



Effectiveness of Telemedicine-Based Health Programs on Accessibility of Health Services in Remote Areas: A Case Study in Talaud Islands Regency, North Sulawesi

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Abstract

This study examines the effectiveness of telemedicine-based health programs in enhancing healthcare accessibility, patient satisfaction, and service quality in the Talaud Islands Regency, North Sulawesi. A quantitative research design was employed, utilizing descriptive and inferential statistical methods, including t-tests, regression analysis, and ANOVA, to analyse data from 300 respondents. The results show that telemedicine significantly reduces travel time, increases satisfaction, and improves access to both general and specialist healthcare services. Frequent telemedicine use correlates with higher patient satisfaction, particularly among older adults and those with higher education. The findings underscore the importance of digital literacy and education in the successful adoption of telemedicine in rural areas. This research contributes to the literature on telemedicine by addressing gaps related to its application in underserved regions, offering valuable insights for policymakers aiming to improve healthcare delivery in remote areas.

INTRODUCTION

Telemedicine has become a critical healthcare approach in 2024, particularly in improving access to medical services in remote areas. The rapid advancements in digital health technologies and the widespread availability of mobile devices have made telemedicine an effective solution to bridge healthcare gaps in underserved regions. This trend is especially relevant in areas like the Talaud Islands Regency, North Sulawesi, where physical healthcare infrastructure and medical professionals are limited, making traditional in-person healthcare inaccessible for many residents.

The growth of the telemedicine market is significant, with projections estimating an annual growth rate of approximately 18.8% from 2024 to 2030, reflecting the increasing reliance on digital health solutions. This expansion is not just driven by convenience but also by the necessity to meet the needs of rural and underserved populations who often face severe barriers to healthcare access (Prynn et al., 2024). In Indonesia, a country with challenging geographical diversity, telemedicine offers a promising avenue to overcome logistical obstacles and provide more equitable healthcare access (Kundu et al., 2022).

Evidence from various studies shows that telemedicine effectively addresses accessibility issues, allowing patients to receive medical consultations, diagnoses, and even chronic care management remotely (Bitar & Alismail, 2021; Omboni et al., 2022). This is particularly beneficial for remote emergency departments, where telemedicine has proven effective in maintaining clinical effectiveness and improving service utilization by reducing unnecessary patient transfers and enhancing local hospital admissions (Boyd & Schwartz, 2021; Volz et al., 2021). Furthermore, telemedicine has shown promise in increasing patient satisfaction and compliance with treatment plans due to the convenience of remote consultations, leading to better health outcomes over time (Haleem et al., 2021; George & George, 2023).

In the case of the Talaud Islands, telemedicine can be particularly transformative, addressing several challenges such as the shortage of healthcare personnel and the limited availability of specialty services (Adeghe et al., 2024; Ftouni et al., 2022). By leveraging telemedicine, residents in these remote areas can access healthcare services without the financial and logistical burdens associated with traveling to urban centers. Recent studies have shown that telemedicine can alleviate these burdens by enabling remote patient monitoring and consultations through digital platforms, facilitating continuous care for chronic conditions and reducing the need for frequent in-person visits (Savitz & Bayliss, 2021; Khera et al., 2020; Kelley et al., 2020).

However, implementing telemedicine in remote regions like Talaud is not without challenges. One primary barrier is the digital divide, which limits access to high-speed internet and digital literacy in some communities. Addressing these gaps is essential to maximizing telemedicine's effectiveness and ensuring it serves all populations equally. Additionally, the regulatory landscape and data privacy concerns pose hurdles that require thoughtful solutions to ensure patient confidentiality and compliance with healthcare standards (Singh & Kaunert, 2024; Rauniyar et al., 2023).

In summary, telemedicine's impact on improving healthcare accessibility in remote areas is profound, especially in areas like the Talaud Islands, where healthcare disparities are pronounced. By facilitating continuous, cost-effective care, telemedicine holds the potential to revolutionize healthcare delivery in Indonesia's remote regions, ensuring that residents receive timely, high-quality medical services regardless of their geographical location. The next steps involve addressing technical and regulatory challenges to enable seamless integration of telemedicine into the broader healthcare system, ensuring its long-term sustainability and effectiveness in providing equitable healthcare access across the nation (Pereno & Eriksson, 2020; Debie et al., 2022; Shaw et al., 2021).

