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RESEARCH ARTICLE

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Access to equitable medicines in a resource-constrained environment. A mixed-methods study from rural Zimbabwe

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ABSTRACT
Inequitable access to essential medicines persists in rural areas due to systemic distribution failures, creating critical evidence gaps for addressing health disparities. In Zimbabwe, where more than 61% of the population resides in rural areas, the determinants of access to medicine remains poorly understood. This study aimed to determine the factors affecting access to medicines in subsistence markets in Zimbabwe. The study was guided by a conceptual framework based on the WHO's dimensions of healthcare access. A mixed methods study was conducted in four rural districts in Zimbabwe using data collected from January 2024 to June 2024. Quantitative data collected from residents, healthcare providers and community leaders were analyzed using linear regression, while thematic analysis was used to analyze qualitative information. Geographical accessibility (13% effect, $p < 0.05$), adequacy (7% effect, $p < 0.1$), and affordability (5% effect, $p < 0.1$) significantly improved access to medicine. Household head education showed a minor positive impact. Qualitative analysis revealed four main themes, financial barriers (poverty, lack of insurance, catastrophic costs), geographic accessibility, supply chain failures, and quality of care. Findings confirm that geographical access, affordability, and adequacy are critical levers for improving medicine access in rural Zimbabwe, aligning with studies in similar resource-constrained settings. Policymakers should focus on improving medicine access, prioritizing rural populations as they form the national majority. Healthcare facilities should implement strategies to reduce geographical barriers and improve medicine availability. Future research should conduct cross-country comparative analyses. This study provides integrated evidence to advance Universal Health Coverage in rural contexts.

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KEYWORDS
Access to medicine; rural Zimbabwe; availability of medicine; mixed method

Introduction

The ability of people to acquire essential medicines and medical services, guaranteeing that they get suitable treatment for their ailments without facing financial, geographic, or structural obstacles, is known as access to medicine, (Abbas et al., 2020; Yenet et al., 2023; Cao et al., 2021). Access to safe, effective, quality, and affordable essential medicines is an integral component of contemporary health systems embraced worldwide (Adebisi et al., 2022; Cortes et al., 2020; Jefford et al., 2022; Mao et al., 2022; World Health Organization, 2004). The World Health Organization (WHO) has set standards that every member country should attain to ensure accessibility to healthcare. Essential medicines are those that address a population's top healthcare needs, are safe and effective, always available in sufficient quantities, in the right dose forms, of guaranteed quality, and reasonably priced for both individuals and the community. Access to healthcare remains a daunting challenge for the poor, especially for those residing in rural areas in developing countries (Adebisi et al., 2022; Amri & Sihotang, 2023). Achieving equitable access (ensuring availability, affordability, accessibility and quality of medicines for all) regardless of location or socioeconomic status remains a formidable challenge in resource-constrained environments.

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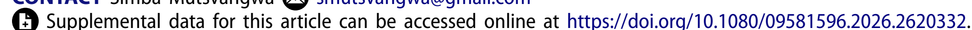
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According to the WHO (2017), at least half of the world's population cannot obtain essential health services. Consequently, more than two billion people, particularly those in marginalized areas, may rely on herbal medicines and other alternative therapies (Ozawa et al., 2019, Mahomoodally, 2013). According to Ozawa et al. (2019), the prevailing situation entails that medicines may be unavailable, unaffordable, and unacceptable, or that those available may be of poor quality. Chandani et al., 2012) observed a serious lack of understanding of the determinants of accessibility and equitable distribution of essential medicines in developing countries, particularly in rural areas. Some writers suggests that identifying and examining these factors may help achieve universal access to medicines by all citizens according to need, regardless of location and their ability to pay. The envisaged net effects include tremendous improvements in health outcomes, such as reduced morbidity and mortality, which translate into increased life expectancy and productivity in the country. Health care, in which access to medicines is a critical component, is therefore a fundamental prerequisite to realizing individual potential and equal opportunity for all, (Adebisi et al., 2022; Cortes et al., 2020; Jefford et al., 2022; Mao et al., 2022; World Health Organization, 2004). Unaffordable prices and the non-availability of medicines have become one of the most pressing concerns for patients and healthcare systems in high-, middle-, and low-income countries.

Zimbabwe is a landlocked country located in Sub-Saharan Africa with an approximate area of 390 760 square kilometres and is divided into eight predominantly rural provinces and two metropolitan provinces, (Mano & Nhemachena, 2007; Samu & Akıntuğ, 2020). According to the population census of 2022, Zimbabwe has a total population of approximately16 million people with 61 percent of whom reside in rural areas, hence, the country is regarded as a rural region. Furthermore, 61% of the total women population lives in the rural areas which give more health access burden as most households in the rural areas are managed by women, (Chipunza & Nhamo, 2023; Lukwa et al., 2024; Mangundu et al., 2023).

At an average life expectancy of 60 years in 2022, compared to the United Nations benchmark of 73 years, Zimbabwe has arguably one of the lowest life expectancies in the world according to the United Nations (Heuveline, 2022; World Health Organization, 2023). This low life expectancy can be directly attributed to suboptimal access to essential medicines, as the lack of timely and appropriate treatment for common and chronic diseases leads to higher mortality rates and preventable deaths. People in Zimbabwe continue to experience a heavy burden of acute and chronic diseases, with rural dwellers carrying the greater part of it. The maternal mortality rate, infant mortality rate, and under-five mortality rate have all risen in the period up to 2022 compared to the periods after the country attained independence in 1980. Using the World Bank Development Indicators data, Zimbabwe maternal mortality ratio per 100 000 live births has been high compared to the World average ratio. The country had maternal mortality ratio per 100 000 live births of 353, 405, 567, 380, 446, 368 and 358 for the years 1990, 2000, 2010, 2020, 2021, 2022 and 2023 respectively while the World ratio for the same period was 391,328, 253, 211, 242, 203 and 197 respectively. Currently, Zimbabwe's health statistics make for a sad reading, for the most part. The figures depict a short life span for both young people and adults, mainly due to issues surrounding equitable access to essential medicines (UNAIDS, 2022).

