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Access and inclusivity in health. The role of digitalization

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Abstract

This study investigates the impact of digitalization on health, particularly on reducing the existing gaps in accessing healthcare services. Focusing on the 2030 Sustainable Development Agenda, health targets are brought to the attention with a special view to divides among world regions. The impact of health barriers is clearly reflected in the gaps between rural and urban, young and elderly, as well as between high and low income populations. The value added of this paper consists in the employment of three regression models, integrating indicators related to digital skills with indicators referring to maternal mortality, sanitation access and life expectancy including data for the European Union member states for the most recent year. The results of the performed analysis confirm the validity of the two out of three regression models, indicating that digital skills of population have influence on life expectancy and use of sanitation, at the EU level. Therefore, the paper explores the relation between digital skills and public health outcomes, focusing on access to sanitation, maternal mortality, and life expectancy. The analysis reveals a statistically significant positive correlation between digital skills and access to sanitation, with basic or above basic digital skills improving access by 15.3%. The study identifies a significant association between digital skills and increased life expectancy, accounting for 30.4% of the variability. Despite this, factors such as infrastructure, affordability, and government policies remain crucial.

Keywords: *digital divide, health literacy, gaps, digitalization, inequalities, sustainable development goals*

I. INTRODUCTION

The study examines the importance of addressing the inequalities in people's access to healthcare services. In this context, the study aims to stress how digitalization brings a positive impact, diminishing the gaps, such as the ones related to the geographical area or to mobility restraints. The research approaches both qualitative and quantitative analyses, reflecting the problem of existing gaps in access to health, as well as the solution offered by digital technologies that improve health outcomes, especially for disadvantaged and marginalized populations.

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According to specialized literature and to past conducted analyses digitalization seems to be a catalyst for health. However, it was demonstrated that without digital literacy, the digital health cannot fulfil its potential for the population. Sustainable development Agenda represents an important aim for which all states make significant efforts. Global progress has been made in the last decade and European Union has undertaken significant action towards achieving the SDGs. While global health has improved overall in recent years, the pandemic corroborated with other large-scale issues such as climate change, war and financial crises pose significant threats to health security. Since 2020, poor and vulnerable regions over the world have shown reversals in Sustainable Development Goals (SDG) progress.

To address these challenges, there is need for a global governance mechanism that could bring policies and soft law instruments with high-level political commitments. Health diplomacy has a major role in addressing and filling the gaps created by the inaccessibility to essential health services and sanitation (Chattu, et al., 2023).

Although the United Nations member states are struggling to reduce the gaps and to strengthen inclusivity, to build the capacity of the less developed states, it is noteworthy that in some respects the gaps are deepening, including in terms of health. Technology and digitalization offer intelligent solutions, as well as new possibilities for people to improve their health.

Economic and social convergence among European Union member states is more important than ever in the context of increasing geopolitical tensions and current crises. The 'leave no one behind' principle call for increased partnerships while reducing inequalities across countries. It is necessary to address both types of inequalities, within and across countries, including the rise of energy and food prices that disproportionally affect the most vulnerable (Sustainable Development Solutions Network, 2024).

Finally, the research results after performing three regression models demonstrate the influence of digital skills on public health outcomes. The first (#1) model finds that improved digital skills are associated with increased life expectancy, accounting for 30.4% of the variability, with each additional unit of digital skills correlating to a 0.127-year increase in lifespan. The third model (#3) reveals a significant positive correlation between digital skills and access to sanitation, explaining 15.3% of the variability. The second model (#2) shows no direct effect of digital skills on maternal mortality, suggesting other factors are more influential. These findings, together with previous studies underscore the potential of enhancing digital skills to improve public health outcomes.

However, much work remains to be done to achieve Goal 3, with a number of priorities needed including achieving universal health coverage, strengthening health systems, investing in disease prevention and treatment, and addressing disparities in access to care and services, particularly for populations vulnerable.

