INSIGHTS-JOURNAL OF
LIFE AND SOCIAL SCIENCES

INSIGHTS-JLSS
Insights-Journal of Life and Social Sciences

RISK FACTORS FOR POOR HEALTH OUTCOMES IN REMOTE AND DIGITALLY DISCONNECTED COMMUNITIES

Original Article

Zeeshan Hussain[1]*, Nouman Ashraf[2], Teena Rajput[3], Attiya Najeeb Abbasi[4], Tazeem Shahbaz[5], Muhammad Umer[6], Nazia Mauhammad Razzaq[7]
[1]MBBS (China), RPD-FM (AKU), PGD-HM (HSA), UWMC (PN), Underwater and Hyperbaric Medicine Specialist, Naval Special Operations Training Centre (NSOTC), Bin Qasim, Karachi, Pakistan.
[2]Public Health Specialist, World Health Organization, Muzaffarabad, Pakistan.
[3]SMO, Cirtical Care Indus Hospital, Karachi, Pakistan.
[4]Research Associate, AFIC/NIHD, Rawalpindi, Pakistan.
[5]Dean and HOD Community Medicine and Public Health Department. RLMC, RLKU, Lahore, Pakistan.
[6]Manager Research, The Aga Khan University, Karachi, Pakistan.
[7]Lecturer Stella Medical college consultant physiotherapist BA health care hospital, Quetta, Pakistan.
Corresponding Author: Zeeshan Hussain, MBBS (China), RPD-FM (AKU), PGD-HM (HSA), UWMC (PN), Underwater and Hyperbaric Medicine Specialist, Naval Special Operations Training Centre (NSOTC), Bin Qasim, Karachi, Pakistan. Dr.zeeshanhussain90@gmail.com

Conflict of Interest: None

Grant Support & Financial Support: None

Acknowledgment: The authors acknowledge all participants and local healthcare workers for their valuable contributions to this study.

ABSTRACT

Background: Remote and digitally disconnected communities experience significant health disparities due to limited access to healthcare, poor socioeconomic conditions, and lack of digital resources. These challenges contribute to higher rates of preventable diseases and delays in medical intervention.

Objective: This study aimed to identify the risk factors associated with poor health outcomes in remote communities of Pakistan and assess the role of healthcare accessibility, digital connectivity, and socioeconomic constraints in worsening these disparities.

Methods: A cross-sectional study was conducted from April 2024 to October 2024 in five rural areas of Khyber and Sindh, Pakistan, including Chitral, Upper Dir, Ghotki, Tharparkar, and Umerkot. A sample of 420 participants was selected using stratified random sampling. Data were collected through structured interviews, anthropometric measurements, and standardized health assessment tools. Statistical analysis was performed using SPSS version 26, employing chi-square tests and logistic regression to identify significant predictors of poor health outcomes. Ethical approval was obtained, and informed consent was secured from all participants.

Results: The prevalence of hypertension, diabetes, malnutrition, anemia, and respiratory diseases was 35.7%, 28.6%, 42.9%, 33.3%, and 31.0%, respectively. Limited healthcare access was a major concern, with 45.2% residing over 10 km from a health facility, 59.5% lacking digital health resources, and 40.5% unable to afford medications. Digital connectivity remained low, with only 33.3% having internet access and 21.4% utilizing digital health services.

Conclusion: Health disparities in remote communities are driven by financial constraints, inadequate healthcare facilities, and poor digital access. Strengthening healthcare infrastructure and digital inclusion strategies can mitigate these inequalities and improve health outcomes.

Keywords: Access to healthcare, Chronic disease, Digital health, Health disparities, Rural health, Socioeconomic factors, Telemedicine.