The biggest contributor to the negative figures is the rural sector, where issues related to access and the equitable distribution of essential medicines, among other challenges, continue to hog the limelight. It is estimated that approximately 50% of the country's population does not have access to essential medicines. On a global level, it is estimated that 33% of the global population has no access to essential medicines (Bazargani, 2019). Adequacy of medicine refers to the availability, quality, and suitability of medical treatments and pharmaceuticals to meet the healthcare needs of a population, and access to medicine refers to the ability of individuals and communities to obtain and use the medicines they need. Based on the previous literature and information related to access to healthcare services, it is still difficult to reach a general consensus on how availability, geographical access, affordability, and adequacy affect access to medicines, especially in the rural areas of Zimbabwe. Against the above background, this study seeks to determine the factors affecting access to medicines in subsistence markets in Zimbabwe. The subsistence markets in Zimbabwe are charectised by mostly community members that do business primarily to meet their basic needs like health and food, rather than to purchase luxury goods and services. This environment is mainly ideal for this research as it accommodate most vulnerable population who are mostly affected by a shortage of health care goods and services. The study addresses the gap by providing integrated quantitative and qualitative evidence on the specific, combined impact of

geographical access, affordability and adequacy within Zimbabwe's rural context. To the best of our knowledge, no comprehensive and in-depth study has been conducted in the past to investigate equitable access to essential medicine. The in-depth study will consider all the determinants discussed in the previous sections. Therefore, this study aims to fill the current research gap and contribute to the literature on the health services access. The findings will ultimately enable pharmaceutical and healthcare policy makers for developing countries to design and improve the healthcare system that addresses the diverse medical needs of the population in an equitable, efficient, and responsive manner in working towards the Universal Health Coverage agenda.

Conceptual framework

The conceptual framework presented in Figure 1 presents that medical access can be affected by the availability, geographical accessibility, affordability, and adequacy of medicine. Other control variables, such as household head's income and education, are also included. The framework presents a clearer relationship between the dependent variables and the main dependent variable giving a clearer guidance on the whole research process. This framework was used to guide the development of data collection instruments, structure the analysis plan, and interpret the findings. Specifically, the framework informed the selection of variables for the regression model and the thematic areas explored in the qualitative component. In this study, access to medicine and equitable access to medicine are used interchangeably to refer to the ability of individuals to obtain needed medicines regardless of their socioeconomic status or geographical location. Equitable access emphasizes the fairness and justice in the distribution of healthcare resources, ensuring that vulnerable populations are not disadvantaged.

Linked to the conceptual framework, this study is guided by the following hypotheses:

H1: Geographical accessibility positively and significantly affect access to medicine

Geographical accessibility is the physical proximity to healthcare facilities and ease of reaching them, measured on a 5-point Likert scale (1=Very difficult, 5=Very easy) assessing distance to nearest health facility, transportation availability, travel time, and terrain challenges.

H2: Affordability of medicine positively and significantly affect access to medicine.

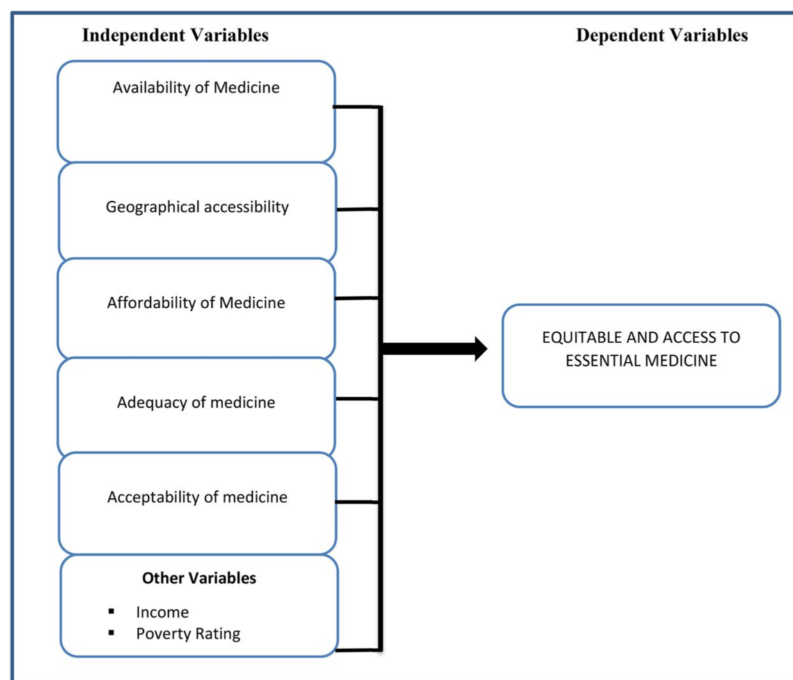

Figure 1. Conceptual model.

Affordability is the financial burden of obtaining medicines, measured on a 5-point Likert scale (1 = Very unaffordable, 5 = Very affordable) assessing medicine costs, household expenditure on medicines, and financial sacrifices made to obtain medicines.

H3: Adequacy of medicine positively and significantly affect access to medicine

Adequacy is the appropriateness and sufficiency of healthcare services, measured on a 5-point Likert scale (1 = Very inadequate, 5 = Very adequate) assessing waiting times, healthcare provider availability, quality of consultation, and follow-up care.

H4: Acceptability positively and significantly affect access to medicine

Acceptability the cultural appropriateness and patient satisfaction with healthcare services, measured on a 5-point Likert scale (1 = Very unacceptable, 5 = Very acceptable) assessing cultural sensitivity, provider attitudes, communication quality, and trust in healthcare providers.

H5: Availability positively and significantly affect access to medicine,

Availability is the presence of essential medicines at healthcare facilities when needed, measured on a 5-point Likert scale (1 = Very poor, 5 = Very good) assessing stock levels, frequency of stockouts, and variety of medicines available, and

H6: Household head education positively and significantly affect access to medicine

Household head education is the highest level of education attained by the household head, measured using categories: 1 (no education), 2 (primary education), 3 (Secondary Education), 4 (certificate), and 5 (diploma, degree, and above).