This study holds substantial significance in the context of global health, rural healthcare access, and digital health innovations. By examining the effectiveness of telemedicine in the Talaud Islands, it contributes to a growing body of knowledge on how telemedicine can alleviate healthcare access disparities in remote and underserved regions. For policymakers, this research provides data-driven insights that can guide decisions on telemedicine expansion and resource allocation, especially in other isolated areas within Indonesia or similar geographies worldwide. Additionally, understanding telemedicine's impact on patient satisfaction and engagement offers healthcare providers valuable information to tailor their services more effectively to the unique needs of remote populations. The study's findings may also address concerns about the feasibility and sustainability of telemedicine in resource-limited settings, ultimately helping to shape more inclusive and accessible healthcare systems.

In the context of this study, several terms are crucial for understanding the research scope and methodology. Telemedicine refers to the use of electronic communication and digital technology to provide clinical healthcare remotely, particularly helpful in situations where traditional, in-person healthcare is difficult to access. Accessibility in healthcare implies the ease with which patients can reach necessary medical services, including factors such as location, availability of services, and affordability. The term remote areas refers to regions geographically distant from urban centres, often characterized by limited infrastructure and healthcare resources. Healthcare quality encompasses the standard of care provided, measured by outcomes like patient satisfaction, efficacy, and safety of services delivered. Lastly, patient satisfaction involves the perceived quality and effectiveness of healthcare from the patient's perspective, including factors like convenience, treatment outcomes, and communication with healthcare providers. These terms collectively frame the study's objectives, focusing on telemedicine as a tool to enhance healthcare accessibility and quality for remote populations.

Despite the potential contributions of this research, there are several limitations to consider. Firstly, the study focuses exclusively on the Talaud Islands Regency, which may limit the generalizability of findings to other remote areas with different sociocultural, infrastructural, or economic contexts. Secondly, telemedicine's effectiveness may be influenced by external factors such as internet connectivity, patient digital literacy, and the availability of healthcare providers to operate the telemedicine platforms. These variables may introduce inconsistencies in the data and affect the outcomes in ways that are not fully controllable within the study's scope. Additionally, the study's reliance on quantitative data might overlook nuanced qualitative aspects of patient experiences and satisfaction with telemedicine services. Finally, the study's cross-sectional design means that it captures a single point in time, limiting insights into the long-term effects of telemedicine implementation. Future longitudinal studies would be beneficial to observe the sustained impact of telemedicine on healthcare accessibility and quality in remote areas.

Literature Review

The use of telemedicine has grown exponentially over recent years, driven by technological advancements, the COVID-19 pandemic, and the increasing need for accessible healthcare in remote areas. Telemedicine, defined as the use of telecommunications technology to provide healthcare services from a distance, has shown promise in improving accessibility, reducing healthcare costs, and enhancing patient satisfaction in underserved regions. Recent studies highlight telemedicine's capacity to bridge healthcare gaps in remote and rural communities by offering essential services like consultations, diagnoses, and follow-ups that would otherwise require extensive travel (Almathami et al., 2020; Kruse et al., 2017).

Several studies confirm that telemedicine can significantly enhance healthcare access in remote areas. For example, a systematic review by Kruse et al. (2017) found that telemedicine reduces healthcare access disparities by enabling remote populations to receive timely care without the need for physical visits, which are often logistically and financially burdensome. Almathami et al. (2020) also demonstrated that telemedicine reduces travel costs and time, particularly beneficial for remote regions with limited healthcare infrastructure. A study in rural Australia found telemedicine useful in managing emergency cases by offering immediate consultation with specialists, thereby improving patient outcomes and reducing hospital transfers (Boyd et al., 2021).

The COVID-19 pandemic further accelerated the adoption of telemedicine worldwide. Research indicates that during the pandemic, telemedicine enabled continuity of care for chronic conditions and other non-emergency services, especially in areas with

limited healthcare resources (Monaghesh & Hajizadeh, 2020). A 2021 survey conducted in various remote Indonesian regions indicated that telemedicine was critical in maintaining healthcare services during the pandemic, as travel restrictions limited physical access to healthcare facilities (Mahendradhata et al., 2021; Effendi et al., 2024).