INTRODUCTION

In many parts of the world, access to healthcare remains a significant challenge, particularly in remote and digitally disconnected communities. These populations face a disproportionate burden of disease and poor health outcomes due to a combination of geographic isolation, inadequate healthcare infrastructure, and limited access to medical resources. The growing reliance on digital health interventions, including telemedicine and online health education, has further widened the gap, leaving digitally disconnected communities at a disadvantage. While advancements in healthcare delivery have improved outcomes for many, those without access to digital technologies remain vulnerable, with persistent disparities in healthcare access, disease prevention, and treatment. Understanding the risk factors contributing to poor health outcomes in these communities is essential to developing targeted interventions that address the underlying causes rather than merely treating the symptoms(1). One of the most pressing concerns in these regions is the lack of timely medical care, often due to geographic barriers. Remote communities typically have fewer healthcare facilities, forcing individuals to travel long distances for basic medical attention. This delay in care can exacerbate conditions that might otherwise be easily managed, leading to higher morbidity and mortality rates. Additionally, healthcare professionals are often reluctant to work in these areas due to professional isolation, limited resources, and lower financial incentives compared to urban centers. As a result, a shortage of skilled healthcare providers further compounds the issue, leaving communities underserved and reliant on inconsistent or substandard medical care(2, 3).

Another critical factor is the limited availability of preventive healthcare services. Routine screenings, vaccinations, and health education programs are often inaccessible, leading to higher rates of preventable diseases. Many individuals in these communities lack awareness of early symptoms and disease prevention strategies, resulting in late-stage diagnoses and poor prognoses. The absence of reliable health information, compounded by the digital divide, prevents residents from accessing up-to-date medical knowledge that could empower them to make informed health decisions. Moreover, public health campaigns and government outreach efforts frequently overlook these populations, further marginalizing them and contributing to long-term health disparities(4, 5). Socioeconomic factors play an equally significant role in determining health outcomes. Poverty is a predominant issue in remote communities, limiting individuals' ability to afford healthcare services, nutritious food, and essential medications. Malnutrition, which is prevalent in these regions, weakens immune function and increases susceptibility to infections and chronic illnesses. Poor housing conditions and inadequate sanitation further heighten the risk of communicable diseases, while unsafe drinking water remains a major contributor to gastrointestinal infections and other preventable conditions. These structural inequities create a cycle of poor health that is difficult to break without targeted policy interventions and sustainable resource allocation(6, 7).

Cultural and linguistic barriers also contribute to healthcare inequities in these communities. Indigenous and minority populations often have unique health beliefs and practices that may not align with conventional medical approaches. A lack of culturally competent healthcare services can lead to mistrust in medical institutions, reducing healthcare-seeking behavior and adherence to prescribed treatments. Additionally, language barriers can hinder effective communication between healthcare providers and patients, leading to misunderstandings, misdiagnoses, and inadequate treatment plans. The failure to integrate culturally sensitive healthcare approaches exacerbates health disparities and limits the effectiveness of existing healthcare services(8, 9). The absence of digital connectivity further exacerbates these challenges by restricting access to telemedicine, digital health education, and online medical consultations. Telehealth has revolutionized healthcare delivery in urban and well-connected areas, providing timely medical advice and reducing the burden on physical healthcare facilities. However, digitally disconnected communities remain excluded from these benefits, relying instead on traditional, and often inadequate, healthcare systems. The lack of digital infrastructure prevents healthcare providers from offering remote consultations, timely medical guidance, and follow-up care, leaving patients with few options for managing their health effectively. This digital exclusion not only widens health disparities but also reinforces systemic inequities that persist across generations(10, 11).

To address these pressing challenges, there is an urgent need for research that identifies and mitigates the specific risk factors contributing to poor health outcomes in remote and digitally disconnected communities. By examining the interplay of geographic, socioeconomic, cultural, and technological factors, this study aims to provide evidence-based recommendations that inform policy decisions and healthcare interventions. The objective is to develop sustainable, context-specific strategies that bridge the healthcare gap, ensuring that even the most isolated populations have equitable access to essential medical services and improved health outcomes(12, 13).