II. LITERATURE REVIEW

A. Sustainable development Agenda and the global health

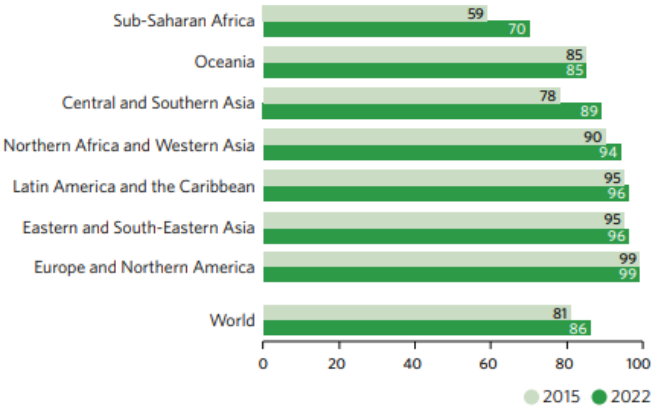
The Sustainable Development Goals adopted by United Nations in 2015 and aimed at 2030 provide a common agenda that can help humanity find a way out of current crises. The goals require integrated action that promote social and economic prosperity, environmental sustainability as well as global partnership (Sustainable Development Solutions Network, 2024). Progress on sustainable development is currently affected by wars, terrorism, financial crises and a continuous societal polarization.

SDG 3 of the 2030 Agenda for Sustainable Development is dedicated to health and calls for ensuring healthy lives and well-being for all at all ages, with associated targets that aim to reduce the maternal mortality ratio, end preventable deaths of newborns/children, end the epidemics of AIDS, tuberculosis, malaria and other communicable diseases, reduce mortality from non-communicable diseases, strengthen the prevention of substance abuse; reduce the number of deaths and injuries from road traffic accidents, hazardous chemicals and pollution, ensure universal access to sexual and reproductive healthcare services and achieve universal health coverage (United Nations, 2023).

In recent years there has been some progress on improving global health. AIDS-related deaths, as well as neglected tropical diseases have been diminished. Nevertheless, in other areas such as maternal mortality and universal health coverage the progress has been insufficient. Globally, pregnancy or childbirth deaths and extreme poverty due to out-of-pocket payments for health remain major issues (United Nations, 2023).

Looking at the assisted childbirth by skilled health personnel (figure 1), there can be seen an increase from 2015 to 2022, with a global coverage of 86 per cent in 2022. However, access remains limited in many countries, particularly in Sub-Saharan Africa and Southern Asia, where mortality rates are the highest.

Figure 1. Proportion of births attended by skilled health personnel, 2015 and 2022 (%)



There is also progress in the field of reproductive health, with decrease in the teenage birth rate and increase in access to contraception. Sub-Saharan Africa continues to face the highest rates of child mortality, with 74 deaths per 1,000 live births for children under 5. Meanwhile, more than 60 countries need to accelerate progress to meet the neonatal target. Regarding the under-5 mortality target, progress must be made in 54 countries, nearly 75 per cent of which are in Sub-Saharan Africa.

Current trends show that there is not enough progress to meet all the targets set in the Agenda. The COVID-19 has jeopardized progress in several targets regarding global health and well being, especially in terms of life expectancy. The pandemic caused large decline in childhood vaccinations and increase in tuberculosis and malaria deaths. The most alarming refer to the maternal mortality ratio which is stuck at a level well below the target, while 35 million children will not live to see their fifth birthday by 2030 (United Nations Statistics Division, 2024).

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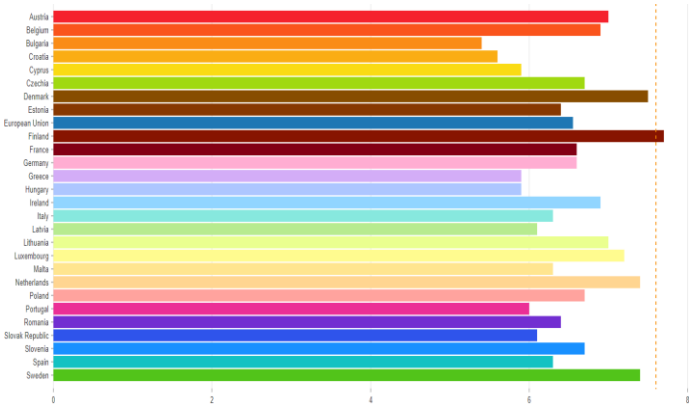
In the next figure (Figure 2) there can be seen the level of subjective wellbeing in European Union (2022). The indicator refers to the self-evaluation of life, where respondents are asked to evaluate where they feel they stand on a ladder, where 0 represents the worst possible life and 10 the best possible life. The long-term objective for this indicator is a value of 7.6, while EU average score was 6.55 in 2022. The highest wellbeing can be seen in Finland (7.7) and Denmark (7.5), while the lowest scores are in Bulgaria (5.4) and Croatia (5.6).