Studies show that telemedicine can enhance healthcare quality by allowing healthcare providers to monitor and follow up with patients more frequently and effectively. A study by Dorsey and Topol (2020) concluded that telemedicine facilitates early diagnosis and management of health issues, which can reduce the severity and cost of treatments required over time. Furthermore, an analysis of telehealth interventions in remote Indian communities highlighted improvements in patient satisfaction, as telemedicine increased the frequency of patient-provider interactions, allowing for more personalized care (Joshi et al., 2021).

In the Indonesian context, a study by Fauzi & Pratama (2022) on telemedicine use in remote Indonesian islands revealed high patient satisfaction due to the convenience and immediacy of care. Patients reported higher satisfaction levels because they could receive professional medical advice without leaving their communities, which is particularly important in geographically challenging areas (Fauzi & Pratama, 2022). Another study by Sudarso and Wijaya (2023) found that the continuity provided by telemedicine improved patient adherence to treatment plans, especially among those managing chronic diseases (Jiang et al., 2022; Nassi et al., 2023).

Despite its benefits, implementing telemedicine in remote areas comes with challenges. One significant barrier is the digital divide, which includes limitations in internet connectivity, digital literacy, and device availability (Monaghesh & Hajizadeh, 2020). A study by Sun et al. (2022) found that while telemedicine improved healthcare accessibility, its effectiveness was limited by internet availability and user familiarity with digital platforms in remote areas of Sub-Saharan Africa, suggesting that similar challenges may apply in Indonesia's rural settings.

Additionally, regulatory issues regarding data privacy and security have raised concerns about the safe implementation of telemedicine services. In regions with inadequate regulations or infrastructure, protecting patient confidentiality and ensuring secure communication can be challenging (Sharma et al., 2023; Shahid et al., 2022). In Indonesia, these concerns have been addressed through recent policy revisions promoting telemedicine while ensuring data privacy, yet challenges persist due to inconsistencies in policy implementation across regions (Putri, 2023).

Several studies have specifically analyzed telemedicine's impact in Indonesia. A study by Handayani et al. (2023) evaluated the effectiveness of telemedicine in reaching underserved regions in West Papua and Kalimantan. The study found improvements in healthcare accessibility and reduced patient travel costs, yet noted that infrastructure limitations hindered optimal telemedicine usage. Similarly, the findings of a study by Fauzi & Pratama (2022) in the remote islands around Bali confirmed that telemedicine improved patient access to primary care, though challenges with internet connectivity were frequently reported.

METHODS

Research Design

This study employed a quantitative, cross-sectional survey design to assess the effectiveness of telemedicine-based health programs in enhancing healthcare accessibility, service quality, and patient satisfaction among residents of the Talaud Islands Regency, North Sulawesi. Given the region's geographical isolation and limited access to in person healthcare, telemedicine offers an alternative model for

delivering medical services. This methodology aimed to capture insights from residents who had directly engaged with telemedicine services, allowing for a comprehensive understanding of telemedicine's impact on healthcare access and satisfaction in a remote setting.

Participants

The study targeted residents within the Talaud Islands who had utilized telemedicine services. Due to the need for participants with specific experience in using telemedicine, a purposive sampling technique was selected. This method ensured that responses were relevant to the study objectives, as participants were chosen based on their direct engagement with telemedicine, providing insights from individuals with firsthand experience. By narrowing the sample to individuals who had used telemedicine, the study aimed to gather detailed and meaningful data regarding telemedicine's influence on healthcare accessibility in the region. The sample size was determined based on a 95% confidence level and a 5% margin of error, factoring in both the population size and characteristics of similar studies. This approach aimed to achieve sufficient statistical power and representation of the target population within the remote community.

Data Collection Instrument

Data was collected through a structured questionnaire, designed specifically to capture key variables related to healthcare accessibility, service quality, and patient satisfaction. The questionnaire was divided into three main sections: (1) Healthcare Accessibility, measuring how often participants accessed telemedicine services and the types of services used; (2) Service Quality, where respondents rated aspects such as the clarity of communication, timeliness, and reliability of the care received through telemedicine; (3) Patient Satisfaction, evaluated through a series of Likert-scale questions covering convenience, treatment effectiveness, and overall experience.

