

**DIGITAL HEALTH, DATA SOVEREIGNTY AND THE SDGs: A FRAMEWORK FOR SUSTAINABLE
PRACTICES WITH MOBILE HEALTHCARE APPLICATIONS**

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Abstract:

In an era where mobile technology permeates every aspect of people's lives, the question of who controls health data has become both urgent and essential. As of 2024, more than 100,000 health-related mobile apps are available in major app stores, and these applications generate large volumes of personal health data every day. In addition, cybersecurity threats have surged and the number of individuals impacted by healthcare data breaches nearly tripled from 14 million to 45 million between 2018 and 2021. Patients increasingly consider data privacy as a fundamental right and over ninety percent people believe that health app developers should be transparent, offer meaningful consent processes, and allow them to opt out of data usage or sharing. These trends expose a growing gap between the promise of mobile health and the realities of ethical and sustainable practice.

Recognizing this, global health leaders and national regulators are emphasizing the need for stronger governance. In 2024, the G20 health ministers affirmed that trusted, secure, interoperable digital health systems supported by regulatory frameworks that respect national context are essential for equitable healthcare and resilience. At the UN World Data Forum, participants called for a global health data governance framework rooted in rights-based, equitable principles, in order to unlock the public value of health data while protecting individuals' rights.

Meanwhile, India's Ayushman Bharat Digital Mission has significantly advanced sovereign digital health infrastructure and by early 2025, more than 739 million health IDs had been issued, linking approximately 490 million health records. The mission includes a Health Data Management Policy that embeds "privacy and security by design," consent frameworks, user control rights, and interoperability as core elements. Nonetheless, draft legislation such as DISHA remains pending, highlighting persistent challenges in implementing robust health data protection in practice. Beyond policy, emerging technological models like the Decentralized Health Intelligence Network (DHIN) offer promising alternatives. DHIN combines federated learning, personal health records, and blockchain incentives to ensure individuals retain control over their health data, benefit financially from participation, and safeguard AI development with decentralized safeguards.

Drawing on these dynamics, this paper proposes a comprehensive framework that aligns mobile health application design and deployment with three pillars: data sovereignty, ethical governance, and SDG-driven impact. It emphasizes clear role definitions (like data owner, data steward), codified consent and ownership rights, federated system architectures, and interoperability standards tailored to local contexts. It also explores how platforms can integrate mHealth apps into broader digital public infrastructure while preserving individual autonomy and privacy.

This study grounds its analysis in real-world data, lived experience, and ethical principles. It demonstrates that privacy and sovereignty are not obstacles to innovation. On the contrary, they serve as foundational enablers that support and guide responsible technological advancement. Properly governed mobile healthcare applications can advance SDG 3 (health), SDG 5 (gender equality), SDG 9 (innovation and infrastructure), and SDG 16 (peace, justice and strong institutions). In summary, when built around user control and accountability, mobile health systems can deliver more trustworthy, sustainable, and inclusive health services empowering individuals while building healthier societies. This research explores how mobile healthcare applications can support the United Nations Sustainable Development Goals, not only by improving health outcomes under SDG 3 but also by reinforcing data sovereignty as a pillar of trust, equity, and sustainability.

Keywords: Digital Health, Data Sovereignty, Mobile Healthcare Applications (mHealth), Sustainable Development Goals (SDGs), Health Data Governance.

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Introduction:

Imagine a young woman in rural Maharashtra who uses her mobile phone to track her blood pressure through a health app, schedule a tele-consultation with a government doctor, and store her prescriptions in her digital health account. Each of these actions generates sensitive personal health data. But where does that data go? Who owns it? And most importantly, how is her right to privacy being protected?

India today stands at the forefront of a digital health transformation. With the Ayushman Bharat Digital Mission (ABDM), the country is building one of the world's largest digital health ecosystems. As of 2025, more than 79.71 crore (791 million) Ayushman Bharat Health Accounts (ABHA) have been issued, and over 65.09 crore health records have been linked to these unique IDs. Over 1.3 lakh healthcare facilities, including more than 17,000 private hospitals and clinics, are ABDM-enabled. These numbers illustrate both the scale of India's ambition and the magnitude of the data governance challenge.

At the same time, India faces increasing risks from data breaches and cyberattacks. In 2024, sensitive medical records of over 31 million Star Health customers were leaked through unauthorized Telegram chatbots. Similar incidents have exposed vulnerabilities in digital health systems and raised critical questions about user consent, transparency, and accountability. For citizens, especially those newly entering the digital ecosystem, the fear that their health information could be misused is a real barrier to trust.

India is uniquely positioned to respond to this trust deficit. With its strong tradition of digital public infrastructure such as Aadhaar, UPI, and now ABDM, the country has shown the world how large-scale, interoperable, and inclusive digital systems can be

designed. However, health data is not like financial transactions. It is deeply personal, lifelong, and tied to dignity and identity. This makes data sovereignty the principle that individuals should retain meaningful ownership and control over their health data—not just a technical matter, but a human rights issue.

This paper argues that India's digital health journey can succeed only if it embeds data sovereignty, ethical governance, and alignment with the Sustainable Development Goals (SDGs) at its core. Far from being a barrier to innovation, privacy and sovereignty are enablers of sustainable progress. By defining clear roles (such as data owners and stewards), codifying consent and ownership rights, and leveraging federated architectures that keep sensitive data closer to individuals, India can build a model of mHealth governance that is not only secure and trusted but also scalable and globally relevant.