Methods

Study design setting and period

This study employed a mixed-methods (qualitative and quantitative) design incorporating focus group discussions FGDs, and key informant interviews (KIIs) and questionnaires for data collection. A mixed method provides a more comprehensive and robust understanding by combining the strengths of both quantitative (breadth, generalizability) and qualitative (depth, context) approaches. The study was conducted in four rural districts of Zimbabwe (Shamva, Rushinga, Bikita, and Chivi) from January 2024 to June 2024. These locations were selected because they represent typical rural settings with documented challenges in health-related problems, making them suitable for investigating factors affecting access to medicines in Zimbabwe A methodological summary is shown in Figure 2.

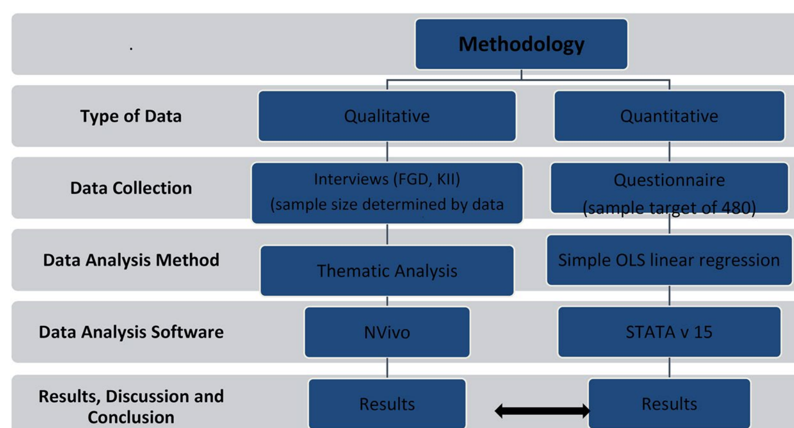

Figure 2. Methodology in summary.

Study population

The qualitative data collection methods used were key informant interviews (KII) with senior medical personnel in the district, community health coordinators, and focus group discussions. Seven FGDs were conducted with 72 participants (with average of 8–10 people per group). Twenty-eight healthcare providers and community heads were interviewed as key informants. Informed written consent for participation was obtained from the interview respondents.

Inclusion criteria for survey participants were adults aged 18 years or above who had sought healthcare in the past 12 months and resided in the study area for at least one year. Exclusion criteria were cognitive impairment preventing participation and inability to provide informed consent. For FGDs, participants were required to have experience with obtaining medicines in the past year. For KIIs, healthcare providers working in the study area were included. Those who had worked in the area for less than three months were excluded.

Sample size and sampling considerations

The sample size for the survey was determined using the Cochran formula (1977), with a 95% confidence interval. This resulted in a minimum required sample size of 384 respondents. Accounting for a 10% non-response rate, the study targeted 480 survey participants. Sampling was done using stratified random sampling. Each district was considered a stratum and within each stratum, random sampling was done. Each of the two selected provinces had the same sample weight of 240 households. From the randomly selected districts, rural wards were randomly selected. The 120 households allocated to the ward were distributed proportionally to the villages according to their size determined by number of households in each ward. Households were then randomly selected using the village registers from the village heads.

For FGDs, 7 groups with 8–10 participants each were planned for. 28 KIIs of healthcare providers were administered and healthcare providers and community heads were selected to ensure representation from different levels of the healthcare system and community leadership. The number of FGDs was based on similar studies in rural health settings, where 6–8 groups typically provide sufficient data depth whilst number of KII was mainly determined to achieve data saturation while capturing diverse perspectives on medicine access challenges in the selected districts. Purposive sampling was used for FGDs and KIIs.

Data collection section

Structured questionnaires, focus group discussion guides and key informant interview guides were the three data collection tools used[1]. The structured questionnaire included sections on demographic characteristics, access to medicines, geographical accessibility, affordability, adequacy, acceptability, and availability of medicines. The questionnaire was administered face-to-face by trained research assistants. The FGD guide included open-ended questions exploring experiences and perceptions related to medicine access, barriers to accessing medicines and suggestions for improvement. Each FGD lasted approximately 40–60 minutes and was conducted in the local language with the assistance of a translator where necessary. KII guide included questions about healthcare system challenges, medicine supply chain management, policy implementation, and recommendations for improving medicine access. KIIs were conducted at the workplace of the participants at their convenience. Informed consent was obtained from the participants.

Data analysis

Quantitative model specification

Quantitative data from the survey were analyzed using SPSS version 26 and STATA. Descriptive statistics and correlation analysis were conducted to examine relationships between the two measures of access

and explanatory variables. Specifically, regression analysis was used for quantitative analysis. The dependent variable was access to medicines (presented as Access 1 and Access 2)[2], and independent variables used are availability, geographical access, affordability, adequacy, acceptability, household head education, and poverty rating. A simple linear regression model using Ordinary Least Squares (OLS) guided by the following quantitative model specification was used:

$$MedAcc_i = \alpha_0 + \beta_1 MedAvail + \beta_2 GeoAcc + \beta_3 Afford + \beta_4 Adeq + \beta_5 Accept + \beta_6 HhIncom + \beta_7 HhEdu + \varepsilon$$