Given the region's limited internet infrastructure, the survey was distributed through a combination of digital platforms and phone or in-person interviews to maximize participant inclusivity. By using a mixed-method approach to survey distribution, the study accommodated both digitally connected participants and those in areas with limited connectivity. This approach was crucial in ensuring that data collection encompassed all demographics within the target population, thus strengthening the representativeness of the study findings.

Validation of Instrument

To ensure the reliability and validity of the survey instrument, a pilot study was conducted with 30 participants who met the inclusion criteria but were not part of the main study population. This pilot testing allowed for the identification and correction of ambiguities in the questionnaire, ensuring that all questions were clear and relevant to the study objectives. The reliability of the survey sections was assessed using Cronbach's alpha, aiming for a reliability coefficient of at least 0.70 for each section. The pilot study results demonstrated adequate internal consistency across sections, with Cronbach's alpha coefficients meeting the minimum threshold, confirming that the instrument was robust and well-suited for the larger study.

Data Analysis

The study applied both descriptive and inferential statistical analyses to examine the data collected. Descriptive statistics, including means, frequencies, and percentages, were used to provide an overview of participants' responses related to healthcare accessibility, service quality, and satisfaction levels. These descriptive analyses highlighted the general patterns and distributions within the data. For inferential

analysis, several statistical techniques were used to test relationships and differences across various variables. Independent t-tests were conducted to compare satisfaction and perceived quality scores across demographic groups such as age and gender. Multiple regression analysis was applied to explore the relationships between independent variables, such as frequency of telemedicine use and internet connectivity, and dependent variables like accessibility and satisfaction levels. This analysis allowed for identifying which factors most significantly predicted improvements in healthcare accessibility and satisfaction. Additionally, ANOVA (Analysis of Variance) was used to assess whether there were statistically significant differences in healthcare accessibility scores across different education levels and income brackets. Finally, Pearson’s correlation analysis was conducted to examine associations between key variables, such as the relationship between perceived quality and overall satisfaction, revealing significant correlations within the data.

RESULTS AND DISCUSSION

These results are based on the questionnaire data collected from participants in the Talaud Islands Regency regarding their experiences with telemedicine services.

Table 1. Frequency of Telemedicine Usage

Frequency of Telemedicine Usage	Number of Respondents	Percentage (%)
Daily	15	12.5
Weekly	50	41.7
Monthly	30	25.0
Rarely	20	16.7
Never	5	4.2
Total	120	100

The majority of respondents (41.7%) reported using telemedicine services weekly, followed by 25% who used it monthly. A small percentage (4.2%) indicated they had never used telemedicine, suggesting that telemedicine is widely adopted in the region. This distribution shows that telemedicine is a frequent source of healthcare access for many, with the bulk of the population utilizing it at least monthly. Similar findings were observed in other remote regions, where regular use of telemedicine was linked to better access to healthcare (Almathami et al., 2022).

Table 2. Satisfaction with Telemedicine Service Quality

Service Quality Aspect	Mean Score (1-5)	Standard Deviation
Clarity of Communication	4.3	0.75
Timeliness of Service	4.0	0.80
Reliability of the Technology	4.2	0.72
Provider Interaction and Support	4.5	0.65
Overall Satisfaction with Telemedicine	4.3	0.70

The respondents reported high levels of satisfaction with telemedicine services, with *"Provider Interaction and Support"* receiving the highest average score (4.5), indicating that patients felt well-supported during consultations. The *"Clarity of Communication"* also received a high score (4.3), reflecting the effectiveness of telemedicine platforms in delivering clear healthcare advice. The overall satisfaction score (4.3) indicates a generally positive experience. Similar findings have been reported by studies such as Joshi et al. (2021), which highlighted high levels of patient satisfaction due to enhanced communication and provider interaction.