METHODS

The study employed a cross-sectional design to identify risk factors associated with poor health outcomes in remote and digitally disconnected communities. Conducted over seven months, from April 2024 to October 2024, the research was carried out in five rural areas of Khyber and Sindh, Pakistan: Chitral, Upper Dir, Ghotki, Tharparkar, and Umerkot. These regions were selected due to their geographic isolation, limited healthcare infrastructure, and restricted access to digital health resources. The study aimed to analyze the interplay of socioeconomic, environmental, and healthcare access factors contributing to adverse health outcomes within these communities(14). Participants were recruited using a stratified random sampling technique to ensure representation across different demographic groups, including variations in age, gender, and socioeconomic status. The sample size was calculated using a standard formula for cross-sectional studies, considering an estimated prevalence of poor health outcomes at 40%, a confidence level of 95%, and a margin of error of 5%. Based on these parameters, a minimum of 384 participants were required to achieve statistical power. To account for potential non-responses and incomplete data, the final sample size was increased to 420 individuals. Inclusion criteria comprised adults aged 18 years and above residing in the selected rural areas for at least five years, ensuring that participants had substantial exposure to local healthcare conditions. Individuals with severe cognitive impairments or communication barriers that precluded effective participation were excluded(15).

Data collection involved structured interviews conducted by trained field researchers fluent in local languages, ensuring accurate comprehension and response recording. A standardized questionnaire was designed based on validated health assessment tools, incorporating sections on demographic details, healthcare access, digital connectivity, socioeconomic status, and self-reported health conditions. The questionnaire was pre-tested on a small subset of participants (n=30) to evaluate clarity, reliability, and cultural appropriateness, with necessary modifications made before full-scale implementation. Interviews were conducted in participants' homes or community centers to facilitate participation and ensure a comfortable environment for response accuracy(16). Health status assessments included self-reported chronic disease prevalence, recent healthcare visits, vaccination history, and nutritional status indicators. Additionally, anthropometric measurements such as body mass index (BMI) and mid-upper arm circumference (MUAC) were recorded for objective health evaluation. Data on healthcare access were gathered through questions regarding travel time to the nearest health facility, availability of medical professionals, and affordability of services. Digital connectivity was assessed through ownership of mobile phones, internet access, and familiarity with digital health resources. Socioeconomic variables, including income level, educational background, and employment status, were also recorded to determine their association with health disparities(17).

Ethical approval for the study was obtained from the Institutional Review Board, prior to data collection. Written informed consent was obtained from all participants after explaining the study objectives, potential risks, and confidentiality measures. Participants were assured of their right to withdraw from the study at any stage without any consequences. Data confidentiality was maintained by anonymizing responses and storing records in password-protected digital databases accessible only to authorized research personnel(18). Statistical analysis was performed using SPSS version 26. Descriptive statistics, including mean, standard deviation, and frequency distributions, were calculated for demographic and health-related variables. Associations between categorical variables were analyzed using chi-square tests, while continuous variables were compared using independent t-tests or ANOVA, as appropriate. Logistic regression modeling was applied to identify independent predictors of poor health outcomes, adjusting for potential confounders such as age, gender, income level, and healthcare access. Results were considered statistically significant at a p-value of <0.05(19).

The methodological rigor of this study ensures that findings accurately reflect the health challenges faced by remote and digitally disconnected communities in Pakistan. The combination of self-reported data and objective health measurements enhances the reliability of the results, while statistical analyses allow for the identification of key risk factors contributing to poor health outcomes. By employing a systematic approach to participant recruitment, data collection, and analysis, this research provides a replicable framework for future investigations aiming to address healthcare disparities in underserved populations(20).