Figure 2. Subjective Wellbeing (average ladder score, worst 0–10 best, 2022)



Source: (Sustainable Development Solutions Network, 2024)

B. The problem of gaps. Access to health services

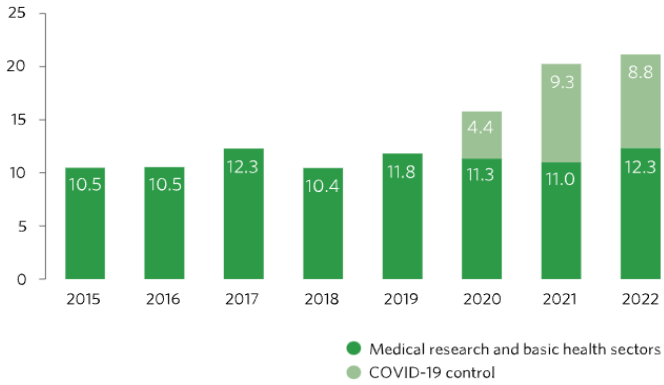
The underdeveloped regions still have the highest burden of disease and even at the national level, disparities persist between rural, remote and hard-to-reach areas compared to capitals and urban centres. Underserved population include individuals with low income, disabilities, language barrier, veterans, older adults of 60 years and older, racial/ethnic minorities and rural residents. A major issue is the socioeconomic divide across the same country. Even in high-income countries population groups may not have similar healthcare or digital services. People with internet access and socioeconomic advantages may have higher access to digital health services (Sultana, et al., 2021).

The most common gaps relate to rural communities and peripheral populations as they are cut off from geographical access to basic health services and specialised referrals, encountering issues as well regarding quality and costs, including from travelling. User charges or extra billing can generate additional barriers to access, especially for low-income groups, as it is the case for certain care, such as dental care and physiotherapy where user charges tend to be higher (Palm, et al., 2021).

Universal health coverage (UHC) aims to ensure quality access for all to health services without facing financial hardship. Financial hardship remains a significant challenge as the UHC Service Coverage Index reached a score of 68 in 2021 (United Nations, 2023). Therefore, increase public health funding and extend coverage for essential medicines, while removing co-payments for the poor are needed.

Total net official development assistance (ODA) for medical and health research has increased significantly in recent years. In 2022, COVID-19 control accounted for the largest share of ODA while other expenditures included infectious disease control, malaria control and basic healthcare. As a region, Sub-Saharan Africa received the largest volume and share of aid for basic health care.

Figure 3. Total ODA for medical research and basic health sectors, 2015-2022 (US dollars)



Source: (United Nations Statistics Division, 2024)

Access to health care plays a major role in improving the health of a population. As inequities in health access persist it is important to define what equity in access to health care means. Access can be defined as "the opportunity to identify health care needs, to seek health services, to be able to reach or to obtain or use health services and to actually have the need for services met." A study identified multiple dimensions of access: approachability, acceptability, availability, accommodation, affordability, and appropriateness (Jindal, et al., 2023).

In another research it was found that women who reported barriers to access health services had a statistically significant lower probability of using essential health services for themselves and their children. Moreover, the need to obtain permission to visit the doctor or not wanting to go alone to a health facility reduced the likelihood of undergoing prenatal checkups and having an assisted delivery (Houghton, et al., 2022). Not wanting to go to a health centre alone also reduced the likelihood of using modern contraceptives. In this context, if sustainable progress toward universal access is to be made sstrategies should focus on issues related to women's empowerment and not only on the range of services offered.

European Union developed a ‘leave no one behind’ index in order to measure inequalities within countries, including the evolution over time. From a global perspective, the EU is among the most equal region offering social protection and universal access to basic services. The index measures inequalities within countries and it is scored on a scale of 0 to 100, where higher scores represent better performance meaning less inequality (Sustainable Development Solutions Network, 2024).

Another important indicator that provides information regarding the income inequalities is represented by *the gap in self-reported unmet need for medical examination and care, by income.* This refers to the gap in percentage of people reporting unmet needs for medical care between the poorest 20% and the richest 20% of the population. A positive value means that people with low income report more unmet needs than people with high income. Reasons for unmet need include that medical care was too expensive, too far to travel or required a waiting list. Figure 3 shows that along EU countries the highest gaps are in Lithuania (46.7), Croatia (44.0) and Estonia (43.8), meaning these countries have the biggest differences between the rich and the poor. The countries with the smallest gaps are Italy (8.6) and Greece (9.0), while the EU average is 21.1.

