A cross-sectional analysis of the impact of health insurance on the use of health care in Rwanda

Roger Muremyi [a,c,*], Dominique Haughton [b], François Niragire [c], Ignace Kabano [a,c]

[a] African Centre of Excellence in Data Science, University of Rwanda, Kigali, Rwanda
[b] Mathematical Sciences and Global Studies, Bentley University, Université Paris 1 Panthéon Sorbonne (SAMM), Université Toulouse 1 (TSE-R), Boston, USA
[c] Department of Applied Statistics, University of Rwanda, Kigali, Rwanda

ARTICLE INFO

ABSTRACT

Although the policy in Rwanda aims at ensuring quality healthcare, a portion of the Rwandan population still does not have access to it due to the lack of health insurance. This study investigates the impact of health insurance on healthcare utilization in all 30 administrative districts of Rwanda, using secondary data from the 5th Integrated Household Living Conditions Survey (EICV 5) in Rwanda, with a total of 14,580 households. A logistic regression model was used to evaluate the effects of health insurance on healthcare utilization, and a decision tree model was adopted to categorize districts based on the use of health services.

This study has made a novel contribution to the existing research by classifying districts based on similarities in the use of health care services, regarding households with or without health insurance. The results showed a significant age effect on the use of health care services for household heads with an age range of 56–65, a significant increase was observed with an adjusted odds ratio of AO = 1.308, (95% CI: 1.044–1.639). It was the same for the household heads whose age range is 66–75 with an adjusted odds ratio of A0 = 1.589 with (95% CI: 1.244–2.028) and those aged 76 and older with an adjusted odds ratio of AO = 1.524, with (95% CI: 1.170–1.985). Households with health insurance interacted with districts (A0 = 2.76) increased health service use threefold compared to households without health insurance, female-headed households increased health service use (AO = 1.423, 95% CI:1.293–1.566) 1.4-fold compared to male-headed households, while households in the third quintile (AO = 1.198, 95% CI: 1.035–1.385) used health services 1.2 times compared to those in the first quintile; households in the fourth quintile (AO = 1.307, 95% CI: 1.134–1.506) and in the fifth quintile (AO = 1.307, 95% CI: 1.136 1.504) used health services 1.3 times compared to those in the first quintile. Similarly, for the households located in the main district group 4 variable had an odds ratio of 1.386 with (95% CI: 1.242–1.547), indicating that the households located in the main district group 4 use the health care services 1.4 times higher compared to those located in Ruhango district.

Households in Rwanda who lack health insurance do not utilize health services to their full capacity, which has a negative influence on the wellbeing of the country's population.

The researchers recommend that future policies target households in rural areas with an elderly head of household and those without health insurance that have a low usage of health care services in Rwanda. They also recommend that health insurance fees are reduced in order to increase health coverage rate as recommended by the World Health Organization.

* Corresponding author. African Centre of Excellence in Data Science, University of Rwanda, Kigali, Rwanda.
  E-mail address: muremyiroger@gmail.com (R. Muremyi).

1. Introduction

According to the World Health Organization, health care is a crucial aspect of a population-wide health assessment [1–3]. However, there are limitations on both the supply and demand of medical services in developing countries [1]. Consequently, these limitations may force families to experience financial difficulties leading to poverty and financial catastrophe [4,5].

The demand for services, the accessibility of services, and the resources available for both providing and paying for treatments, all have an impact on how often people use healthcare [6].

The distribution of health services in Rwanda has been documented and it has been found that those in need of healthcare do not receive an adequate portion of it [7]. In 1960, Rwanda's public health insurance system began to operate in order to improve health services [8,9]. Yet, from the 1960s–1990s, the system still had shortfalls and lacked effective implementation due to the absence of good governance practices such as billing policy, accountability and participation of the population.