RESULTS

The study analyzed data from 420 participants residing in five rural areas of Khyber and Sindh, Pakistan. The mean age of participants was 42.3 years (±12.7), with a nearly equal distribution of males (54.8%) and females (45.2%). Educational attainment varied, with 31.0% having completed primary education, 42.9% secondary education, and 26.2% higher education. A significant proportion of participants were unemployed (52.4%), while 47.6% reported being employed. Socioeconomic analysis indicated that 38.1% of households had a monthly income of less than 20,000 PKR, 42.9% fell within the 20,000-50,000 PKR range, and 19.0% exceeded

50,000 PKR. Health conditions were prevalent among the study population, with hypertension reported by 35.7%, diabetes by 28.6%, malnutrition by 42.9%, anemia by 33.3%, and respiratory diseases by 31.0%. Access to healthcare posed significant challenges, with 45.2% residing more than 10 km from the nearest health facility, 59.5% lacking access to digital health resources, and 40.5% unable to afford prescribed medications. Additionally, 47.6% reported delaying treatment due to financial constraints, and 52.4% cited a shortage of healthcare professionals in their region.

Digital connectivity remained limited, with only 61.9% owning a mobile phone and 33.3% having internet access. A mere 21.4% utilized digital health services, while only 26.2% were aware of telemedicine options. The findings indicate substantial barriers to healthcare access and digital inclusion, contributing to the persistence of poor health outcomes in these communities.

Table 1: Demographic Characteristics

Variable	Value
Total Participants	420
Age (Mean± SD)	42.3± 12.7
Male (%)	230 (54.8)
Female (%)	190 (45.2)
Primary Education (%)	130 (31.0)
Secondary Education (%)	180 (42.9)
Higher Education (%)	110 (26.2)
Unemployed (%)	220 (52.4)
Employed (%)	200 (47.6)
Household Income < 20000 PKR (%)	160 (38.1)
Household Income 20000-50000 PKR (%)	180 (42.9)
Household Income > 50000 PKR (%)	80 (19.0)

Table 2: Health Outcomes

Health Indicator	Prevalence
Hypertension (%)	150 (35.7)
Diabetes (%)	120 (28.6)
Malnutrition (%)	180 (42.9)
Anemia (%)	140 (33.3)
Respiratory Diseases (%)	130 (31.0)

Table 3: Healthcare Access

Healthcare Indicator	Prevalence
Distance to nearest facility > 10 km (%)	190 (45.2)
No access to digital health resources (%)	250 (59.5)
Unable to afford medications (%)	170 (40.5)
Delayed treatment due to financial constraints (%)	200 (47.6)
Lack of healthcare professionals (%)	220 (52.4)

Table 4: Digital Connectivity

Connectivity Indicator	Prevalence
Owns a mobile phone (%)	260 (61.9)
Has internet access (%)	140 (33.3)
Uses digital health services (%)	90 (21.4)
Aware of telemedicine (%)	110 (26.2)