Anchored in the Indian experience, this framework demonstrates how mobile health applications can drive progress on SDG 3 (health), while also advancing SDG 5 (gender equality), SDG 9 (innovation and infrastructure), and SDG 16 (peace, justice, and strong institutions). In a nation where mobile phones are already in the hands of over 1.2 billion people, getting health data governance right is not just about technology, it is about equity, trust, and the promise of healthier societies.

Current status of health care in India:

India's healthcare sector is growing rapidly, driven by increased investments from public and private sectors, policy reforms by government and technological advancements. Since 2016, the Indian healthcare industry has experienced a compound annual growth rate (CAGR) of approximately 22%, reflecting consistent expansion and rising demand for medical

services. In the interim budget for 2024-2025, the Union Health Ministry allocated ₹90,658.63 crore, marking a 12.59% increase from the previous fiscal year, highlighting the government's commitment to improving healthcare infrastructure and accessibility. The private sector continues to play a crucial role in shaping the healthcare landscape with India witnessing 22 healthcare deals worth \$4.6 billion in 2023, slightly below the \$4.7 billion recorded in 2022, reflecting sustained investor confidence in the sector. Despite these challenges, the Indian healthcare sector continues to attract substantial investments due to a favorable risk-return profile and the potential for strong financial returns (Bain & Company). This dynamic environment reflects both the opportunities and challenges facing India's healthcare industry as it strives to enhance quality, accessibility, and innovation.

Healthcare Landscape in India: India's healthcare system is a blend of public and private providers, with significant disparities in access and quality between urban and rural areas.

Challenges include:

- **Infrastructure Gaps:** Rural areas often lack adequate healthcare facilities and professionals. Approximately 74% of doctors are concentrated in urban regions, serving only 28% of the population, leaving rural areas underserved.
- **Out-of-Pocket Expenditure:** A significant portion of healthcare expenses is borne directly by individuals, leading to financial strain.
- **Digital Health Initiatives:** Programs like the Ayushman Bharat Digital Mission (ABDM) aim to digitize health records and promote telemedicine, enhancing accessibility.

Research Methodology:

Research Design:

A descriptive research design was adopted to develop a sustainable framework linking digital health, data sovereignty, and the SDGs. The study synthesizes

policy analysis, ethical considerations, and mobile health practices to propose inclusive and responsible digital healthcare strategies.

Data Collection

- **Primary Data:** Collected through structured questionnaires disseminated via a Google Form.
- **Secondary Data:** Sourced from academic journals, government reports, and credible online platforms.

Sampling:

The study targeted the age group from 18-60, ensuring a diverse representation across regions, genders, and socioeconomic backgrounds.

Sample Size: 215 Respondents.

Sampling Technique: A non-probability sampling approach was employed, combining convenience sampling through voluntary responses via Google Forms and snowball sampling, where participants were encouraged to share the form within their networks.

Problem Statement:

- This research explores how mobile health applications can advance ethical and sustainable healthcare by aligning digital health practices with data sovereignty and the Sustainable Development Goals (SDGs).
- It proposes a rights-based framework emphasizing privacy, consent, and decentralized innovation to address governance gaps and empower users while fostering trust and systemic transformation.

Objectives of the study:

1. To examine the integration of data sovereignty principles in mobile healthcare applications.
2. To evaluate the alignment of digital health practices with the Sustainable Development Goals (SDGs).
3. To identify ethical, technological, and policy-related barriers to sustainable mHealth implementation.
4. To explore emerging models like decentralized health networks as enablers of responsible innovation.

5. To propose a framework for designing mHealth applications that ensure privacy, equity, and long-term sustainability.

Hypothesis:

Null Hypothesis: H₀ : There is no co-relation between familiarity with mobile healthcare applications and the perceived ability of these apps to improve healthcare access.

Alternate Hypothesis: H₁: There is co-relation between familiarity with mobile healthcare applications and the perceived ability of these apps to improve healthcare access.

Literature Review:

As per the study conducted by Richardson et al., title:A Framework for Digital Health Equity(2022).

The study introduces a comprehensive model to address disparities in digital healthcare. As digital tools like mobile apps, telehealth, and remote monitoring become central to health systems, the authors emphasize that equitable access and outcomes must be prioritized. The framework expands the National Institute on Minority Health and Health Disparities (NIMHD) Research Framework by adding a “digital environment” domain, which includes access to technology, digital literacy, broadband infrastructure, and sociocultural factors.

These digital determinants of health (DDoH) operate across individual, interpersonal, community, and societal levels, interacting with traditional social determinants of health (SDoH) such as education, income, and healthcare access. The framework is particularly relevant for health disparity populations racial and ethnic minorities, rural communities, low-income groups, sexual and gender minorities, and individuals with disabilities who face systemic barriers to digital health engagement.

The authors advocate for a root-cause, multi-level approach to digital health equity, urging developers, policymakers, and healthcare leaders to embed equity

into the design and deployment of digital health solutions. By doing so, the framework aims to ensure that digital transformation in healthcare leads to inclusive, just, and sustainable outcomes for all, rather than deepening existing inequities.

As per the study conducted by Solomon Nsor Anabiah’s., title:mHealth Framework for Sustainable Reduction in Healthcare Cost in Selected Rural Regions of Ghana (2019).