That is why since 1996, municipal public health insurance plans were developed through the amendment of billing policy [10,11]. The development of community health insurance has been signficantly improved [10]. While in 1999, health insurance was only available in 4 provinces of the country, by August 2004, it covered 11 provinces as well as Kigali city [10]. The Community Based Health Insurance Programme (CBHI) has been designed to meet the needs of Rwandans outside the normal range, where their medical awareness history was very limited [12]. As it can be argued, from the 1999 pilot project to the National guidelines in 2004, Rwanda accelerated CBHI nationwide. In 2007, approximately 75% of the population had health insurance [13]. By the end of 2008, the national health coverage reached an impressive 89% and by 2010–2011 it grew further, reaching 91% of the projected population [13]. Equal and affordable health services are the primary goals of the Rwandan government's health policy for all Rwandans [13]. The priorities in health policy are stated as part of the economic development and poverty reduction strategy, as well as the development goals outlined in Rwanda Vision 2020 [14]. Today in Rwanda, health insurance appears to be doing well due to the policy related to the health insurance scheme. A new system has been implemented, where people make contributions based on the financial capacity of each household. This new system uses information from the Rwandan cultural value that encourages neighbours to assist each other in addressing or resolving socioeconomic issues (UBUDEHE)[1] [10]. In the first category, contributions are made by the government, in categories 2 and 3, the contribution is 3000 frw per person per year, while in the fourth category the contribution is 7000 frw per person per year [4]. This is a universal insurance policy whose aim is not to leave anyone behind especially those who are in difficulties to cater for the required premiums [15]. Although there is an easy way to get health care for households with health insurance in Rwanda, households may face the problem of financial incapability as mentioned earlier. For example, a family of seven in the third category of UBUDEHE will have to pay a subscription fee for seven members [13]. This means that if a household fails to pay the total premium for the entire family and one of them gets sick, the latter will not have an access to health care services unless he/she pays 100% of the total cost as a free mover since he/she is excluded from the insurance scheme [4,16].

Researchers in developing countries such as Vietnam and South Africa [17,18], found that for students and the poor/impoverished citizens with health insurance, the use of inpatient medical examination and treatment services increased, but there was no increase regarding outpatient medical examination and treatment services [17]. In addition, for children, health insurance increases the use of medical services, but this is not the case for adults [17]. Similarly, research conducted by Guidon (2014) [17] found that having health insurance does not significantly reduce costs compared to not having health insurance.

The study conducted by Thuong (2020) [18], revealed that the use of health insurance increases the number of outpatients and that health insurance participation plays an important role in the use of medical services in hospitals [17]. The impact of rapid growth on health insurance programs on health outcomes has been analyzed in developed countries like Japan [19] and the findings show an increase in the use of health care services as well as an increase in the estimated impact of health care services at individual level [20].

The results of a study conducted by R. Muremyi et al. (2023) highlighted the factors influencing the rise in healthcare costs in Low and Middle Income Countries [21].

In Rwanda, a recent study on the role of economic factors in the selection of healthcare providers was done by Ruhara et al. (2016) using structural models [22]. Their findings show that health insurance influences people to choose health centers instead of hospitals, given that the latter are not only far from citizens but also their services are expensive. Therefore, the cost is one of the main barriers to access to healthcare, especially in developing countries like Rwanda, in which financial means of households are limited [22–24].

A study conducted by Andinet et al. (2016) [25] shows that a community-based health insurance program has a non-linear and mixed impact on out-of-pocket spending. While the health insurance program significantly increases the likelihood of overall spending, it decreases per capita healthcare spending. Many other researchers in Rwanda have discussed different aspects of the impact of health insurance on the use of medical services in Rwanda [15,25–27], but no research until now has used a decision tree model and a logistic regression model to assess the impact of health insurance on Rwanda's use of medical services. In this article, the researchers analyzed the impact of health insurance on the use of health care in Rwanda at national level with 14,580 households. The study complements existing research by analyzing the covariates that play a key role in health service utilization in Rwanda and by identifying geographic differences regarding the impact of health insurance on healthcare usage.

---

[1] UBUDEHE is a mechanism that the Rwandan Government uses to determine the level of poverty among households before it provides social protection to the poorest members of the community [42,43].

2. Materials and methods

2.1. Study setting and study design

Rwanda is a sub-Saharan African country (SSA) ranked 160th out of 189 countries in terms of human development in 2019 (HDR, 2020). From 2000 to 2019, poverty decreased from 59% to 46% in 2010 and to 39.1% in 2019 [28]. Currently, 17.6% of Rwanda's population lives in cities [29]. The country borders the Democratic Republic of the Congo to the west, Uganda to the north, Tanzania to the east, and Burundi to the south [28]. The country has 30 districts divided into four provinces besides the City of Kigali.

The setting of health service tariffs are overseen by the National Council on Health Insurance in accordance with the Health Insurance Law 2016 [30,31].