Where $MedAcc_i$ is medical access which is the dependent variable measured in two ways, (that is $i = \text{medical access 1 and medical access 2}$ shortened as Access 1 and Access 2 respectively. It was measured as Access 1 on a 5-point Likert scale (1 = Strongly disagree, 5 = Strongly agree) capturing perceived ease of obtaining medicines and Access 2, measured as a percentage of perceived access (0-100%) based on responses about success in obtaining needed medicines. Two main regression with all independent variables are estimated, one as full model (column 1 in Tables 1 and 2) and for robustness checks, each dependent variable is also run with one explanatory variable and the results are presented in columns 2–6 in Tables 1 and 2. The individual variable models are presented in columns 2–6 in Tables 1 and 2 and these models are presented as:

$$MedAcc_i = \alpha_0 + \beta_1 GeoAcc + \beta_2 HhEdu + \varepsilon \ldots (\text{model specification for columns 2 results})$$

$$MedAcc_i = \alpha_0 + \beta_1 Afford + \beta_2 HhEdu + \varepsilon . (\text{model specification for columns 3 results})$$

$$MedAcc_i = \alpha_0 + \beta_1 Adeq + \beta_2 HhEdu + \varepsilon \ldots . (\text{model specification for columns 4 results})$$

$$MedAcc_i = \alpha_0 + \beta_1 Accept + \beta_2 HhEdu + \varepsilon \ldots (\text{model specification for columns 5 results})$$

$$MedAcc_i = \alpha_0 + \beta_1 MedAvail + \beta_2 HhEdu + \varepsilon \ldots (\text{model specification for columns 6 results})$$

MedAvail is availability of medicine in the health service providers including the pharmacies. This was also measured on a 5-point Likert scale (1 = Very poor, 5 = Very good) assessing the presence of essential medicines at healthcare facilities when needed. This was an index constructed from questions about stock levels, frequency of stockouts, and variety of medicines available.

GeoAcc is geographical access to medicine. Measured on a 5-point Likert scale (1 = Very difficult, 5 = Very easy) assessing the physical proximity to healthcare facilities and ease of reaching them. This was

Table 1. Linear regression with the dependent variable as: Access 1.

	(1)	(2)	(3)	(4)	(5)	(6)
Variables	Access 1	Access 1	Access 1	Access 1	Access 1	Access 1
Geographical accessibility	0.125**	0.130**				
	(0.0634)	(0.108)				
Affordability of medicine	0.0523*		0.0738*			
	(0.0286)		(0.1480)			
Adequacy of medicine	0.0771*			0.0783*		
	(0.0430)			(0.0749)		
Acceptability	0.0396*				−0.0698	
	(0.0228)				(0.0890)	
Availability	0.0379***					0.0135**
	(0.012)					(0.0831)
Household head education	0.0217*	0.0213*	0.0216**	0.0223**	0.0212**	0.0206**
	(0.0115)	(0.0588)	(0.0596)	(0.0597)	(0.0592)	(0.0593)
Constant	1.595***	1.807***	1.948***	1.938***	2.296***	2.098***
	(0.4819)	(0.337)	(0.411)	(0.267)	(0.296)	(0.270)
Observations	399	399	399	399	399	399
R-squared	0.62	0.67	0.59	0.61	0.52	0.63

Robust standard errors in parentheses.
***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.
The dependent variable was Access 1. Household Head Income, an independent variable, was excluded because it was highly correlated with affordability.
Source: *Author's calculation from primary data.*

Table 2. Linear regression with the dependent variable as: Access 2.

	(1)	(2)	(3)	(4)	(5)	(6)
Variables	Access 2	Access 2	Access 2	Access 2	Access 2	Access 2
Geographical accessibility	0.208*	0.215				
	(0.1121)	(0.1144)				
Affordability of medicine	0.0629*		0.0667*			
	(0.0353)		(0.0381)			
Adequacy of medicine	0.022**			0.035**		
	(0.009)			(0.0165)		
Acceptability	0.1141				0.195	
	(0.3355)				(0.611)	
Availability	0.0488*					0.051**
	(0.0289)					(0.0260)
Household head education	0.0233*	0.023**	0.024**	0.0238**	0.03	0.0321
	(0.0136)	(0.0219)	(0.0116)	(0.0094)	(0.0141)	(0.0161)
Constant	42.16***	43.31***	42.36***	46.34***	43.56***	44.00***
	(2.079)	(2.132)	(2.772)	(1.258)	(1.851)	(2.041)
Observations	399	399	399	399	399	399
R-squared	0.47	0.50	0.65	0.41	0.53	0.60

Robust standard errors in parentheses.
***$p < 0.01$, ** $p < 0.05$, * $p < 0.1$.
The dependent variable was Access 2. Household Head Income, an independent variable, was excluded because it was highly correlated with affordability.
Source: Author's calculation from primary data.

an index constructed from questions about distance to nearest health facility, transportation availability, travel time, and terrain challenges

Afford is affordability also measured on a 4-point Likert scale (1 = Very unaffordable, 4 = Very affordable) assessing the financial burden of obtaining medicines. This was an index constructed from questions about medicine costs, household expenditure on medicines, and financial sacrifices made to obtain medicines.

Adeq is medical adequacy measured on a 5-point Likert scale (1 = Very inadequate, 5 = Very adequate) assessing the appropriateness and sufficiency of healthcare services. This was an index constructed from questions about waiting times, healthcare provider availability, quality of consultation, and follow-up care.

Accept is acceptability measured on a 5-point Likert scale (1 = Very unacceptable, 5 = Very acceptable) assessing the cultural appropriateness and patient satisfaction with healthcare services. This was an index constructed from questions about cultural sensitivity, provider attitudes, communication quality, and trust in healthcare providers.

HhIncom is household head average income measured in USD per month and later excluded due to high correlation with affordability.

HhEdu is Household Head Highest education measured using the following categories: 1 (no education), 2 (primary education), 3 (Secondary Education), 4 (certificate), and 5 (diploma, degree, and above).

ε = is the error term.

To validate linear regression results, we conducted ordered logit regression for Access 1. Models were specified identically to linear regressions presented above, with the same independent variables and controls. The ordered logit uses the Likert scale 1 to 5 as the dependent variable. Maximum Likelihood of the causal effect will be estimated.

Qualitative data from FGDs and KIIs were analyzed using thematic analysis following the approach by Braun and Clarke (2006). The analysis involved familiarization with data, generating initial codes, searching for themes, reviewing themes, and defining themes. Thematic analysis for qualitative analysis. Initially, transcripts were read multiple times to achieve familiarity. Then, initial codes were generated inductively from the data. These codes were then grouped into potential themes, which were reviewed and refined. Finally, clear definitions and names for each theme were established. NVivo software was used to facilitate the coding process and theme development. A total of 87 initial codes were identified, which were then grouped into 4 main themes and 12 subthemes.