The study explores the transformative potential of mobile health (mHealth) technologies in resource-limited settings. With the rapid expansion of telecommunications and mobile penetration, mHealth offers a promising avenue for delivering cost-effective and quality healthcare to remote communities. The study focuses on the Mobile Text Messaging System (MTMS), a tool designed to disseminate vital health information and collect patient data via mobile devices. MTMS has proven more efficient than traditional communication methods but presents significant challenges related to data security particularly in areas using older mobile phones. Key concerns include authentication, confidentiality, data integrity, and secure storage. The research highlights how the advent of smartphones has helped mitigate some of these vulnerabilities. Anabiah’s work aims to develop a practical framework for implementing MTMS-based mHealth interventions in budget-constrained and underserved regions. The study contributes to the growing body of literature on digital health by emphasizing the need for secure, scalable, and context-sensitive solutions that bridge healthcare gaps in rural Africa. It underscores the importance of integrating technological innovation with local infrastructure and user capabilities to ensure sustainable healthcare delivery.

As per the study conducted by Degavre et al., title:Searching for Sustainability in Health Systems:

Toward a Multidisciplinary Evaluation of Mobile Health Innovations (2022).

The study explores the sustainability of mobile health (mHealth) innovations beyond their clinical impact. While mHealth is often hailed as a catalyst for more efficient and equitable health systems, the authors argue that sustainability assessments remain fragmented across disciplines. Drawing from health technology assessment, life-cycle analysis, communication studies, and socio-economic perspectives, the paper reveals that each field prioritizes different outcomes ranging from cost-effectiveness and environmental impact to user engagement and systemic transformation.

The review highlights that evaluations vary in time horizons, stakeholder perspectives, and methodological approaches, making cross-disciplinary synthesis challenging but essential. The authors propose a dual-level framework: one that assesses sustainability at the device level (e.g., eco-design, energy use) and another at the health system level (e.g., equity, scalability, policy alignment). They emphasize the need for integrated metrics and collaborative research to capture the full spectrum of mHealth's potential.

Key challenges include the lack of standardized evaluation tools, limited longitudinal data, and ethical concerns around digital inclusion and data governance. Ultimately, the paper calls for transformative innovation—mHealth solutions that not only improve care delivery but also contribute to reshaping health systems toward long-term sustainability and inclusivity.

As per the study conducted by Gupta, Rajendra Pratap, title:A Study of the Health Policy Process in India. (2021)

The study critically examines the institutional, political, and stakeholder dynamics involved in shaping health policy, highlighting the complex

interplay between central and state governments, bureaucratic structures, political influences, and interest groups. It emphasizes that while India has introduced several national health programs and reforms such as the National Health Policy (2017) and Ayushman Bharat the policymaking process often lacks coherence, inclusivity, and evidence-based frameworks. The researcher points out that fragmented governance, limited stakeholder engagement, and inadequate integration of public health data weaken the effectiveness of policies. Additionally, the study underscores the importance of health planning, program evaluation, and adaptive strategies to make policies responsive to ground realities. By proposing a more transparent, consultative, and data-driven policy process, the dissertation aims to strengthen public health governance in India. It concludes that effective health policy must align with India's socio-economic diversity and evolving healthcare needs, especially in the pursuit of goals like Universal Health Coverage and equitable access to healthcare services.

Vidhi Thakkar's 2024 research at Indus University

This study explores how permissioned blockchain, specifically Hyperledger Fabric, can enhance privacy and anonymity in electronic healthcare record (EHR) systems. Recognizing the sensitivity of healthcare data and the limitations of conventional sharing mechanisms, the study proposes a blockchain-based framework that ensures secure, private, and controlled access to patient information. The research emphasizes the importance of privacy-preserving mechanisms and introduces a model that leverages cryptographic techniques, access control policies, and decentralized trust to facilitate private data sharing among authorized stakeholders.

By using a permissioned blockchain, the system restricts participation to verified entities, thereby reducing the risk of data breaches and unauthorized access. The study also addresses anonymity by

decoupling patient identities from their medical records through pseudonymization and selective disclosure protocols. Hyperledger Fabric's modular architecture allows for fine-grained control over data visibility, making it suitable for healthcare environments where compliance and confidentiality are paramount.

The thesis contributes to the growing body of work on blockchain in digital health by offering a scalable, secure, and ethically sound solution for managing sensitive health data. It concludes that permissioned blockchain can significantly improve trust, transparency, and data sovereignty in healthcare systems, aligning with global goals for secure digital health infrastructure.

Manish Nandal's 2024 research at Maharshi Dayanand University

This study offers a comparative legal analysis of data protection and the right to privacy in India, contextualized within global frameworks. Guided by Jaswant Saini, the study critically examines the evolution of privacy as a fundamental right in India, especially post the landmark Puttaswamy judgment, and evaluates the adequacy of existing legal mechanisms in safeguarding personal data. It juxtaposes India's legal landscape with international standards such as the EU's General Data Protection Regulation (GDPR), highlighting gaps in enforcement, accountability, and citizen empowerment.

The thesis explores constitutional provisions, statutory laws like the Information Technology Act, and proposed legislation such as the Personal Data Protection Bill. It underscores the tension between state surveillance, corporate data practices, and individual autonomy, arguing for a rights-based approach to data governance. Through comparative insights, the research reveals that India's framework remains fragmented and reactive, lacking robust institutional safeguards and clear consent architecture.

Nandal advocates for comprehensive reforms that balance innovation with civil liberties, emphasizing the need for independent oversight, transparency, and public awareness. The study contributes to the discourse on digital rights in India, urging policymakers to align domestic laws with global best practices to ensure meaningful privacy protection in the digital age.