2.2. Data source

In this study, the researchers used data from the 5th Rwanda Integrated Household Living Conditions Survey collected by the National Institute of Statistics of Rwanda. The data used here are relevant because no other Rwandan integrated living survey has been conducted in Rwanda since 2016 [14]. This nationally representative survey contains 14,580 households found in all 30 districts[2] of the country. The current dataset includes the head of the household age and gender, quintile, health insurance status of households, household locations, insurance status, self-reported health needs, and use of household medical services. This paper investigates the relationship between getting health insurance and using medical services.

2.3. Sampling techniques

The EICV5 cross-sectional survey's sample frame was created using master sample data from the National Institute of Statistics of Rwanda (NISR) [14]. Nonetheless, a sample of 3960 villages were taken into consideration for the various national household surveys in Rwanda for this EICV5 Multistage Random Sampling using the 2012 Rwandan Census. The number of households in the villages that make up the primary sampling units (PSUs) for the Master Sample was calculated using information from the 2012 Census. A new list of households was created in order to update the structure of the EICV5 cross-sectional survey. Sample households of 14,580 were selected from the updated directory of the sample villages [29].

2.4. Variable selections

2.4.1. Dependent variable
For this research, we use the heads of households that have received medical services in the last four weeks as a dependent variable. The researchers assigned two values to the dependent variable, 1 if the head of the household received medical services and 0 if the head of the household did not receive medical services. Medical care was considered as a function of variables that was characterized by $Y = f(x_i)$, where x_i denotes independent variables, in this case $Y_i = 1$, if the head of household received medical care, and $Y_i = 0$, if the head of household did not receive medical care.

Medical services: refers to any medical or health care services given to a person, including but not limited to those covered by an insurance policy. These services may include but are not limited to: dentist services, hospital services, skilled nursing facility services, complete outpatient rehabilitation treatments, home health care services, residential and out-patient mental health services [32].

Outpatient: Refers to a patient who does not spend the night when seeking diagnosis or treatment at a medical facility [32,33].

Inpatient services: Refers to a hospital admission of a patient on a physician's order for treatment. The moment you are formally admitted, and spend at least one night in the hospital under supervision of a health care provider, you are considered an inpatient [33, 34].

Hospitalization: The act of taking someone to the hospital and keeping them there while they receive treatment due to serious sickness or injury, and the patient needs to be admitted to the hospital [9].

2.4.2. Independent variables
The choice of independent variables was supported by the prior analytical methodology, which was similar to the findings of other studies [15,18,35]. Demographics and socioeconomic status were used to select independent variables. The ages were grouped into class intervals to avoid age squares that might influence the choice of variable ages, head of household's school, region and quintiles, size and sex of head of household, health insurance status of the household head, and the districts used in the analysis [36]. Variables were coded and the first category was chosen as the reference level; districts were grouped according to their similarities in the use of healthcare services using a decision tree model.

The groups have emerged as follows: group one composed of the districts Muhanga, Kamomyi, Burera, Gakenke, Gatsibo; group two with districts Ngororero, Gicumbi, Nyagatare, Nyarugenge, Kicukiro; group three with districts Gisagara, Nyaruguru, Karongi, Rwamagana, Kirehe; group four with districts Huye, Nyamagabe, Nyamasheke, Nyanza, Bugesera, Kayonza, Ngoma. In group five we

---

[2] Rwanda is divided into territorial administration entities, namely Provinces, Districts, Sectors, Cells and Villages.

have districts Rubavu, Musanze, Rulindo, Rutsiro; in group six we have Nyabihu district; and group seven Rusizi district; and lastly in group eight we have Ruhango District.

2.4.3. Statistical analysis

The probability of making a choice concerning the demand for health care was given by [37].

$$Prob[Y_i = 1] = \frac{exp^{(\beta_0 + \beta X_i)}}{1 + exp^{(\beta_0 + \beta X_i)}} \tag{1}$$

where $Y_i = 1$ if the head of household i received health care services in the last four weeks and the X_i, was set as independent variable. For this study, the logistic regression model was used to estimate the probability of health services to be received by the household. The choice of independent variable was made referring to previous similar studies [17,22] and the classification of districts based on the same similarities in the use of health services was made using a decision tree model. In this study, we used the decision tree model to classify districts based on the use of health services at the household level [1].

The odds =

$$\frac{P(y = 1)}{P(y = 0)} \frac{P(y = 1)}{1 - P(y = 1)} \tag{2}$$

were used to assess the impact of covariates on the use of health services.