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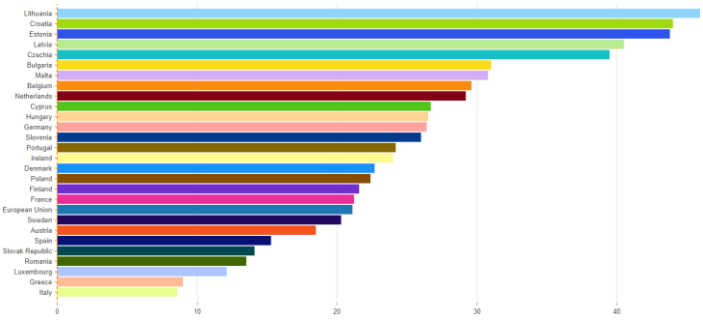
Figure 4. Gap in self-reported unmet need for medical examination and care, by income – 2022



Source: (Sustainable Development Solutions Network, 2024)

C. The role of digitalization in reducing gaps

The development of digital health technology has transformed the current medical practice. However, digital health should be well designed to improve health outcome among underserved communities and to not exacerbate the existing health disparities. Health Information Technologies (HIT) are holding great promises to address health disparity, making it crucial for researchers to identify and understand the gaps in equitable digital health in order to provide improved healthcare delivery in the underserved communities (Wu, et al., 2024).

In the field of public health, digital health technologies enhance the population well-being. For instance, amid the global crisis posed by the COVID-19 pandemic, medical services grounded in digital health technologies, such as remote appointment services, online consultations and examinations, remote imaging diagnostics or digital pharmaceutical prescriptions and sales (Ji, et al., 2024).

Digitalisation offer major opportunities to bridge the gaps, engaging decision-makers, service providers and users of digital services at different levels. An integrated approach is needed in order to address health challenges that may impact lives engaged at different phases of palliative care. Geographic constraints in availability and accessibility to both digital technologies and healthcare present as a major challenge (Sultana, et al., 2021).

The most recognized and best-utilized examples of HIT applications are the Telehealth, enabling the expansion of access to care particularly among patients residing in rural area and Electronic Health Records (EHR) which facilitate the exchange of information between healthcare facilities. Moreover, the progressive utilization of digital tools, mobile applications, wearable devices and mobile Health (mHealth) help in overcoming barriers and expanding digital health use among underserved population.

Leveraging EHRs may facilitate positive lifestyle change, for example, an admission order template can make a healthful diet order the default. Online platforms and mobile applications enhance as well the way physicians and other allied healthcare workers manage patient care. Morever, telehealth use for prevention has grown into programs such as nurse-led interventions to educate patients or home-based rehabilitation programs using heart rate telemonitoring and telecoaching.

Electronic alert reminders to physicians can improve statin titration in patients. In addition, some digital platforms allow patients to manage their diagnosis while still hospitalized and to transition to post-acute care at home, integrating a smartphone app with a smart watch and blood pressure monitor in order to provide patient medication tracking, vital signs and care coordination (Apple, et al., 2023).

As digital health has become more common, digital literacy and health literacy have become important determinants when it comes to digital health technologies and their usefulness. Digital literacy refers to "the ability to use information and communication technologies to find, evaluate, create, and communicate information, requiring both cognitive and technical skills". As health literacy is an important determinant of health, improving digital health literacy at the population level could reduce health inequalities and the digital divide (Yang, et al., 2022).

Many tools were developed to measure health literacy, allowing governments and health institutions to identify and respond to health literacy needs (Kaloyanova, et al., 2023):

- Health Education Impact Questionnaire is used for the evaluation of health education and self-management programs.
- Information and Support for Health Actions Questionnaire is used to identify specific health literacy strengths and limitations, being designed for cultures that often make decisions as a group.
- eHealth Literacy Questionnaire provides insight into users' perceptions and experiences of digital health solutions, helping people to understand why implementations work or fail.

Testing the influence of health literacy determinants, significant joint effect of age, gender, economic capacity to pay for medical examinations, education, and professional status was observed. There were higher levels of literacy in the younger age groups, males, in the ones with greater economic capacity or in people with higher levels of schooling (Arriaga, et al., 2022).