Ritu Ratra's 2023 research at Maharshi Dayanand University

This study focuses on designing and implementing privacy-preserving algorithms tailored for big data applications in healthcare. With the exponential growth of digital health records and analytics, safeguarding sensitive patient information has become a critical challenge. This study addresses the dual need for data utility and privacy by developing algorithmic solutions that ensure secure data processing without compromising analytical performance.

Guided by Preeti Gulia, the thesis explores various cryptographic and anonymization techniques, including differential privacy, secure multiparty computation, and homomorphic encryption. These methods are evaluated for their effectiveness in protecting patient identities while enabling meaningful data analysis across large, heterogeneous datasets. The research also considers the scalability and computational efficiency of these algorithms in real-world healthcare environments.

Implementation is carried out using simulated healthcare datasets to test privacy guarantees under different threat models. The study concludes that a hybrid approach combining algorithmic rigor with contextual awareness of healthcare workflows can significantly enhance data protection. Ratra's work contributes to the broader field of privacy engineering in digital health, offering practical frameworks for secure big data analytics that align with ethical standards and regulatory requirements. It lays the

groundwork for future innovations in privacy-aware healthcare systems.

Sangeetha S's 2022 thesis at Anna University

This study integrates differential privacy into recommendation systems to safeguard user data while maintaining system utility. Recommendation systems, widely used across eCommerce, social platforms, and healthcare, rely heavily on personal user data to generate relevant suggestions. However, this reliance introduces significant privacy risks, especially in the context of data sparsity and high dimensionality, which make systems vulnerable to inference attacks.

The research addresses these challenges by applying differential privacy, a mathematical framework that ensures privacy through controlled noise addition to recommender algorithms. It explores the limitations of traditional perturbation techniques, which often degrade recommendation accuracy due to excessive noise, and proposes optimized privacy-preserving models such as CryptoDP and Private Bloom. These models aim to balance privacy guarantees with recommendation quality, even in sparse datasets.

Through theoretical analysis and experimental validation, the study demonstrates that differential privacy can be effectively adapted to recommender systems with careful algorithmic design. It emphasizes the importance of tuning privacy parameters and selecting appropriate mechanisms based on data characteristics. The thesis contributes to privacy-aware computing by offering scalable solutions that uphold user confidentiality without compromising the personalization benefits of recommendation systems. This work is particularly relevant in today's data-driven digital ecosystem.

Priya J's 2022 thesis at Anna University

This study explores a robust framework for enhancing data privacy and access anonymity in smart healthcare systems using Internet of Things (IoT) technologies. With the proliferation of IoT-enabled medical devices

and cloud-based health data storage, safeguarding sensitive patient information has become a critical concern. The research proposes an integrated architecture that combines IoT, blockchain, and cloud computing to ensure secure data transmission, decentralized control, and privacy-preserving access.

The study leverages blockchain's immutability and transparency to prevent unauthorized data manipulation, while cloud computing supports scalable storage and processing. A key innovation lies in the use of permissioned blockchain models to restrict access to verified entities, thereby enhancing anonymity and trust. The system also incorporates encryption techniques and access control policies to protect data at multiple levels from device to cloud.

Experimental validation demonstrates that the proposed model effectively mitigates privacy risks such as data leakage, identity exposure, and unauthorized access, without compromising system performance. Priya's work contributes to the field of smart healthcare by offering a practical, secure, and scalable solution for managing health data in real time. It aligns with global efforts to build resilient digital health infrastructures that prioritize patient privacy and ethical data governance.

Kokila's 2024 research at Amity University, Noida

This study investigates the adoption of mobile health (mHealth) applications and their implications for healthcare management in India. Situated at the intersection of business, economics, and social sciences, the study explores how digital health tools are transforming healthcare delivery, accessibility, and administrative efficiency. It examines key drivers influencing mHealth adoption, including technological readiness, user awareness, cost-effectiveness, and policy support.

The research employs both qualitative and quantitative methods to assess user behavior, stakeholder engagement, and institutional responses to mHealth

integration. It highlights the role of mobile apps in bridging healthcare gaps, especially in underserved regions, by enabling remote consultations, health monitoring, and data-driven decision-making. However, the study also identifies barriers such as digital literacy, data privacy concerns, and infrastructural limitations that hinder widespread adoption.

Kokila's work emphasizes the need for strategic alignment between technology providers, healthcare institutions, and regulatory bodies to ensure sustainable implementation. The thesis concludes that mHealth applications hold significant promise for improving healthcare outcomes and operational efficiency, but their success depends on inclusive design, robust data governance, and continuous stakeholder collaboration. This research contributes to the evolving discourse on digital health in India, offering actionable insights for policymakers and healthcare managers.

Shyam Sundaram's research at the University of Madras

This study explores the application of data mining models within the healthcare domain, aiming to enhance clinical decision-making, patient care, and operational efficiency. Guided by T. Santhanam, the study investigates how various data mining techniques such as classification, clustering, association rule mining, and predictive modeling can be effectively deployed to extract meaningful insights from complex and voluminous healthcare datasets.

The thesis emphasizes the importance of transforming raw medical data into actionable knowledge, addressing challenges like data heterogeneity, missing values, and privacy concerns. It evaluates multiple algorithms across real-world healthcare scenarios, including disease diagnosis, treatment recommendation, and patient risk stratification. Comparative analysis is conducted to assess model

accuracy, scalability, and interpretability, with a focus on optimizing performance for clinical relevance.