By letting

$$\pi(y = 1 | x_1, x_2, x_3, \ldots, x_p) = \pi(\underline{x}) \tag{3}$$

as the probability of household used health services by the household for given covariates p, the logistic regression model can be written as [37].

$$\ln(y') = logit[\pi(\underline{x})] = \ln\left[\frac{\pi(\underline{x})}{1 - \pi(\underline{x})}\right] = \alpha + \beta_1 x_1 + \beta_2 x_2 + \ldots + \beta_p x_p \tag{4}$$

where y' is the odd ratio in the transformed outcome variable rather than predicting y and the transformed outcome is [37]

$$f(y) = \ln(y') = \ln\left[\frac{\pi(\underline{x})}{1 - \pi(\underline{x})}\right] \tag{5}$$

which referred to as the logit link and by solving for $\pi(\underline{x})$ this lead to the familiar logistic regression model for the probability of households used health services, which is [37]

$$\pi(\underline{x}) = \frac{exp\ (\alpha + \beta_1 x_1 + \beta_2 x_2 + \ldots + \beta_p x_p)}{1 + \alpha + \beta_1 x_1 + \beta_2 x_2 + \ldots + \beta_p x_p} \tag{6}$$

α is the intercept, while β_i are parameters of interest need to be computed, x_1 is an independent variable of head of households aged between 56 and 65, x_2 is an independent variable of head of households aged 66–75 years, x_3 is an independent variable of households aged over 76 years, x_4 is households with health insurance, x_5 is households headed by female, x_6 household quintile 3, x_7 is households quintile 4, x_8 is household quintile 5, x_9 Main district group 1, x_{10} Main district group 2, x_{11} main district group 3, x_{12} main district group 4, x_{13} main district group 5, x_{14} main district group 6 and interaction between households with health insurance and district group 1 is x_4*x_9, interaction of the households with health insurance and group district 2 is $x_4* x_{10}$. The evaluation of the impact of the covariates on the use of healthcare services was carried out using a logistic regression model. We assessed the interactions between districts and other independent variables [38]. Variables with a level of significance less than 5% have been classified as significant, the adjusted odd ratios were discussed [18] and the results were obtained using a R predictor installed in ALTERYX as well as Stata.

3. Results

[3]The results in Table 1 indicated that 29% of the heads of households were aged between 25 and 35. The biggest part, 75%, were males, while 25% were females. Seventy-five percent of all heads of households had health insurance, while 25% had none; primary education was completed by 61%, while 23% had no education level at all. Eighty three percent of the heads of households were from rural areas, and 17% were living in urban areas. On average, there were four members per household. Out of 14,580 households, only 3015 (20.68%) reported receiving medical care in the four weeks during the survey. This means that 79.32% of households did not receive medical care.

---

[3] Std. Dev.: Standard Deviation, Min: Minimum, Max: Maximum.

Table 1
Univariate analysis of the variables used in this study.

Variables		Frequency	Percentages	Mean	Std. Dev.	Min	Max
The head of household received health care in the last four weeks	14,580	3015	20.68	0.206	0.405	0	1
Age groups of the head of households							
Between 14-24 years old (reference level)	14,580	717	4.92		0.216	0	1
Between 25 and 35 years	14,580	4231	29.02		0.453	0	1
Between 36 and 45 years	14,580	3291	22.57		0.418	0	1
Between 46 and 55 years	14,580	2602	17.85		0.382	0	1
Between 56 and 65 years	14,580	2068	14.18		0.348	0	1
Between 66 and 75 years	14,580	1009	6.92		0.253	0	1
Over 76 years	14,580	662	4.54		0.208	0	1
Per capita expenditure	14,580			2.242	3.786	0.413	1297.35
Household size	14,580			4.411	2.118	1	22
Sex of the head of household							
Male (reference)	14,580	10,856	74.46		0.436	0	1
Female	14,580	3724	25.54		0.436	0	1
Household without insurance	14,580	3608	25		0.431	0	1
Household with insurance		10,972	75				
Region							
Urban (reference level)	14,580	2526	17.33		0.378	0	1
Rural	14,580	12,054	82.67		0.378	0	1
Head of household education level	14,580						
None (reference level)	14,580	3412	23.4		0.423	0	1
Primary	14,580	8930	61.25		0.487	0	1
Secondary	14,580	1667	11.43		0.318	0	1
University	14,580	571	3.92		0.193	0	1
Quintile							
Quintile 1 (reference level)	14,580	2429	16.66		0.372	0	1
Quintile 2	14,580	2656	18.22		0.385	0	1
Quintile 3	14,580	2868	19.67		0.397	0	1
Quintile 4	14,580	3078	21.11		0.408	0	1
Quintile 5	14,580	3549	24.34		0.429	0	1

Fig. 1 indicates the classification of the districts with respect to similar use of healthcare services and shows the interactions with some covariates such as the location of the households and the education level achieved by the household head. Households with health insurance were taken as the first split and other nodes were split depending on the primary one. Proportion of the true predictions was found to be 79.3% and proportion of precision and recall was found to be 79.4% and 88.55% respectively (Table 2).