III. RESEARCH METHODOLOGY

This paper aims to examine the relation between digital skills, as a key asset in the digital health arena, and indicators related to health for the 27 EU states. Three regression models were conducted using SPSS software (26 version) in order to analyze the influence of digital skills towards life expectancy, maternal mortality and sanitation access. The data for variables refer to the most recent year available (varying from 2020 to 2023) and it was retrieved from Eurostat and World Bank.

The independent variable refers to individuals with basic or above basic overall digital skills and it is expressed as percentage of individuals (Eurostat, 2024).

The dependent variables are: (1) life expectancy at birth, expressed in number of years (World Bank, 2023); (2) maternal mortality ratio referring to the number of women who die from pregnancy-related causes while pregnant or within 42 days of pregnancy termination per 100,000 live births (World Bank, 2023); (3) people using safely managed sanitation services expressed as percentage of population (World Bank, 2024).

Given the proposed specifications, the hypotheses tested in this research are the following:

#1 The first hypothesis assumes that the increase in digital skills coverage leads to a longer lifespan for people in the EU.

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#2 The second hypothesis is affirming that the increase in digital skills coverage leads to a lower maternal mortality rate in EU countries.

#3 The third hypothesis assumes that the increase in digital skills coverage leads to an increase in access to adequate sanitation.

IV. RESULTS AND DISCUSSIONS

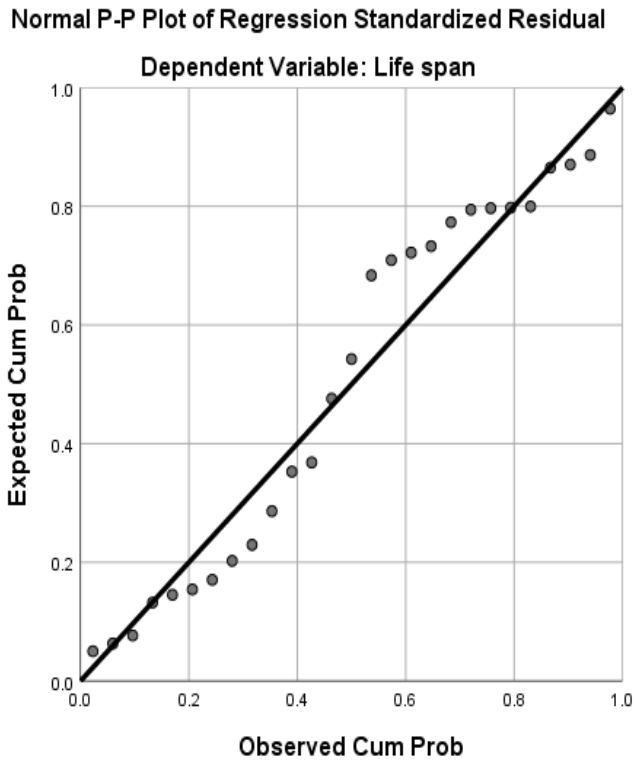
The variables included in the analysis are presented in the next table:

Nr crt.	Variables	Source
1	Digital skills	Eurostat
2	Life expectancy	World Bank
3	Maternal mortality	World Bank
4	Sanitation access	World Bank

Source: made by author based on research

The first regression model aims to test the first hypothesis (#1), which is confirmed by a 0.003 significance of the model. Therefore, the increase in digital skills coverage does lead to a longer lifespan for people in the EU. The correlation coefficient is 0.551, indicating a positive, moderate relationship between digital skills and life expectancy, while 30.4% of the variability in life expectancy can be explained by digital skills. The standard error of the estimate is 2.48, which indicates the average distance of the observed values from the regression line (Figure. 5).

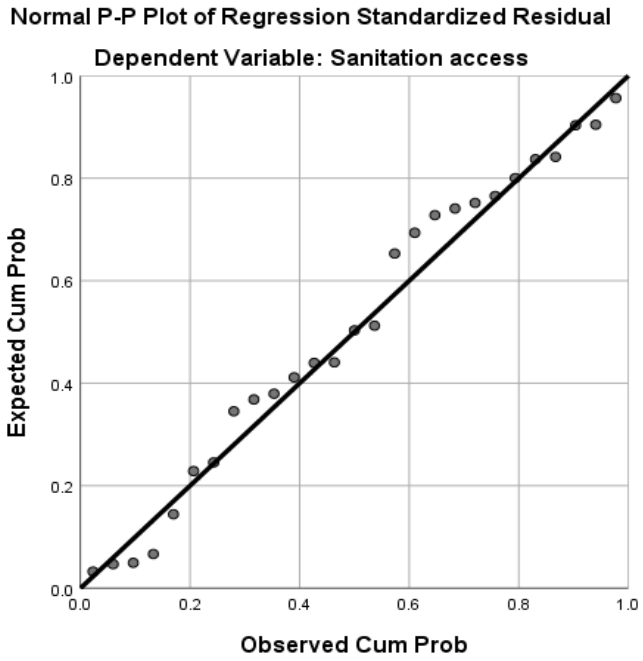
Figure. 5 Regression line and the observed values