Sundaram's work also highlights the integration of data mining with electronic health records (EHRs), showcasing how intelligent systems can support evidence-based medicine. The research concludes that data mining not only improves healthcare outcomes but also aids in resource allocation and policy formulation. By bridging computational techniques with medical expertise, the study contributes to the growing field of health informatics and lays the groundwork for future innovations in data-driven healthcare systems.

Bhuvanewari T's 2006 research at Sri Chandrasekharendra Saraswathi Visva Mahavidyalaya

This study presents a comprehensive study on the application of knowledge discovery in databases (KDD) to healthcare management. The thesis focuses on developing intelligent healthcare applications that leverage data mining techniques to extract actionable insights from vast medical datasets. Central to the study is the AVECS (Automated Validation and Evaluation of Clinical Systems) framework, which integrates knowledge management principles to support clinical decision-making and improve healthcare delivery.

The research explores various data mining models such as classification, clustering, and association rule mining and evaluates their effectiveness in identifying patterns related to disease diagnosis, treatment outcomes, and patient behavior. By applying these models to real-world healthcare data, the study demonstrates how KDD can enhance predictive accuracy, streamline resource allocation, and support evidence-based practices.

Bhuvanewari emphasizes the importance of integrating domain knowledge with computational intelligence to build adaptive systems capable of learning from evolving medical data. The thesis also discusses challenges such as data heterogeneity,

privacy concerns, and system scalability. Ultimately, the work contributes to the field of health informatics by proposing a robust, knowledge-driven approach to healthcare management, laying the foundation for future innovations in intelligent clinical support systems and data-driven public health strategies.

Data Analysis: The analysis and interpretation of the primary data , collected through primary questionnaire, reveals the following:

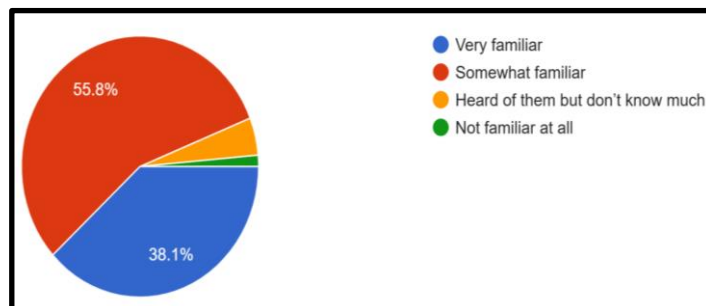
1) Demographic details

Demographic	Description	Number	Percentage
Age Group	18-28	74	34.40
	29-44	138	64.20
	45-60	03	01.40
	Total	215	100
Gender	Male	92	42.80
	Female	123	57.20
	Total	215	100
Area of Residence	Urban	128	59.50
	Semi-Urban	14	06.50
	Rural	73	34.00
	Total	215	100
Occupation	Students	34	15.80
	Employed	119	55.30
	Self Employed	62	28.80
	Total	215	100

Limitations of the Study:

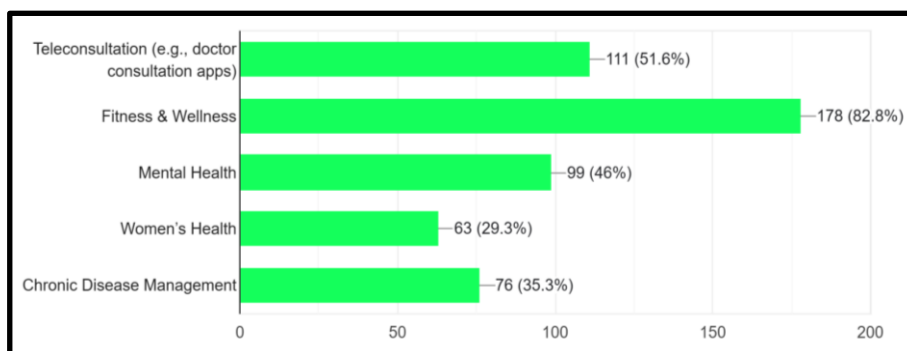
- **Sampling Bias:** The online nature of the survey may exclude individuals without internet access.
- **Cross-Sectional Design:** Limits the ability to infer causality.

2) Respondents level of familiarity with mobile healthcare applications



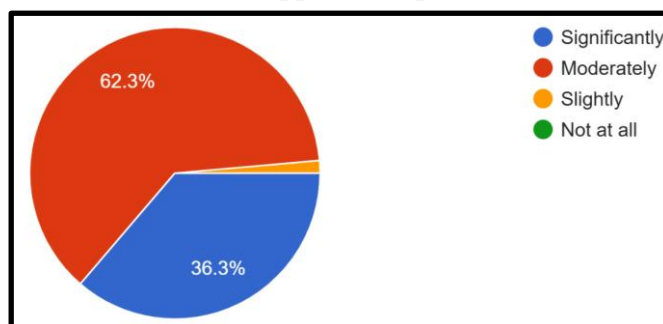
The survey indicates that most respondents are familiar with mobile healthcare applications, with 55.8% reporting being "somewhat familiar" and 38.1% "very familiar." Only a small fraction had limited or no awareness. This suggests a high level of general exposure to mHealth technologies, which may support broader adoption and engagement in digital health initiatives.