These eight districts were classified using a decision tree technique, which classify districts based on their utilization of health care services.

Fig. 2 indicated the geographical distribution of the districts based on similarities in the patterns of use of health services in Rwanda. In the legend, G_1 indicates group districts located in group one, G_2 districts located in group 2, G_3 districts located in group 3, G_4 districts located in group 4, G_5 districts located in group 5, G_6 districts located in group 6, G_7 districts located in group 7, and G_8 districts located in group 8.

[4]Table 3 indicates the summary of the model where the coefficients with significant level were retained to assess whether there was a change in the predictor variable provoking the use of health care services more likely in the model.

The results from Table 3 indicates that the estimated odds of the use of health services increased 1.3 times for the head of household aged between 56 and 65. For the households headed by individuals aged between 66 and 75 the odds ratio was 1.589 for (95% CI: 1.244–2.028), which significantly increases the use of health services about 1.5 times. Those aged over 76 years of age had an adjusted odds ratio of 1.524 for (95% CI: 1.170–1.985). Similarly, the households with health insurance in interactions with districts variable has an odds ratio of 2.76 indicating that households with health insurance with interactions of districts use health care services with estimated odds of about 3 times higher than those without health insurance.

Furthermore, for the households headed by women variable, with an odds ratio of 1.423 with (95% CI:1.293–1.566), indicates that households headed by women use healthcare services 1.4 times higher compared to those headed by males. In the same line of idea, the households located in the third quintile have an adjusted odds ratio of 1.198 with (95% CI: 1.035–1.385), indicating that the households in the third quintile use health care services about 1.2 times higher compared to those in the first quintile.

Households located in the fourth quintile had an adjusted odds ratio of 1.307 (95% CI: 1.134–1.506) and households located in the fifth quintile had an adjusted odds ratio of 1.307 (95% CI: 1.136–1.504), indicating that households in the fifth quintile used healthcare services 1.3 times higher compared to those in the first quintile. The households located in the main district group 4 variable had an odds ratio of 1.386 with (95% CI:1.242–1.547), indicating that households located in the main district group 4 used health care services 1.4 times higher as compared to those located in Ruhango district.