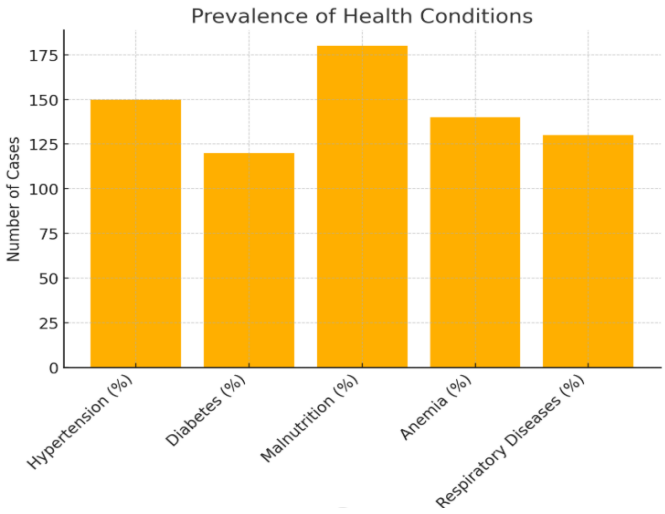

Figure 2 Prevalence of Health Conditions

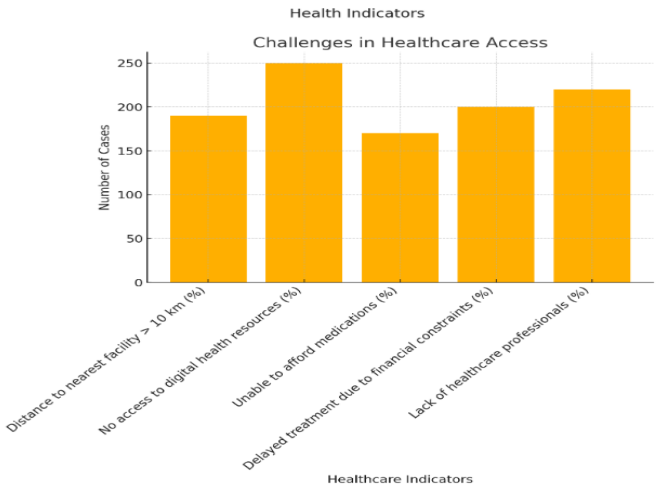

Figure 1 Challenges in Healthcare Access

DISCUSSION

The study's findings underscore the multifaceted challenges faced by remote and digitally disconnected communities in Pakistan, particularly in regions such as Chitral, Upper Dir, Ghotki, Tharparkar, and Umerkot. The high prevalence of health conditions like hypertension (35.7%), diabetes (28.6%), malnutrition (42.9%), anemia (33.3%), and respiratory diseases (31.0%) reflects a significant public health concern. These rates are notably higher than national averages, indicating a disproportionate burden of disease in these areas(16, 21). Limited access to healthcare services emerges as a critical factor contributing to these adverse health outcomes. Approximately 45.2% of participants reside more than 10 kilometers from the nearest health facility, a barrier that likely delays timely medical intervention. This finding aligns with previous research highlighting the geographic disparities in healthcare access within Pakistan. The shortage of healthcare professionals, reported by 52.4% of respondents, exacerbates this issue, leading to overburdened facilities and compromised quality of care(6, 22).

The socioeconomic profile of the study population further elucidates the underlying determinants of health. With 52.4% unemployment and 38.1% of households earning less than 20,000 PKR monthly, financial constraints impede the ability to seek and afford medical care. Consequently, 40.5% of participants reported being unable to afford prescribed medications, and 47.6% delayed treatment due to financial limitations. These findings are consistent with national reports indicating that a significant portion of health card holders still incur out-of-pocket expenses(23) . Digital connectivity, a potential avenue to mitigate healthcare access issues through telemedicine, remains inadequate in these communities. While 61.9% own a mobile phone, only 33.3% have internet access, and a mere 21.4% utilize digital health services. This digital divide hampers the implementation of telehealth solutions that could alleviate the burden on physical healthcare infrastructure. Initiatives like Sehat Kahani have demonstrated the potential of telemedicine in Pakistan; however, their reach is limited by digital infrastructure constraints.(24) .

The study's strengths include a robust sample size and the use of both subjective and objective health measures, providing a comprehensive assessment of health outcomes. The inclusion of diverse geographic regions enhances the generalizability of the findings

to similar remote settings. However, limitations must be acknowledged. The cross-sectional design precludes causal inferences, and reliance on self-reported data may introduce reporting biases. Additionally, the exclusion of individuals with severe cognitive impairments or communication barriers could result in underrepresentation of the most vulnerable populations(25). Comparative analysis with existing literature reveals congruence with national health challenges. Pakistan's healthcare system faces significant disparities between urban and rural areas, with rural regions often lacking adequate facilities and trained personnel . The prevalence of communicable diseases, such as tuberculosis, remains a concern, particularly among marginalized groups . Moreover, environmental factors, including climate-induced disasters, have been linked to adverse health outcomes and socioeconomic hardships, further exacerbating vulnerabilities(22) .