Table 3. Healthcare Accessibility before and after Telemedicine Implementation

Accessibility Criteria	Before Telemedicine (Mean Score 1-5)	After Telemedicine (Mean Score 1-5)	Difference (Mean)
Access to General Practitioner	2.8	4.2	+1.4
Access to Specialist Care	2.5	3.9	+1.4
Travel Time to Healthcare Facility	3.7	1.5	-2.2
Overall Access to Healthcare	3.0	4.0	+1.0

The data reveals a significant improvement in healthcare accessibility following the implementation of telemedicine services. The mean score for "Access to General Practitioner" rose by 1.4 points, and "Access to Specialist Care" also increased by 1.4 points, indicating that telemedicine has successfully facilitated easier access to both general and specialized healthcare. The reduction in "Travel Time to Healthcare Facility" (a decrease of 2.2 points) suggests that telemedicine has substantially reduced the burden of travel, a major issue in remote regions (Kruse et al., 2017). These results reflect the findings of Boyd & Schwartz (2021), which demonstrated that telemedicine reduces the need for long distance travel for healthcare in rural areas.

Table 4. Correlation Between Telemedicine Usage and Patient Satisfaction

Variables	Pearson Correlation Coefficient	Significance (p-value)
Frequency of Telemedicine Usage vs. Overall Satisfaction	0.72	0.001
Frequency of Telemedicine Usage vs. Service Quality	0.65	0.003
Clarity of Communication vs. Satisfaction	0.77	0.000

There is a strong positive correlation between the frequency of telemedicine usage and both overall patient satisfaction ($r = 0.72$) and service quality ($r = 0.65$), with both correlations being statistically significant ($p < 0.05$). The correlation between "Clarity of Communication" and "Satisfaction" is even stronger ($r = 0.77$), which supports the idea that clear and effective communication via telemedicine enhances patient satisfaction. These findings are consistent with studies that suggest frequent use of telemedicine leads to higher satisfaction levels, especially when communication is clear and technology is reliable (Monaghesh & Hajizadeh, 2020).

Table 5. Comparison of Healthcare Access Before and After Telemedicine Using Paired t-test

Healthcare Access Metric	Mean Before Telemedicine	Mean After Telemedicine	t-value	p-value
Access to General Healthcare Services	2.8	4.2	-14.55	0.000
Access to Specialist Services	2.5	3.9	-13.24	0.000

The results of the paired t-test show significant improvements in healthcare access after the implementation of telemedicine services, with both p-values (0.000) being less than the significance level of 0.05. The t-values indicate that the mean scores for healthcare access to both general and specialist services have significantly increased, confirming that telemedicine has positively impacted healthcare access in

the region. These findings align with studies such as those by Dorsey and Topol (2020), who observed similar improvements in healthcare accessibility following telemedicine adoption.

Table 6. Independent t-test – Satisfaction by Age Group

Age Group	Mean Satisfaction Score	Standard Deviation	t-value	p-value
18-30 years	4.0	0.75	-2.31	0.022
31-50 years	4.3	0.70		
51 years and above	4.5	0.65		

The results of the independent t-test indicate a statistically significant difference in satisfaction scores between the younger age group (18-30 years) and the older age groups (31-50 years and 51+ years). The p-value of 0.022 suggests that age plays a role in satisfaction with telemedicine services, with older age groups reporting higher satisfaction levels. This finding aligns with other studies, such as those by Wang et al. (2020), which observed that older adults tend to have a higher satisfaction rate due to perceived improvements in healthcare access and support.

Table 7. Independent t-test – Satisfaction by Gender

Gender	Mean Satisfaction Score	Standard Deviation	t-value	p-value
Male	4.2	0.70	1.45	0.149
Female	4.3	0.75		

The independent t-test results show no significant difference in satisfaction scores between males and females ($p = 0.149$), indicating that gender does not significantly influence patient satisfaction with telemedicine services. This is consistent with findings from several other studies (e.g., Monaghesh & Hajizadeh, 2020), which found that satisfaction with telemedicine is typically independent of gender.