In the same vein, households located in the main district group 5 have an odds ratio of 0.556 (95% CI:0.477–0.648) which indicate
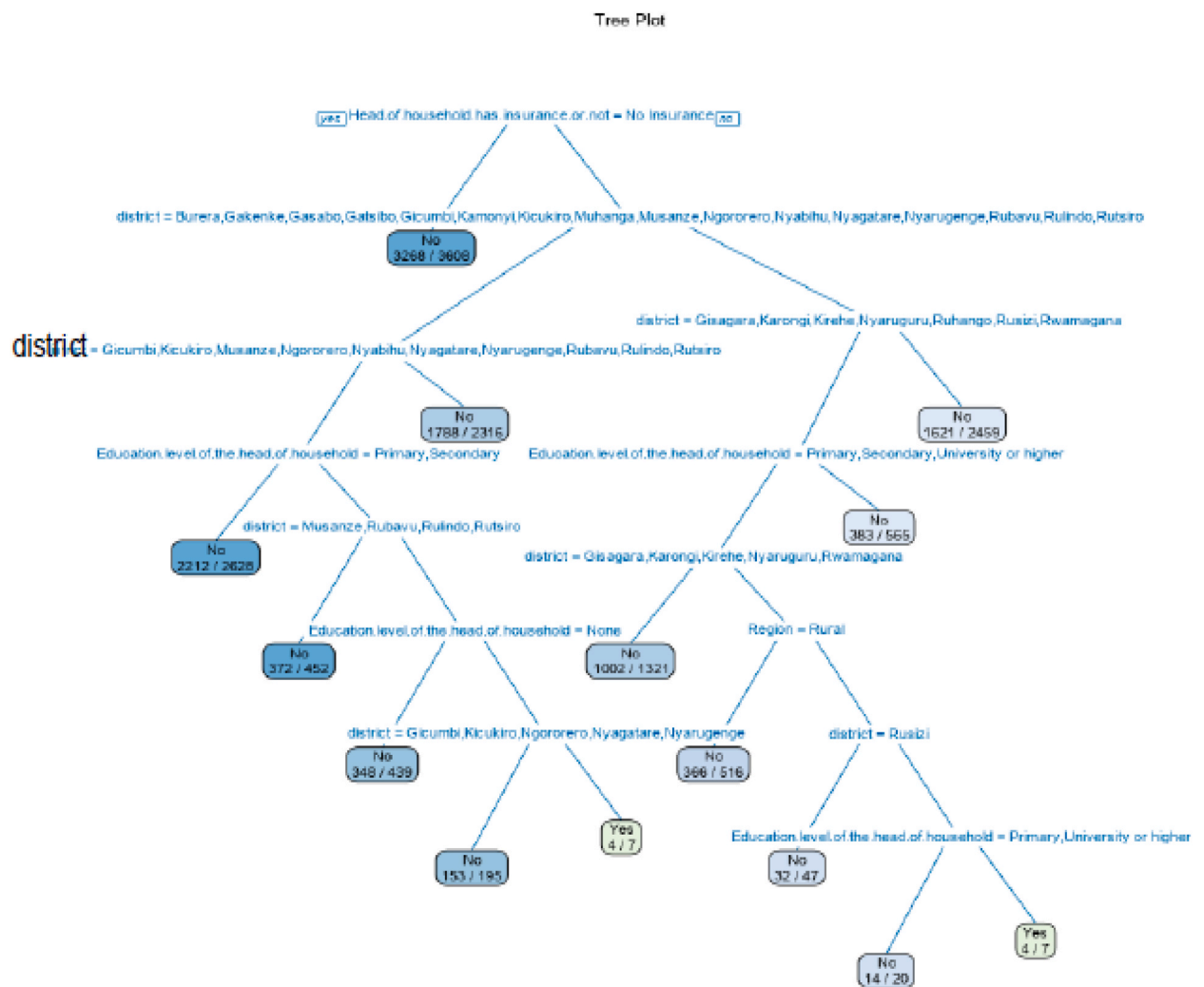
---

[4] Std. Err.: Standard Error.

Fig. 1. Decision tree model which classifies the districts based on similarities for the use of health services.

Table 2
The decision tree classified the districts into eight groups.

Group of districts	Districts
Group 1	Muhanga, Kamonyi, Burera, Gasabo, Gatsibo, Gakenke.
Group 2	Ngororero, Gicumbi, Nyarugenge, Kicukiro, Nyagatare.
Group 3	Gisagara, Karongi, Kirehe, Nyaruguru, Rwamagana.
Group 4	Nyamasheke, Nyamagabe, Huye, Nyanza, Bugesera, Ngoma, Kayonza
Group 5	Musanze, Rubavu, Rulindo, Rutsiro.
Group 6	Nyabihu
Group 7	Rusizi
Group 8	Ruhango

that the households located in the main district group 5 use health care services about 0.5 times higher than those located in Ruhango district. Finally, for households located in the main district group 6, the odds ratio was 0.467 with (95% CI: 0.349–0.626) indicating that the households located in the main district group 6 use health care services about 0.5 times higher compared to those located in Ruhango district.

[5]Table 4 gives the coefficients and odds ratios for the health insurance variable for all 8 groups. Since the logistic model includes

---

[5] Coef.: Coefficient.

Fig. 2. Geographic distribution of districts based on similar patterns of use of health services in Rwanda.

Table 3

Logistic regression model for the probability of using health care services by the head of household.