Source: done by authors using SPSS v26

A second regression model was conducted in order to test the second hypothesis (#2). With a p-value of 0.141, the model is not statistically significant, therefore we reject the second hypothesis. This means that the increase in digital skills coverage does not lead to a lower number of maternal deaths. Results suggest that other factors not included in this model are likely to be more significant for maternal mortality ratio.

Figure. 6 Regression line and the observed values



Source: done by authors using SPSS v26

The third regression model is testing the third hypothesis (#3) of this analysis. The result obtained validates the hypothesis, thus indicating that there is a significant relationship between digital skills and access to sanitation. Nevertheless, the correlation coefficient is only 0.391, which indicates a weak positive relation between digital skills and access to sanitation, while only 15.3% of the variability in access to sanitation can be explained by the digital skills of the population. The standard error of the estimate is 6.915, which indicates the average distance of the observed values from the regression line (Figure. 6).

This analysis shows a statistically significant positive correlation between digital skills and access to sanitation, with basic or above basic digital skills leading to better access to sanitation. The model explains 15.3% of the variability in access to sanitation depending on digital skills, suggesting that while digital skills are important other factors also play a role. Studies mention that availability of physical infrastructure, affordability and government policies are among primary determinants of sanitation (Toilet Board Coalition, 2016).

Regarding the second regression model, there is no evidence that digital skills affect directly the maternal mortality, implying that other factors are more important in this area. In a study done for the World Bank Group it is mentioned that access to mobile phones improves health behaviors, such as increased uptake of insecticide-treated bednets against malaria and better sanitation practices (Mensah, et al., 2022). Indirectly, health knowledge, practices and care utilization can contribute to reducing maternal mortality.

Furthermore, results support the hypothesis that improving digital skills is associated with longer lifespan and explains 30.4% of the life expectancy at birth variability. Specifically, each additional

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unit of digital skills corresponds to an increase in life expectancy of about 0.127 years. In a study done by (Wilson-Menzfeld, et al., 2023) it is emphasized that digital skills training can enhance older adults' engagement with technology, leading to improved health behaviors and social connections, both of which are important for longevity. Also, another research mentions that older adults who engaged in digital skills training reported increased utilization of health services, which is associated with better health outcomes (Pihlainen, et al., 2023). Therefore, improving digital skills in the population could significantly improve public health outcomes, particularly in terms of sanitation and life expectancy.

CONCLUSIONS

Increased investment in health systems in order to overcome healthcare shortcomings and address long-standing challenges is needed as countries have to recover and build resilience against future health threats. As half of the world's population is not yet covered by essential health services, ensuring universal health coverage without financial burden is crucial to well-being. Therefore, innovative strategies together with sustained efforts are necessary in order to counter inequalities that jeopardize previous accomplishments.

In the future, digital health inclusion must evolve to narrow the gap in health disparities and reduce the disease burden. Nevertheless, when it comes to fostering equitable digital health and delivering quality healthcare the cost can be a barrier for both the providers and user, while ensuring broadband connectivity to support widespread adoption of digital health tools remains a challenge.

Digital literacy actions in the health domain are essential for disease prevention from a very young age. Mastering the use of digital health facilitates contributes to active involvement in one's own health and towards the development of attitudes, beliefs and behaviors that promote health.

Results of the performed analysis demonstrate a statistically significant positive correlation between digital skills and access to sanitation, indicating that individuals with basic or above basic digital skills tend to have better access to sanitation, however subject to the fact that other factors, such as physical infrastructure, affordability and government policies, also play significant roles. The second regression model shows no direct impact of digital skills on maternal mortality, highlighting the importance of other factors. However, a World Bank Group study indicates that mobile phone access improves health behaviors, indirectly contributing to reduced maternal mortality. Additionally, the results indicate that enhancing digital skills is associated with increased life expectancy, while previous studies support that digital skills improve health behaviors, social connections, and utilization of health services, particularly among the elderly, leading to better health outcomes.

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