The theoretical and empirical literature reviews covered in the preceding sections play a significant role in the study's variable selection (Khatib et al., 2016; Sibley & Weiner, 2011). Tests for reliability were conducted using Cronbach's alpha, goodness of fit using R-squared, and correlations. Correlation tests

were performed to check for multicollinearity among the independent variables. According to (Piantadosi, 2024), correlation is useful for highlighting areas where trial research might be conducted and for producing novel findings because it can demonstrate the existence or absence of a relationship between two parameters.

Access to medicines was defined in two ways, Access 1 was measured on a 5-point Likert scale (1 = Strongly disagree, 5 = Strongly agree) capturing perceived ease of obtaining medicines. Access 2 was measured as a percentage of perceived access (0-100%) based on responses about success in obtaining needed medicines. The rationale for using both formats was to capture both the subjective experience and the objective success rate in accessing medicines.

Ethical considerations

All ethical procedures were followed. Institutional Research Committee approval was provided by the Bindura University of Science Education under approval number BUSEREC/0059/2025. Informed written consent for participation was obtained from all interview respondents. Participants were informed about the study purpose, procedures, risks, benefits, and their right to withdraw at any time without penalty. All data were anonymized to protect participant confidentiality.

Results

Participant selection

The sample size used in the research was 399, with 17% of it being a representative of Chivi District. 26%, 28% and 29% of the sample size were selected from Bikita, Rushinga and Shamwa Districts, respectively. The sample size is large enough to avoid the normal error problem, Schmidt and Finan (2018). As presented in Supplementary Table 1, of the 480 targeted respondents, 399 responded to distributed questionnaires and interviews conducted in the four districts, resulting in a response rate of 83.1%. Survey participants were predominantly from households with heads who had secondary education. Most participants reported challenges in accessing medicines, with mean Access 1 score of 2.391 (SD = 1.308) and mean Access 2 score of 45.426% (SD = 8.025).

Demographic characteristics

As presented in Supplementary Table 1, majority of the respondents were women (n = 399; 71%). Across all the districts, women constituted a larger percentage than men. Shamva district had the highest percentage of female respondents (81%) followed by Chivi (72%), Bikita (66%), and Rushinga (63%). Most rural areas in Zimbabwe are headed by women (n = 399; 58%). The respondents by highest attained education showed that majority of them fell in the Secondary category (n = 399; 51%) and the category with minimum number of respondents was the No Education group. Supplementary Table 1 shows that, on average, the income level group (US$30-US$100), had the highest percentage of respondents = (n = 399; 61%), see Supplementary Table 1. Less than US$30 income category had the second largest sample representation (n = 399; 20%). More than US$500 income category had only 3% sample representation of the sample used (n = 399; 3%).

Table 3 presents the descriptive statistics of the main variables used in this study. Medical access2, which is measured in percentage, has a minimum value of 10% and a maximum value of 80%, with an average value of 45.426%. The access1 was measured using a Likert scale and has values ranging from 1 to 5. Availability, geographical access, accessibility, and adequacy were constructed using an index of more than two variables. For instance, acceptability is an index of the variables of culture, medical personnel attitude, and the feeling of the person seeking medicine after being served by the medicine service provider. Geographical access, availability, affordability, acceptability, and adequacy had a minimum of one and a maximum of five, while the mean indices were 2.465, 2.391, 2.433, 2.390, and 2.391, respectively. Household head education was measured using the following categories: 1 (no education), 2 (primary education), 3 (Secondary Education), 4 (certificate), and 5 (diploma, degree, and above). Most respondents belonged to the secondary education category.

Table 3. Descriptive statistics (N = 399).

	Observations	Minimum	Maximum	Mean	Std. Deviation
Medical Access 2 (% rating)	399	10	80	45.426	8.025
Medical Access 1 (Likert Scale)	399	1	5	2.391	1.308
Availability	399	1	5	2.391	0.759
Geographical Access	399	1	5	2.465	0.618
Affordability	399	1	4	2.433	0.452
Adequacy	399	1	5	2.391	0.919
Acceptability	399	1	5	2.390	0.753
Household head education	399	1	5	3.386	1.013

Source: Author's calculation from primary data.

Correlation

The correlations between various pairs of variables used in this study are presented in Supplementary Tables 2 and 3. The only difference between these two tables is the dependent variable, which was measured in two ways. Medical Access 1 was measured using a Likert scale ranging from one to five. As presented in Supplementary Table 2, Access 1 was significantly correlated with availability ($r = 0.803$, $p < 0.000$), geographical access ($r = 0.768$, $p < 0.001$), affordability ($r = 0.823$, $p < 0.000$), adequacy ($r = 0.456$, $p < 0.013$) and household head income ($r = 0.861$, $p < 0.001$). None of the explanatory variables exhibit multicollinearity except for the variable Affordability and Household head income, which have a collinearity of approximately 91% ($r = 0.910$; $p < 0.016$) in both correlations presented. Therefore, the latter variable was dropped. Household income was excluded for both correlations (Access 1 and Access 2) in favour of affordability as they were highly correlated ($r = 0.91$, $p < 0.016$) and affordability was more directly related to medicine access.

Medical Access 2 was measured as a percentage of perceived access to medicine and the results are presented in Supplementary Table 3. Access 2 was significantly correlated with availability ($r = 0.803$, $p < 0.002$), geographical access ($r = 0.719$, $p < 0.000$), affordability ($r = 0.842$, $p < 0.000$), and acceptability ($r = 0.512$, $p < 0.013$).

There is a causal relationship between the medical access variable and all independent variables as presented in the two tables of collinearity matrices. However, Adequacy has a correlation with dependent variable of less than 50%. This indicates that the majority of independent variables have a strong relationship with the dependent variable. Overall, there is a very low correlation between the independent variables, which indicates a very low likelihood of multicollinearity, except for variable Affordability and Household income.