Table 8. Multiple Regression Analysis – Predictors of Patient Satisfaction

Predictor Variables	Unstandardized Coefficient (B)	Standardized Coefficient (Beta)	t-value	p-value
Frequency of Telemedicine Use	0.45	0.35	4.20	0.000
Clarity of Communication	0.50	0.42	5.10	0.000
Access to Healthcare Services	0.30	0.25	3.20	0.002
Reliability of Technology	0.25	0.20	2.50	0.015

The multiple regression analysis reveals that frequency of telemedicine use ($B = 0.45$), clarity of communication ($B = 0.50$), and access to healthcare services ($B = 0.30$) are significant predictors of patient satisfaction, with p-values all less than 0.05. The positive coefficients suggest that as these factors improve, patient satisfaction with telemedicine increases. Notably, clarity of communication has the strongest predictive power ($Beta = 0.42$), which is consistent with findings in the literature (e.g., Joshi et al., 2021), where clear communication in telemedicine was linked to improved patient satisfaction.

Table 9. One-Way ANOVA – Healthcare Accessibility by Education Level

Education Level	Mean Healthcare Accessibility Score	Standard Deviation	F-value	p-value
No Formal Education	3.0	1.05	6.15	0.003
Primary Education	3.5	0.95		
Secondary Education	4.0	0.80		

Higher Education	4.3	0.70		
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The one-way ANOVA results indicate significant differences in healthcare accessibility scores across different education levels ($p = 0.003$). Post-hoc tests (Tukey's HSD) would likely show that individuals with higher education report the best access to healthcare services through telemedicine, followed by those with secondary education. Lower scores for participants with no formal education suggest they face more barriers to accessing telemedicine, which could be due to a lack of familiarity with technology or lower digital literacy. These findings align with similar research by Almathami et al. (2022), which indicated that individuals with higher education levels were more likely to use and benefit from telemedicine services.

Table 10. ANCOVA – Adjusted Travel Time to Healthcare Facility by Telemedicine Usage Frequency

Telemedicine Usage Frequency	Mean Travel Time (Before)	Mean Travel Time (After)	F-value	p-value
Daily	2.0 hours	0.5 hours	22.30	0.000
Weekly	2.5 hours	1.0 hours	18.45	0.000
Monthly	3.0 hours	1.5 hours	15.20	0.000
Rarely	3.5 hours	2.0 hours	11.10	0.000

The ANCOVA analysis, adjusted for telemedicine usage frequency, shows that telemedicine significantly reduced the travel time required to access healthcare services. The p-values for all groups are less than 0.05, indicating statistically significant reductions in travel time after the implementation of telemedicine. Respondents who used telemedicine daily reported the greatest reduction in travel time (from 2.0 to 0.5 hours). This result supports the assertion that telemedicine alleviates the burden of travel in remote areas (Kruse et al., 2017), enabling quicker access to healthcare services.

Discussion

This study sought to assess the effectiveness of telemedicine-based health programs in improving healthcare accessibility, service quality, and patient satisfaction in remote regions of the Talaud Islands Regency, North Sulawesi. The findings highlight significant trends in how telemedicine impacts healthcare delivery and patient experiences, particularly in underserved and geographically isolated areas. The statistical results derived from the analysis comprising t-tests, regression analysis, and ANOVA helped to reveal critical factors influencing the success of telemedicine interventions. These findings contribute to a growing body of literature on telemedicine in rural and remote settings, addressing gaps in current knowledge regarding its effectiveness in enhancing access to healthcare services.

This study revealed that age and education level are significant factors influencing patient satisfaction and healthcare accessibility. The regression analysis showed that older individuals and those with higher education levels tend to have higher satisfaction with telemedicine services. Specifically, older individuals (aged 51 and above) reported greater satisfaction, likely due to the perceived reduction in travel time and the convenience telemedicine provides in terms of accessing healthcare without the need for physical travel. This finding echoes, previous studies by Wang et al. (2020) and Krausz et al. (2021), which found that older adults, who may have difficulty traveling long distances or accessing healthcare due to mobility or financial constraints, experience greater benefits from telemedicine interventions.

Furthermore, the significant differences in healthcare accessibility scores based on education level (as shown by the ANOVA results) underscore the importance of digital literacy and education in telemedicine adoption. Higher education levels were linked to better access to healthcare services, suggesting that individuals with higher

education may be more familiar with technology and thus better able to navigate telemedicine platforms. These results are consistent with studies by Almathami et al. (2022) and Kruse et al. (2017), which emphasized the role of education and technological literacy in telemedicine uptake and satisfaction. These findings address a critical gap in the literature regarding the influence of socio demographic factors on telemedicine utilization in rural areas, an issue that had not been adequately explored in previous studies focusing primarily on larger cities or more technologically advanced populations.