3) Participants' perception regarding the types of mHealth apps they believe are most commonly used

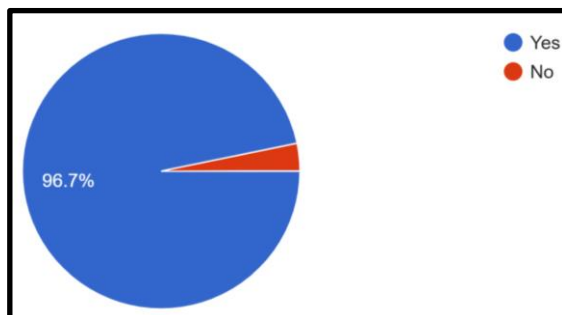


The survey results indicate that Fitness & Wellness apps are perceived as the most common type of mHealth application, cited by 82.8% of respondents. Teleconsultation apps followed at 51.6%, with Mental Health (46%), Chronic Disease Management (35.3%), and Women's Health (29.3%) trailing behind. This suggests that public awareness and usage are highest for general wellness tools, while more specialized health domains may require increased visibility and outreach.

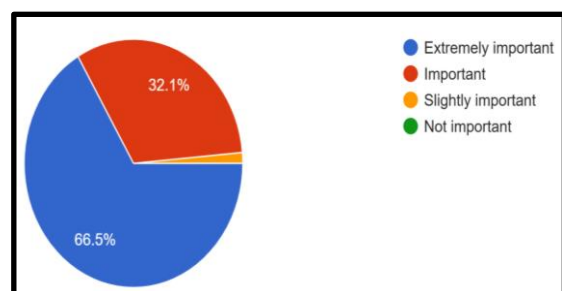
4) Views regarding the extent to which mHealth apps can improve access to healthcare services



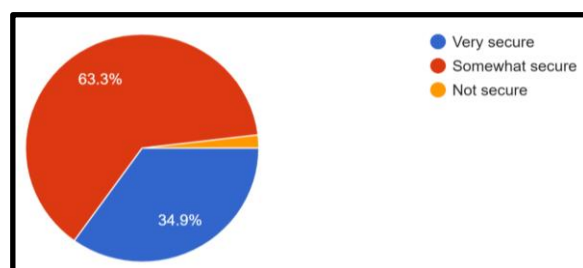
Survey responses indicate that mHealth apps are widely perceived as effective tools for improving healthcare access. A majority (62.3%) believe these apps can enhance access moderately, while 36.3% see their impact as significant. Minimal responses in the "slightly" and "not at all" categories suggest strong overall optimism about the role of mobile health technologies in expanding healthcare reach.

5) Respondents beliefs regarding individual ownership of personal health data collected by mobile apps


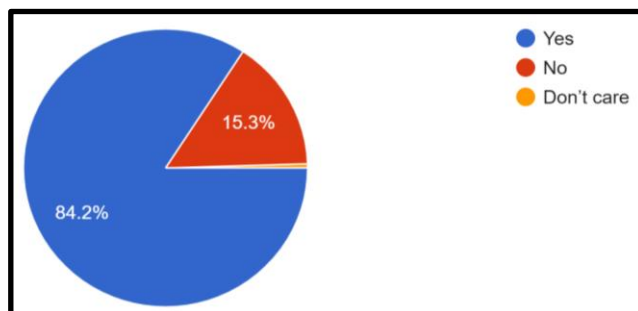
The survey reveals overwhelming support for individual ownership of personal health data collected by mHealth apps, with 96.7% of respondents affirming this view. This strong consensus underscores the public's demand for autonomy, transparency, and ethical data governance in digital health platforms. The minimal opposition suggests that data ownership is a widely accepted standard among users.

6) Participants rating relating to clarity and privacy policies of mobile apps


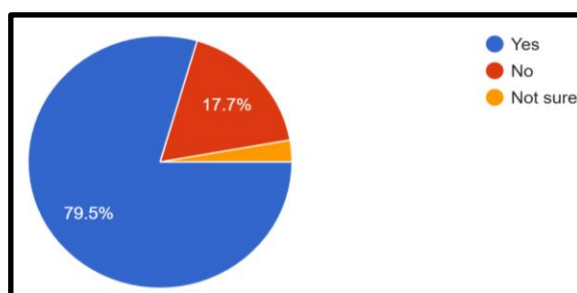
The pie chart reveals that a significant majority of respondents (66.5%) consider clarity in privacy policies to be extremely important, while an additional 32.1% deem it important. This overwhelming consensus (98.6% combined) underscores a strong user demand for transparent and comprehensible privacy documentation. The negligible proportions for slightly important and not important indicate that unclear policies may erode trust and hinder informed consent. These findings highlight the critical role of user-centric communication in digital platforms.

7) Participants assessment relating to the general security of health data stored by mHealth applications


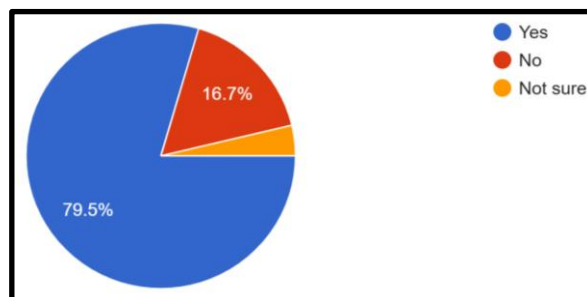
The chart indicates that a majority of respondents (63.3%) perceive health data stored by mHealth apps as somewhat secure, while 34.9% view it as very secure. Only a small fraction consider it not secure. This suggests a moderate level of trust in mHealth data security, though the predominance of cautious optimism highlights ongoing concerns. These insights emphasize the need for stronger transparency and robust security measures to bolster user confidence in digital health platforms.

