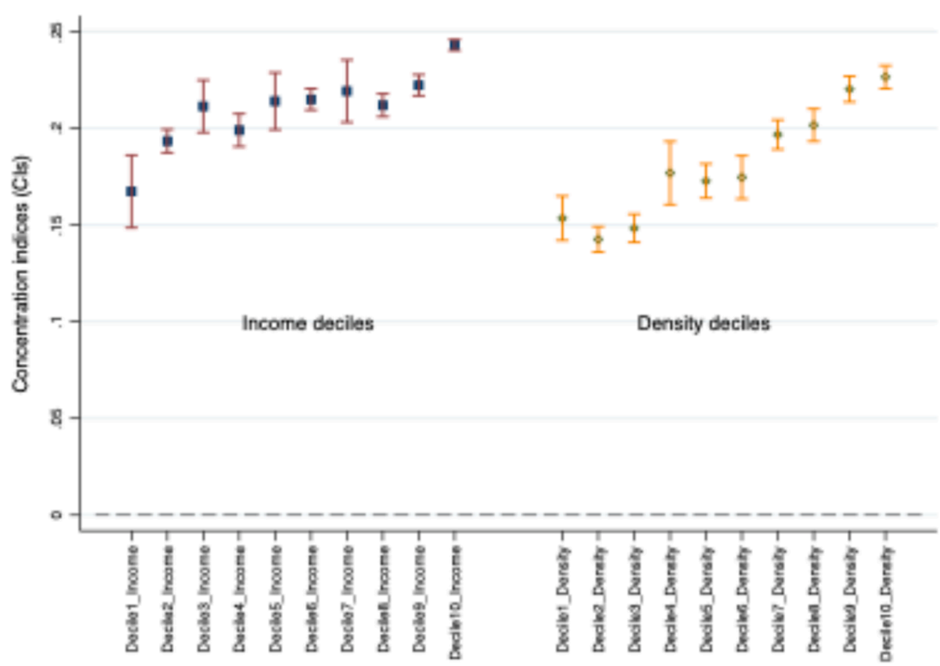

Fig. 3. Concentration index based on population density and income deciles at the municipality level for MyHealth utilisation.
Note: Deciles of income and rurality were constructed based on individual-level data. The methodology for constructing these deciles is detailed in the Data section.

insecurity, immigration status, or access barriers, rather than individual preferences alone. In addition, the evolution of the MyHealth platform, including the integration of eConsulta and the gradual improvements in registration and access procedures, likely contributed to increased uptake over time, particularly among groups that initially faced access barriers. However, further research is needed to disentangle these mechanisms more robustly. Framing digital exclusion purely as a "digital literacy" issue risks individualising what are, in reality, collective and structural barriers. This raises important questions about the governance of digital health systems: Who determines the functionalities of these platforms? Whose needs are prioritised in design? How is "successful" use defined and incentivised? Without equity-centred design and implementation, digital health risks entrench a two-tier system—one mediated by digital tools that may alienate marginalised communities.

Digital health platforms must therefore be understood as socio-technical systems embedded in broader social relations. Promoting equity requires more than technical infrastructure or outreach; it demands inclusive design, participatory governance, and critical attention to how social stratification is reproduced through technology. Policies must move beyond efficiency narratives to actively confront and reduce structural inequalities.

In summary, while MyHealth has become a central component of healthcare delivery in Catalonia, patterns of adoption, retention, and use remain uneven across socioeconomic, demographic, and geographic groups. Higher uptake and sustained use among individuals with higher copayment levels, Spanish nationality, and residents of less rural areas point to persistent socioeconomic gradients in digital health use. These findings indicate that the large-scale expansion of digital health platforms does not automatically translate into more equal patterns of engagement across the population. Future research may further explore how platform design and implementation features are associated with these observed inequalities.

Ethical statement

This study was conducted in accordance with ethical guidelines and received formal ethical approval from Universitat Internacional de Catalunya, under the ethical approval number **2023-IRAPP02**.

All procedures involving human participants, animals, or sensitive data were carried out in compliance with relevant ethical standards. Informed consent was obtained from all participants where required, and confidentiality/anonymity has been maintained throughout the research process.

Declaration of competing interest

None

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Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.hlpt.2026.101184.

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