The implications of these findings are profound. Addressing healthcare access in remote areas necessitates multifaceted strategies. Enhancing physical infrastructure, such as building more healthcare facilities and improving transportation networks, is imperative. Simultaneously, expanding digital infrastructure to support telemedicine could bridge the gap in healthcare delivery. Training and incentivizing healthcare professionals to serve in rural areas would alleviate workforce shortages. Economic empowerment initiatives, including vocational training and microfinance programs, could mitigate financial barriers to healthcare access(7). Future research should explore longitudinal designs to assess causal relationships between identified risk factors and health outcomes. Investigating the effectiveness of telemedicine interventions in digitally limited settings would provide valuable insights into scalable solutions. Additionally, qualitative studies exploring community perceptions of healthcare services could inform culturally tailored interventions. Collaborative efforts between government agencies, non-governmental organizations, and local communities are essential to implement sustainable health improvements in these underserved regions(1).

CONCLUSION

The study highlights the significant health disparities faced by remote and digitally disconnected communities in Pakistan, driven by geographic isolation, socioeconomic constraints, and inadequate healthcare access. High disease prevalence, limited affordability of medical care, and poor digital connectivity exacerbate health inequities. Addressing these challenges requires targeted interventions, including improved healthcare infrastructure, financial support mechanisms, and expanded telemedicine services. Strengthening digital literacy and healthcare accessibility in rural areas can mitigate these disparities, fostering equitable health outcomes. Future research should explore sustainable, region-specific solutions to bridge the healthcare gap and enhance the well-being of underserved populations.

AUTHOR CONTRIBUTIONS

Author	Contribution
Zeeshan Hussain*	Substantial Contribution to study design, analysis, acquisition of Data Manuscript Writing Has given Final Approval of the version to be published
Nouman Ashraf	Substantial Contribution to study design, acquisition and interpretation of Data Critical Review and Manuscript Writing Has given Final Approval of the version to be published
Teena Rajput	Substantial Contribution to acquisition and interpretation of Data Has given Final Approval of the version to be published
Attiya Najeeb Abbasi	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Tazeem Shahbaz	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Muhammad Umer	Substantial Contribution to study design and Data Analysis Has given Final Approval of the version to be published
Nazia Mauhammad Razzaq	Contributed to study concept and Data collection Has given Final Approval of the version to be published

REFERENCES

1. Cora-Cruz MS, Wilson EM, Vargas GB, Thompson V, Enenmoh I, Goffe C, et al. Applications of Mobile Health Technologies to Address Cardiometabolic Health Disparities in the United States: A Systematic Review. Ethn Dis. 2023;33(4):180-93.

2. Kim DS, Eltahir AA, Ngo S, Rodriguez F. Bridging the Gap: How Accounting for Social Determinants of Health Can Improve Digital Health Equity in Cardiovascular Medicine. Curr Atheroscler Rep. 2024;27(1):9.

3. Golden SH, Joseph JJ, Hill-Briggs F. Casting a Health Equity Lens on Endocrinology and Diabetes. J Clin Endocrinol Metab. 2021;106(4):e1909-e16.

4. Shanab BM, Gaffey AE, Schwamm L, Zawalich M, Sarpong DF, Pérez-Escamilla R, et al. Closing the Gap: Digital Innovations to Address Hypertension Disparities. Curr Cardiol Rep. 2025;27(1):23.

5. Edelman EJ, Aoun-Barakat L, Villanueva M, Friedland G. Confronting Another Pandemic: Lessons from HIV can Inform Our COVID-19 Response. AIDS Behav. 2020;24(7):1977-9.

6. Menon DU, Belcher HME. COVID-19 Pandemic Health Disparities and Pediatric Health Care-The Promise of Telehealth. JAMA Pediatr. 2021;175(4):345-6.

7. Romain CV, Trinidad S, Kotagal M. The Effect of Social Determinants of Health on Telemedicine Access During the COVID-19 Pandemic. Pediatr Ann. 2022;51(8):e311-e5.

8. Rosenblatt R, Lee H, Liapakis A, Lunsford KE, Scott A, Sharma P, et al. Equitable Access to Liver Transplant: Bridging the Gaps in the Social Determinants of Health. Hepatology. 2021;74(5):2808-12.