8) Opinions regarding on whether mHealth apps should always request explicit consent before sharing data with third parties


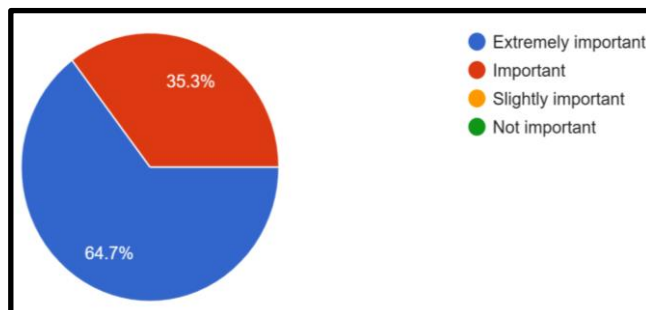
The survey results show strong public support for explicit consent in mHealth data sharing. A significant majority (84.2%) believe that mHealth apps should always request user permission before sharing data with third parties. This underscores the importance of user autonomy and privacy in digital health platforms. The relatively low opposition (15.3%) and negligible indifference suggest a clear ethical expectation among users for transparent and consent-driven data practices.

9) Respondents response relating to whether individuals should have control over what data they share and with whom


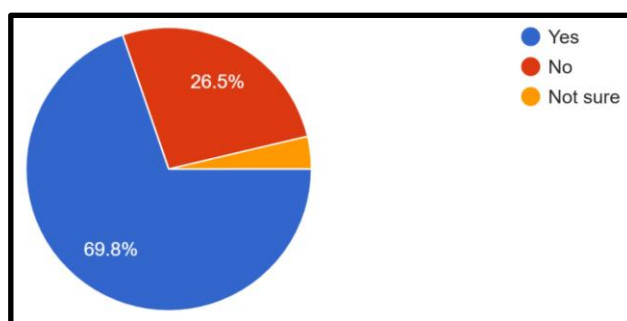
The results show that a large majority (79.5%) believe people should be able to choose exactly what data to share and with whom, reflecting strong support for personal control over data. A smaller portion (17.7%) disagreed, while only 2.8% were unsure. This indicates clear preference for greater transparency and autonomy in data governance.

10) Views on whether individuals should be able to benefit financially from sharing their health data for research or commercial purposes


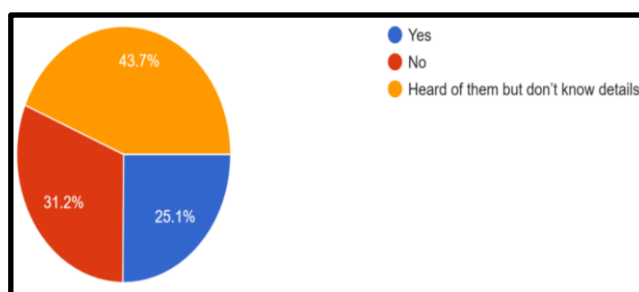
The findings reveal that 79.5% of respondents believe individuals should be able to benefit financially from sharing their health data, while 16.7% opposed the idea and 3.7% were uncertain. This indicates strong public support for compensating individuals in exchange for the use of their health data in research or commercial purposes.

11) Perceived importance of data privacy in the context of digital health


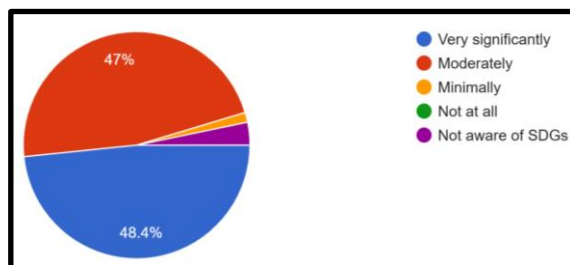
The results show that 64.7% of respondents consider data privacy in digital health to be extremely important, while 35.3% regard it as important. No respondents rated it as only slightly important or not important. This highlights a unanimous recognition of data privacy as a critical factor in digital health.

12) Participants' views on whether mobile health apps should be regulated by national laws and health authorities.


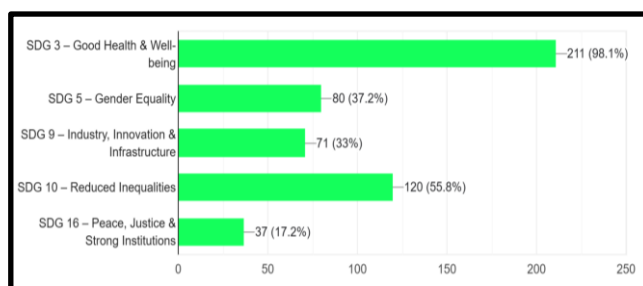
The findings indicate that 69.8% of respondents support the regulation of mobile health apps by national laws and health authorities, while 26.5% opposed the idea, and 3.7% were unsure. This suggests a strong public preference for regulatory oversight to ensure safety, reliability, and accountability in mobile health applications.

13) Awareness of data protection laws such as GDPR, HIPAA, or the Digital Personal Data Protection Act


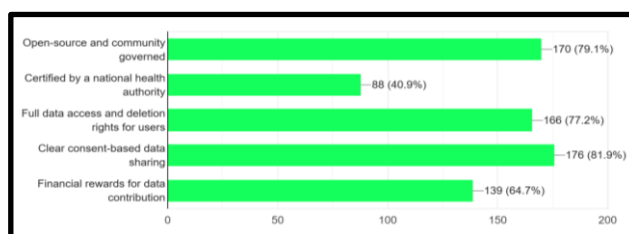
The pie chart presents the responses of 215 participants regarding their awareness of data protection laws such as GDPR, HIPAA, and the Digital Personal Data Protection Act. Only 25.1% of respondents reported being aware of such laws, while 31.2% indicated no awareness. A significant portion, 43.7%, had heard of these laws but lacked detailed knowledge. This indicates a general lack of in-depth understanding of data protection regulations among the majority, highlighting the need for increased awareness and education on data privacy issues.