Reliability test results

Supplementary Table 4 shows a reliability coefficient slightly higher than 70% for Set 1, which indicates that there is internal consistency of the variables chosen. Same table under Set 2 shows a reliability coefficient test of 70%, which is also falls within an acceptable range. Household income was dropped because it had a high correlation with affordability.

Estimation, presentation and interpretation of results

Factors associated with access to medicines

The main linear regression results are presented in Tables 1 and 2. These tables present the main linear regression results with access1 and Access 2 as the dependent variables, respectively. The independent variables were geographical access to medicine, affordability of medicine, adequacy of medicine, acceptability, and household head level of education. The first column of Table 1 presents all the independent variables against Access 1, while the other columns in the same table present Access 1 and one main variable as well as the control variable, household head education. This is performed as a robustness check for the main regression results. As indicated in Column (1) of Table 1, geographical accessibility has a positive and significant effect on access.[3]

At 5% level of significance, geographical access has a positive effect of approximately 13% in the change from one scale to another. The Ologit results in Supplementary Table 5 shows a marginal effect of 17% of a change in geographical access variable. This means an improvement in geographical access is associated with an improved medical access. That is, a marginal change in geographical access index will increase the likelihood of accessing essential medicine by about 17%, confirming results of related studies (Tharumia Jagadeesan, & Wirtz, 2021; Newhouse, 1990; Tegegne et al., 2018). In the same table, column (1), affordability, adequacy, and acceptability variables also had a positive effect on access to medicine. At 10% level of significance, affordability and adequacy have a positive effect on the change of scale of access to medicine by 5% and 8% respectively. This in turn means a marginal change in these two variables by a unit change will result in an increased likelihood to accessing essential medicine of 4% and 2% (see supplementary Table 5). This confirms the results of previous studies (Anyinam, 1987; Falkingham, 2002; Gelders et al., 2006; Ocran Mattila et al., 2021). At 1% level of significance, availability of medicine positively affects access1 by approximately 4%. We have also presented the ordered logit results as presented in Supplementary Table 5 to ascertain if the is no violation of the equal interval assumptions which may lead to biased results. The Ologit results are supporting the main regression results in Table 1.

The household head's level of education has a significant and positive effect on access to medicine, however, the magnitude is very low. At 1% level of significance, the household head's highest level of education has a positive effect of 2% on access to medicine. This is a surprising result (lower magnitude), as most previous studies show that the higher the educational level, the more likely an individual is to access medical care from formal health institutions (Adam & Aigbokhaode, 2018; Awoyemi et al., 2011; Jeste et al., 2020). The results were also supported by qualitative results presented in the next section

Ordered logit results

Supplementary Table 5 presents ordered logit results for the dependent variable Access 1. Marginal effects confirm primary findings, geographical access (17% increase in likelihood of higher access, $p < 0.05$), affordability (4% increase, $p < 0.1$), and adequacy (2% increase, $p < 0.1$) were significant.[4]

The first column of Table 2 presents all the explanatory variables against access2 (which was measured as a percentage), while the other columns in the same table presents access2 and one main variable, and the control variable household head education. Just like under acces1, as indicated in the column (1) of Table 2, geographical accessibility has a positive and significant effect on access. At 10% level of significance, geographical access has a positive effect on access to essential medicine by approximately 19%. This means, a marginal change in geographical access index will result in a significant improvement in access to medicine, confirming results of related studies (Tharumia Jagadeesan, & Wirtz, 2021; Newhouse, 1990; and Tegegne et al., 2018; Chen et. al., 2023). Column (2) also confirms the results when other explanatory variables are removed except household head highest education and geographical access variables. supports the above statement. In the same table, columns. In the same table, column (1), affordability, adequacy, and availability variables also had a positive effect on access to medicine. At 5% and 10% levels of significance, affordability and adequacy had a positive and significant effect on access of 6% and 2%, respectively. This, in turn, means a marginal change in these two variables by a unit change will result in access to medicine by 8% and 3%. This confirms the results of previous studies (Anyinam, 1987; Falkingham, 2002; Gelders et al., 2006; Ocran Mattila et al., 2021). The results were also supported by the qualitative information.

At 10% level of significance, availability of medicine positively affects access1 by around 3%. The household head's level of education has a significant and positive effect on access to medicine. This also confirms the results of previous studies (Adam & Aigbokhaode, 2018; Awoyemi et al., 2011; Jeste et al., 2020).

Findings from KIIs and FGDs

For the qualitative component, seven FGDs were conducted with 72 participants (average of 8–10 per group). Twenty-eight healthcare providers and community heads were interviewed as key informants.

The FGD participants included 42 women (58.3%) and 30 men (41.7%), with ages ranging from 18 to 75 years. The KII participants included 16 healthcare providers (57.1%) and 12 community leaders (42.9%), with professional experience ranging from 3 to 25 years. Thematic analysis of FGDs and KIIs revealed four main themes as financial barriers, geographic accessibility, supply chain challenges, and quality of care. Main results are presented as follows:

Theme one: Financial barriers

Participants emphasized that cost was a major barrier to accessing medicines. Many community members reported lacking financial means to afford basic medical services. The absence of medical insurance schemes in rural areas was highlighted as a significant challenge. Some respondents had to say:

> *"Virtually the whole community has no financial means and therefore would find it very difficult to afford basic medical services. We are talking about people who barely have enough to eat for the day"*…… Respondent 1

> *"Medical aid scheme is an alien word in our area. There is no such! Its either you have cash or you cannot access medical services."* …. Respondent 2

> *"I have personally seen only a very few numbers of patients, most probably pensioners, who have medical aids schemes. But the disappointing fact is that these schemes, particularly the Premier Services Medical Aid Society, are shunned by service providers because of their delays in settling payments. In any case, there are services where cash is demanded and the medical aid is rendered useless."* …. Respondent 3

> *"Medical expenses, particularly for chronic illnesses, are very high. I am aware of this because I have witnessed families having to sell some livestock for a song just to meet such expenses. It becomes worse where one has been booked for a major surgery. In most cases, families just can't afford such, leading to premature deaths."*…. Respondent 5

Sub-themes for financial barriers theme were mainly centered around poverty and inability to pay for health access, absence of health insurance, catastrophic health expenditures and inequitable pricing systems.