9. Towfighi A, Ovbiagele B. Health Equity and Actionable Disparities in Stroke: 2022 Update. Stroke. 2023;54(2):374-8.

10. Jaffe DH, Lee L, Huynh S, Haskell TP. Health Inequalities in the Use of Telehealth in the United States in the Lens of COVID-19. Popul Health Manag. 2020;23(5):368-77.

11. Madubuonwu J, Mehta P. How Telehealth Can be Used to Improve Maternal and Child Health Outcomes: A Population Approach. Clin Obstet Gynecol. 2021;64(2):398-406.

12. Novacek DM, Hampton-Anderson JN, Ebor MT, Loeb TB, Wyatt GE. Mental health ramifications of the COVID-19 pandemic for Black Americans: Clinical and research recommendations. Psychol Trauma. 2020;12(5):449-51.

13. Dolcini MM, Canchola JA, Catania JA, Song Mayeda MM, Dietz EL, Cotto-Negrón C, et al. National-Level Disparities in Internet Access Among Low-Income and Black and Hispanic Youth: Current Population Survey. J Med Internet Res. 2021;23(10):e27723.

14. Coccolini F, Cicuttin E, Cremonini C, Tartaglia D, Viaggi B, Kuriyama A, et al. A pandemic recap: lessons we have learned. World J Emerg Surg. 2021;16(1):46.

15. Monaghan M, Marks B. Personal Experiences With COVID-19 and Diabetes Technology: All for Technology Yet Not Technology for All. J Diabetes Sci Technol. 2020;14(4):762-3.

16. Chapman RR, Mohamed SB, Rage H, Abdulahi A, Jimenez J, Gavin AR, et al. Preventing Health Disparities during COVID through Perinatal Home Screening as Black Authoritative Knowledge. J Racial Ethn Health Disparities. 2024;11(3):1286-300.

17. Kerr D, Sabharwal A. Principles for virtual health care to deliver real equity in diabetes. Lancet Diabetes Endocrinol. 2021;9(8):480-2.

18. Disler R, Glenister K, Wright J. Rural chronic disease research patterns in the United Kingdom, United States, Canada, Australia and New Zealand: a systematic integrative review. BMC Public Health. 2020;20(1):770.

19. Summers-Gabr NM. Rural-urban mental health disparities in the United States during COVID-19. Psychol Trauma. 2020;12(S1):S222-s4.

20. Pham H, Ober A, Baldwin LM, Mooney LJ, Zhu Y, Fei Z, et al. Social Determinants of Health and Continuity of Medications for Opioid Use Disorder Among Patients Receiving Treatment in Rural Primary Care Settings. J Addict Med. 2024;18(3):331-4.

21. Kamitani E, Mizuno Y, Koenig LJ. Strategies to Eliminate Inequity in PrEP Services in the US South and Rural Communities. J Assoc Nurses AIDS Care. 2024;35(2):153-60.

22. Menendez ME, Moverman MA, Puzzitiello RN, Pagani NR, Ring D. The Telehealth Paradox in the Neediest Patients. J Natl Med Assoc. 2021;113(3):351-2.

23. Verduzco-Gutierrez M, Lara AM, Annaswamy TM. When Disparities and Disabilities Collide: Inequities during the COVID-19 Pandemic. Pm r. 2021;13(4):412-4.

24. Dixon-Shambley K, Gabbe PT. Using Telehealth Approaches to Address Social Determinants of Health and Improve Pregnancy and Postpartum Outcomes. Clin Obstet Gynecol. 2021;64(2):333-44.

25. Hernandez-Green N, Davis MV, Farinu O, Hernandez-Spalding K, Lewis K, Beshara MS, et al. Using mHealth to reduce disparities in Black maternal health: Perspectives from Black rural postpartum mothers. Womens Health (Lond). 2024;20:17455057241239769.