The study found that frequency of telemedicine use was a major predictor of patient satisfaction. Individuals who used telemedicine services more frequently particularly those using the service daily reported higher satisfaction scores. This result aligns with findings by Monaghesh & Hajizadeh (2020), which suggested that frequent engagement with telemedicine services helps build trust in the system and enhances the overall user experience. As Joshi et al. (2021) indicated, regular use of telemedicine services leads to greater familiarity with the technology, reducing initial apprehension and leading to increased satisfaction over time. This study, therefore, extends the existing literature by highlighting how the frequency of use rather than just the availability of service can drive satisfaction and long-term adoption in remote regions.

One of the most striking findings of this study was the significant reduction in travel time to healthcare facilities as a result of telemedicine use. The ANCOVA results clearly showed that individuals who used telemedicine regularly experienced notable reductions in travel time, with daily users benefiting the most. This supports findings from Kruse et al. (2017), who concluded that telemedicine can significantly reduce the logistical burden of healthcare access, particularly in rural or remote areas where physical healthcare facilities are scarce. The travel time reduction observed in this study is consistent with global trends in telemedicine adoption, where users report less need to travel long distances for care, thus increasing healthcare access and decreasing the financial and emotional strain associated with long distance travel (Dorsey & Topol, 2020).

This study makes several contributions to the existing body of telemedicine literature, particularly in the context of remote rural areas like the Talaud Islands Regency. While telemedicine has been extensively studied in urban and suburban settings, its impact on healthcare in remote regions with limited internet infrastructure had not been thoroughly examined. This study provides critical insights into how telemedicine can enhance access to healthcare in hard to reach areas, confirming that telemedicine is not just a supplementary option, but a necessary tool in addressing the geographical and infrastructural challenges faced by these communities. By focusing on the specific needs of remote regions, this study helps bridge the gap in literature regarding telemedicine's effectiveness in rural Southeast Asia, where challenges related to geography, poverty, and healthcare infrastructure are particularly pronounced.

Furthermore, this study addresses a notable gap in the literature regarding education and technological literacy as determinants of telemedicine success. Previous research often focused on general adoption rates or user experiences without differentiating the impact of socio demographic factors such as education, which can significantly affect how individuals engage with telemedicine platforms. By examining how educational background influences telemedicine use and satisfaction, this study offers a more nuanced understanding of the barriers and facilitators to telemedicine in rural populations.

Finally, the study contributes to the growing literature on telemedicine's role in improving access to specialized care. The ANOVA results demonstrated that

specialist healthcare services were more accessible than general healthcare services through telemedicine, confirming previous research by Dorsey & Topol (2020). This finding suggests that telemedicine may particularly improve access to specialized care in underserved regions, where patients often face long wait times and travel burdens to see specialists. By providing accessible teleconsultations with specialists, telemedicine may help reduce the disparity in healthcare availability between urban and remote areas.

CONCLUSION

This study highlighted the effectiveness of telemedicine-based health programs in improving healthcare accessibility, patient satisfaction, and service quality in the remote Talaud Islands Regency of North Sulawesi. The findings indicate that telemedicine is not only a valuable tool for reducing travel time but also enhances satisfaction, particularly among frequent users and those with higher levels of education. By exploring the relationship between socio-demographic factors, frequency of use, and healthcare access, the study adds significant depth to existing literature on telemedicine's role in remote and underserved areas. The results demonstrate that telemedicine has a pronounced positive impact on healthcare delivery by bridging geographical and logistical barriers, allowing for greater access to both general and specialized care. This study contributes to the understanding of telemedicine in rural Southeast Asia, an area underrepresented in prior research, and emphasizes the need for digital literacy to fully leverage telemedicine's potential in such communities. Furthermore, the study underlines the importance of healthcare policies that support technological access and promote widespread adoption, as these factors can significantly enhance the benefits of telemedicine in improving health outcomes. Overall, the results validate telemedicine as an essential component in modern healthcare delivery systems, especially in regions where traditional healthcare infrastructure remains limited.

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