The head of household has received health care within the past four weeks	Odds ratio	Std. Err.	P -Values	[95% conf. Interval]	
Households without health insurance (base level)					
Households with health insurance	3.438	0.224	0	3.024	3.908
Age groups of household heads					
Between 14 and 24 years (Base level)					
Between 25 and 35 years	0.912	0.1	0.405	0.735	1.132
Between 36 and 45 years	0.967	0.108	0.767	0.776	1.205
Between 46 and 55years	1.114	0.126	0.338	0.892	1.392
Between 56 and 65 years	1.308	0.15	0.019	1.044	1.639
Between 66 and 75 years	1.589	0.197	0	1.244	2.028
0ver 76 years	1.524	0.205	0.002	1.170	1.985
Sex of the head of household					
Male (Base level)					
Female	1.423	0.069	0	1.293	1.566
Quintiles					
Quintile 1 (Base level)					
Quintile 2	1.112	0.085	0.162	0.957	1.292
Quintile 3	1.198	0.088	0.015	1.035	1.385
Quintile 4	1.307	0.094	0	1.134	1.506
Quintile 5	1.307	0.093	0	1.136	1.504
Main group districts 4	1.386	0.077	0	1.242	1.547
Main group districts 5	0.556	0.043	0	0.477	0.648
Main group districts 6	0.467	0.069	0	0.349	0.626
Interaction of district group 1 with Household with health insurance	0.787	0.051	0	0.691	0.895
Interaction of district group 2 with Household with health insurance	0.545	0.041	0	0.471	0.632
Constant	0.074	0.009	0	0.058	0.095

interactions of district groups 1 and 2 with the health insurance variable, the odds ratio for these district groups are more different than other district groups. The findings from Table 4 indicate that for districts of group 1 (Muhanga, Kamonyi, Burera, Gasabo, Gatsibo, Gakenke), households with health insurance have a propensity to use health services about three times as high as those households without health insurance. For group 2, with districts of Ngororero, Gicumbi, Nyarugenge, Kicukiro, and Nyagatare, the results show that the households located in those districts used health care services around 2 times compared to the households located in Ruhango district. So for group 2, the estimated odds of using health services for households with health insurance are approximately twice higher than those without health insurance. Finally, for district group 3 with districts of Rwamagana, Karongi, Nyaruguru, Kirehe,

Table 4
Odds ratio of households with health insurance for districts located in eight groups.

The head of household received health care in last four weeks	Coef.	Odds Ratio
Household with health insurance for district located in group 1	1.016	2.76
Household with health insurance for district located in group 2	0.648	1.91
Household with health insurance for district located in group 3	1.233	3.43
Household with health insurance for district located in group 4	1.233	3.43
Household with health insurance for district located in group 5	1.233	3.43
Household with health insurance for district located in group 6	1.233	3.43
Household with health insurance for district located in group 7	1.233	3.43
Household with health insurance for district located in group 8	1.233	3.43

Gisagara, district group 4 with districts of Nyamasheke, Nyamagabe, Huye, Nyanza, Bugesera, Ngoma, Kayonza, district group 5 with districts of Musanze, Rubavu, Rulindo, Rutsiro, district group 6 with the district of Nyabihu, district group 7 with the district of Rusizi and district group 8 with the district of Ruhango, the findings indicate that the health insurance variable has the same adjusted odds ratio of 3.43, indicating that households with health insurance in the districts without interactions of health insurance use health care services with estimated odds of about 3.4 times those without health insurance.

3.1. Goodness of fit after logistic regression model

The results reveal that Prob > chi2 = 0.019552, demonstrating the goodness of fit of our model, for the 14,580 observations we employed in this investigation with 1176 covariate patterns. Thus, the model is appropriate because the p-value is below 5%.

4. Discussion

The purpose of this research was to assess the impact of health insurance on the utilization of the use of healthcare services in Rwanda. The findings of this study indicate that for districts of group 1 (Muhanga, Kamonyi, Burera, Gasabo, Gatsibo, Gakenke), households with health insurance have a propensity to use health services about three times as high as that of households without health insurance. For group 2, with districts of Ngororero, Gicumbi, Nyarugenge, Kicukiro, Nyagatare the results show that households with health insurance are approximately twice higher than those without health insurance. For district group 3 with districts of Rwamagana, Karongi, Nyaruguru, Kirehe, Gisagara, district group 4 with districts of Nyamasheke, Nyamagabe, Huye, Nyanza, Bugesera, Ngoma, Kayonza, district group 5 with districts of Musanze, Rubavu, Rulindo, Rutsiro, district group 6 with the district of Nyabihu, district group 7 with the district of Rusizi and finally district group 8 with the district of Ruhango, households with health insurance in those districts without interactions use healthcare services about 3.4 times more than those without health insurance.

All in all, these findings are related to the earlier study conducted by Manning et al. (1987) on the evaluation of factors for the choice of health facilities related to the health insurance used [39]. Consistent with the findings of other researchers around the world [35] and Rwanda [15], the findings of this paper are also related to other research findings that stated that the households headed by older adults increase the use of health services [40]. Similarly, our results revealed that the head of households over 56 years are more likely to use healthcare services in Rwanda compared to others.