14) Respondents relating to opinions on the contribution of mHealth apps to the United Nations Sustainable Development Goals (SDGs)


The survey results indicate that a substantial majority of respondents perceive mobile health (mHealth) applications as contributing positively to the United Nations Sustainable Development Goals (SDGs). Specifically, 48.4% rated the contribution as "very significant," while 47% viewed it as "moderate." This suggests strong public confidence in the role of mHealth technologies in advancing global health and development objectives.

15) Participants response relating to SDGs they believe mHealth apps could help achieve


The findings reveal that mHealth applications are overwhelmingly perceived as instrumental in achieving SDG 3 – Good Health & Well-being, with 98.1% of respondents affirming this link. Additionally, significant associations were noted with SDG 10 – Reduced Inequalities (55.8%), SDG 5 – Gender Equality (37.2%), and SDG 9 – Industry, Innovation & Infrastructure (33%). A smaller proportion (17.2%) recognized relevance to SDG 16 – Peace, Justice & Strong Institutions. These results underscore the multifaceted potential of mHealth technologies in advancing health-centric and equity-driven global development goals.

16) Respondents' response relating to the features they believe would make mHealth apps more trustworthy


The data reveals that user trust in mHealth apps is strongly influenced by transparency and user control. The most endorsed features were clear consent-based data sharing (81.9%), open-source and community governance (79.1%), and full data access and deletion rights (77.2%). Financial incentives for data contribution (64.7%) and certification by national health authorities (40.9%) were also valued, though to a lesser extent. These findings suggest that ethical data practices and participatory governance are key to enhancing trust in digital health platforms.

The Pearson correlation coefficient (r) between:

Dependent Variable (Y): In your opinion, how much can mHealth apps improve access to healthcare?

Independent Variable (X): How familiar are you with mobile healthcare applications?

$r = +0.452$, which indicates a **moderate positive correlation** between these two variables.

Direction:

The positive sign suggests a direct relationship between the two variables. This means that as familiarity with mobile healthcare applications increases, the perceived ability of these apps to improve healthcare access also increases.

Strength:

Since $r = +0.452$ falls between $+0.3$ and $+0.5$, it indicates a moderate positive correlation. While the relationship isn't perfectly linear, it is strong enough to suggest a meaningful trend.

Thus, we accept the Alternate Hypothesis (H1) i.e. There is co-relation between familiarity with mobile healthcare applications and the perceived ability of these apps to improve healthcare access and reject the Null Hypothesis (H0)

Interpretation of Findings:
Reinforcing Relationship:

The correlation suggests that individuals who are more familiar with mHealth apps tend to view them as more effective in improving healthcare access.

This may reflect:

- Greater exposure to app features that enhance convenience and reach.
- First-hand experience with teleconsultations, appointment booking, or remote monitoring.
- Increased trust in digital health tools due to familiarity.

User Confidence Effect:

Familiarity likely builds confidence, making users more optimistic about the potential of mHealth apps to bridge healthcare gaps especially in underserved or

remote areas.

Implications for Digital Health Stakeholders

a) Boost Awareness Campaigns:

Investing in educational outreach and onboarding tutorials can increase familiarity, which in turn may improve public perception of mHealth impact.

b) Design for Accessibility:

Simplifying user interfaces and ensuring multilingual support can help broaden familiarity across diverse populations.

c) Leverage Familiarity to Drive Adoption:

Healthcare providers and startups can use familiarity metrics to target users more likely to engage deeply with digital health solutions and tailor messaging accordingly.

Views were shared on the principles that should guide the design of ethical and sustainable mHealth applications.

- Ethical and sustainable mHealth apps should prioritize user privacy, transparency, and control over personal data.
- Key principles include obtaining clear user consent, ensuring data security through encryption, and avoiding unauthorized third-party data sharing.
- Apps should also provide clinically accurate health information, be accessible and inclusive for all users, and promote equitable healthcare.
- Minimizing environmental impact and reducing surveillance further support ethical design.

Suggestions:

- Mobile health apps should protect user privacy through strong encryption, clear consent processes, and options for anonymous use.
- Mobile health apps interfaces must be designed to include diverse languages, accessibility features, and cultural relevance to serve all communities.
- Health apps should educate users with trustworthy, easy-to-understand content that supports informed

decisions.

4. Transparency and regular independent audits are essential to build trust and ensure ethical data practices.
5. Real-time data from wearables and sensors can support early diagnosis, but must be handled with privacy-preserving techniques.
6. Hospitals and researchers need secure, standardized systems to share insights without compromising patient confidentiality.
7. Predictive analytics should be used to plan for public health needs by integrating social, environmental, and health data.

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Cite This Article:

Mr. Solanki M.K. & Dr. (Mrs.) Ganatra V. (2026). *Digital Health, Data Sovereignty And The Sdgs: A Framework For Sustainable Practices With Mobile Healthcare Applications*. In **Aarhat Multidisciplinary International Education Research Journal**: Vol. XV (Number II, pp. 122–137) Doi: <https://doi.org/10.5281/zenodo.20411229>