Theme two: Geographic accessibility

Long travel distances and transportation challenges were identified as major barriers to accessing healthcare facilities. Participants described the difficulties of reaching healthcare facilities, especially during emergencies. Some respondents had to say:

> *"I travel 40 kilometres to the clinic. I use my last money in the house, I wake up at 3 and spend 3 hours to get to the clinic. When I get there, the nurse tells me to wait for the doctor, and as fate would have it, this doctor never shows up! He is almost always caught up somewhere"*…Respondent 6.

Sub-themes for geographic accessibility were long travel distances, transportation challenges, terrain and infrastructure barriers.

Theme three: Supply chain challenges

Frequent stockouts of essential medicines were reported in the study areas. Healthcare providers highlighted inefficiencies in the medicine supply chain, including delays in procurement and distribution. Some respondents had to say:

> *"Drugs/medicines unavailability at our hospital is nothing new, we are used to it. Infact, we seldom have more than 50% of our drug requirements. We have reached a point where we do not have basic drugs and other tools of the trade such as gloves, needles. And this is the referral centre. Reality is that we operate on very skeleton number of drugs. In 90% of the time, we have less than 10% of our drugs requirements. Its a monumental disaster."*…Respondent 11.

> *"I have personally witnessed a number of cases where patients die in the queue as they wait for medical attention. At Karanda, a rural but well-funded mission hospital, one can wait up to 24 hours before being attended to. This is*

*because the facility now serves patients from as far afield as Harare, owing to better services as well as reasonable charges." …*Respondent 8.

"It's a never win situation for the patient in our district. The lack of access is a minefield, attributed to so many factors. In some cases, we are told that the drug is available but the health personnel available have no authority to dispense it. We are told to wait for the doctor whose schedule says he visits our rural clinic once per week. Believe me, this is a schedule that is barely honoured.".….. Respondent 10

Sub-themes for supply chain challenges were chronic medicine stockouts, procurement and distribution failures, personnel-related dispensing barriers, lack of basic medical supplies.

Theme four: Quality of care

Participants reported long waiting times, inadequate healthcare infrastructure, and insufficient healthcare personnel as major barriers. Negative attitudes of some healthcare providers were also mentioned as a deterrent to seeking care. Some respondents had to say:

"Waiting time is a big barrier to access to medical facilities. Sometimes the required medical personnel, mostly the doctors, are not around. This is the reality that we encounter on a daily basis. All this speaks to resource constraints and in some cases, lack of motivation. Contrast this with the private sector where patients are treated as customers who must be served with dignity and in the shortest possible time.".… Respondent 9.

"It's a never win situation for the patient in Bikita. The lack of access is a minefield, attributed to so many factors. In some cases, we are told that the drug is available but the health personnel available have no authority to dispense it. We are told to wait for the doctor whose schedule says he visits our rural clinic once per week. Believe me, this is a schedule that is barely honoured.".….. Respondent 10

Discussion

The aim of this study was to identify factors associated with access to medicines in rural communities of Zimbabwe, incorporating both patient-level and system-level determinants. The study found that geographical accessibility, affordability, adequacy, acceptability, and availability of medicine all significantly influence access to essential medicines in rural Zimbabwe. These findings highlight the multifaceted nature of medicine access and the need for comprehensive interventions. Thematic analysis of FGDs and KIIs information revealed four main themes which are financial barriers, geographic accessibility, supply chain challenges, and quality of care. Qantitative and qualitative results presented the same conclusion about access to medicine.

The findings of this study on access to equitable essential medicines in rural Zimbabwe, a resource-constrained environment, demonstrate the positive influence of several key factors on medicine accessibility. First, the availability of essential medicines at local health facilities has emerged as a foundational element, with increased stock levels directly correlating with improved access to medicines for rural populations. This highlights the critical need for robust supply chain management and consistent drug procurement to ensure that medicines are present when and where they are needed. Second, geographical access, measured by the proximity of households to healthcare facilities, exhibited a significant positive effect. Reduced travel distances directly translate to greater ease in obtaining necessary medications, underscoring the importance of a well-distributed network of healthcare points within rural communities to overcome logistical barriers and transportation costs. Several studies have reported these results (Castillo-Laborde et al., 2022, Curfman et al., 2022; Mutsvangwa, 2016; Shelgikar, 2020; Timyan et al., 2018; Tanser et al., 2006).

Furthermore, affordability proved to be a crucial determinant of medical accessibility for the rural population. Holding everything constant, households with greater financial resources are significantly more likely to access the needed medications, emphasizing the persistent challenge of poverty and its impact on healthcare equity. This finding underscores the urgency of implementing policies and programs that mitigate the financial burden of healthcare, such as subsidies, insurance schemes, or community-based financing mechanisms, to ensure that cost is not a prohibitive barrier to accessing essential medicines. The level of education attained by the household head also demonstrated a positive

correlation with accessibility to medicine. Higher levels of education are likely to equip individuals with greater health literacy, awareness of available resources, and the ability to navigate the healthcare system more effectively, ultimately leading to improved access to necessary treatments for their households. These interconnected findings highlight the multifaceted nature of ensuring equitable access to essential medicines in resource-constrained rural settings, such as Zimbabwe, demanding integrated interventions that address availability, geographical reach, affordability, and health literacy.

Geographical accessibility emerged as a significant factor influencing medicine access, with a marginal change in geographical access index resulting in approximately 13% improvement in access to medicine. This finding is consistent with previous studies (Tharumia Jagadeesan & Wirtz 2021, Conti et al., 2022 and Yenet et al., 2023), which also identified geographical barriers as critical determinants of healthcare access. The qualitative findings further supported this, with participants highlighting long travel distances and transportation challenges as major barriers. This suggests that improving the distribution of healthcare facilities and transportation options in rural areas could significantly enhance medicine access.

Affordability was another significant determinant of essential medicine access, with the study showing that financial constraints severely limit access to essential medicines. This is also supported by some findings from previous studies in similar contexts (Chen et al., 2021; Chiumia et al., 2024; Lane et al., 2024). In a similar way, the qualitative data provided rich insights into this issue, with participants describing the devastating impact of medical expenses on household finances. This finding underscores the importance of implementing financial protection mechanisms such as national health insurance, subsidies, and community-based financing schemes to improve medicine access for poor rural populations, (Muchabaiwa et al., 2017). The study also found that adequacy of healthcare services significantly influenced essential medicine access in the rural areas. Participants reported long waiting times, inadequate healthcare infrastructure, and insufficient healthcare personnel as major barriers. These findings are consistent with previous literature, who also identified service adequacy as a critical factor in healthcare access, (Wafula, 2024; The qualitative data revealed that patients sometimes waited for hours or even days to receive care, and in some extreme cases, died while waiting. This highlights the need for investments in healthcare infrastructure and human resources to improve service adequacy.

Acceptability of healthcare services was another important factor influencing essential medicine access. The study found that negative attitudes of healthcare providers, perceived poor quality of care, and cultural factors affected patients' willingness to seek care. This is consistent with findings from other studies (Ritter et al., 2022; Bucyibaruta et al., 2022), which also identified acceptability as a key determinant of healthcare access. The qualitative data revealed instances of disrespectful behavior by healthcare providers, which deterred patients from seeking care. This suggests the need for interventions to improve provider-patient relationships and cultural competence in healthcare delivery. Availability proved to be one of an important factor in accessing essential medicines, with frequent stockouts reported in the study areas. This finding is consistent with those of Yenet et al. (2023) and Dong et al. (2020) and others, who have identified medicine availability as a critical challenge in low-resource settings. The qualitative data revealed that in some cases, medicines were available but could not be dispensed due to regulatory requirements or absence of authorized personnel. This highlights the need for improved supply chain management and regulatory flexibility to ensure consistent availability of essential medicines.

Interestingly, the study found that household head education had a positive but relatively small effect on medicine access. This contrasts with some previous studies (Adam & Aigbokhaode, 2015; 2018), which found stronger associations between education and healthcare access. Education positively affects access to essential medicine by empowering individuals with knowledge about healthcare resources, enabling informed decisions and advocacy for better health services. The qualitative data suggested that in rural Zimbabwe, even educated individuals face significant barriers to medicine access due to widespread poverty and limited healthcare infrastructure. This indicates that education alone may not be sufficient to overcome systemic barriers to healthcare access in resource-constrained settings.

The strengths of this study include its mixed-methods design, which allowed for a comprehensive understanding of the multifaceted nature of essential medicine access. The combination of quantitative and qualitative data provided both statistical evidence and rich contextual insights. Additionally, the examination of multiple determinants simultaneously offered a more holistic view

of the factors influencing medicine access than previous studies that focused on single determinants. However, the study has some limitations. First, the cross-sectional design limits the ability to establish long term causality, however, the study strengthened causal inference by using theoretically grounded regression models controlling for confounders like education, triangulating quantitative results with qualitative narratives, conducting robustness checks via ordered logit models and using different measures of the same variable. Second, despite that the researchers followed proper data collection procedures, the reliance on self-reported measures may introduce recall bias, however, we reduced this bias by using dual medical access metrics (Likert and percentage based) for cross-validation, anchoring questions to specific timeframes, piloting instruments to ensure clarity and corroborating self-reports with KII data on systemic barriers. Third, the study was conducted in only four rural districts of Zimbabwe, which may limit the generalizability of the findings to other country contexts, however, we enhanced representativeness by selecting districts via stratified random sampling to capture socio-economic and geographic diversity, achieving a high response rate to reduce selection bias and explicitly contextualizing results within Zimbabwe's rural healthcare landscape.

Conclusions and limitation of the study

Quantitative and qualitative methods used both confirmed that geographical accessibility, affordability, adequacy, acceptability, and availability of medicine all significantly influence access to essential medicines in rural Zimbabwe. These findings highlight the multifaceted nature of medicine access and the need for comprehensive interventions. To check the validity of the results, the study employed mixed method with different variables to define medical access and the components of the multivariate regression model. The primary findings indicate that equal access to medicine in rural Zimbabwe is positively affected by acceptability, affordability, adequacy and geographic accessibility. Qualitative data analysis also confirmed the relationship between equitable access and independent variables. This highlights the critical need for robust supply chain management and consistent drug procurement to ensure that medicines are physically present when and where they are needed, therefore, policymakers should prioritize policies that improve the accessibility of medicines in rural areas where the majority of the poor population resides. For further study, researchers recommend that future researchers on the same research area may extend to the study on access to essential medicine for more than one country and do a comparative study.

Notes

1. See supplementary section A: Questionnaire, Supplementary section B: FGD Guide, Supplementary section C: KII Guide.
2. Access1 is the dependent variable measuring medical access using a Likert scale, 1 to 5 and Access2 measured as a percentage.
3. Supplementary Tables 6-12 present a detailed presentation of results.
4. Supplementary Tables 13-17 present a detailed presentation of the results.

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Tongofa and Chingwaru conceptualized, designed, and collected data for this study. Mutsvangwa analyzed the data for this study. All authors participated in the writing and editing of the original manuscript. All authors reviewed the final version of the text and agreed to send it for publication and to be accountable for all issues of the work.

Ethics approval and consent to participate

Institutional Research Committee approval was provided by the Bindura University of Science Education under approval number BUSEREC/0059/2025.

Author contributions

CRediT: **Simba Mutsvangwa**: Methodology, Project administration, Writing – review & editing; **Mathias Tongofa**: Conceptualization, Writing – original draft; **Trymore Chingwaru**: Conceptualization, Formal analysis, Software, Supervision.

Disclosure statement

No potential conflict of interest was reported by the author(s).

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Data availability statement

Data will be available from the corresponding author (trymorec8@gmail.com) upon reasonable request.

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