The findings of this research are related to the research findings conducted by Hanawi et al. (2020)on the assessment of the impact of health insurance on health seeking behavior in Saudi Arabia [41], their results revealed that having health insurance increases the likelihood of visiting the doctor. Compared to Saudi citizens, non-Saudi nationals are more affected. Additionally, those who purchase personal health insurance plans are more likely to visit the doctor than those who use government- and privately-funded plans. Finally, the study discovered that insurance positively influences medical examinations for high cholesterol, diabetes, and blood pressure [41]. These results are comparable to those of this study, which showed that households in Rwanda with health insurance access medical services more frequently than households without insurance. Similarly, a study conducted by Johannes (2010) "on the impact of health insurance on the access to health care and financial protection in rural areas of Senegal", showed that members of health insurance schemes are more likely to use hospitalization services than non-members, and they pay significantly less for care when they do. The findings of this study has an effect on how people can get health care and has made a novel contribution to the existing research by classifying districts based on similarities in the use of health care services, regarding households with or without health insurance. The results of current research show that households with health insurance use medical services more frequently than households without health insurance, but the impact of having health insurance on health care usage depends on the location of the household in Rwanda. Districts in rural, hilly areas with bad infrastructure, and lower rate of health-insured population showed a higher impact of health insurance on health services usage. The study found that besides the geographical location, other factors such as the household's economic status and the age of the household's head also determine the use of health services. Households in Rwanda who lack health insurance do not utilize health services to their full capacity, which has a negative influence on the wellbeing of the country's population. To begin with, health insurance has the potential to reduce the cost of curative health care by raising the chance of seeking medical treatment. This finding is in line with previous research on the effect of insurance in reducing healthcare expenses [38].

The use of the decision tree model to classify districts based on similarity in health service usage is considered as the strength of this study because the generated clusters are used as independent variables to assess the impact of health insurance on health service utilization in Rwanda using a multi-variable logistic regression model. The impact of health insurance on the use of healthcare in

Rwanda has never been thoroughly studied before. The data were obtained from the Rwandan Household Living Standard Survey (EICV5), a large population sample size that can be regarded as representative of the entire population. The results are generalizable to the Rwandan population and offers other low- and middle-income countries useful insight.

4.1. Limitations

Since the study employed secondary data from the EICV5 survey, several factors that might be helpful for assessing the impact of health insurance, like distance to medical facilities and the cost of transportation to medical facilities, were left out of the dataset. Furthermore, self-reported data may be subject to recall bias. The estimated results from the logistic regression approach, which measures the causal effect, may be skewed if unrecognized confounders have an impact on both the outcome and the treatment variables. A further limitation is that the Integrated Living Condition Survey Data was taken between 2016 and 2017, and there is no more recent data available.

5. Conclusions

This study has made a novel contribution to the existing research by classifying districts based on the same similarities in patterns of use of health care services, concerning households with or without health insurance. The results show that households with health insurance use medical services more frequently than households without health insurance, but the impact of having health insurance on health care usage depends on the location of the household in Rwanda. Notably, households located in group one (Muhanga, Kamonyi, Burera, Gasabo, Gatsibo, Gakenke), and in group two (Ngororero, Gicumbi, Nyarugenge, Kicukiro, Nyagatare) had a lower impact of having health insurance on health services usage compared to households located in other groups, because the vast majority of these districts are located in rural areas with elevated hills and insufficient infrastructure. The latter groups also include districts with the lowest rates of contributions of health insurance fees in the country, which could be one explanation for the lesser impact of health insurance on health care usage. Additionally, the results show a significantly different use of healthcare services for households located in the third, fourth and fifth quintiles as compared to those located in the first and second quintiles, which were classified as the poorest households. Households in Rwanda that lack health insurance do not utilize health services to their full capacity, which has a negative influence on the wellbeing of the country's population. The researchers suggest that future policies target households in rural districts that have a low impact on the use of health care services due to a lack of access to advanced health facilities. They also recommend health insurance fees are reduced in order to increase the rate of health coverage as recommended by the World Health Organization.

Author contribution statement

Roger Muremyi: Conceived and designed the experiments; Performed the experiments; Wrote the paper.
Dominique Haughton: Performed the experiments; Analyzed and interpreted the data.
François Niragire: Performed the experiments; Analyzed and interpreted the data.
Ignace Kabano: Analyzed and interpreted the data.

Data availability statement

Data will be made available on request.

Additional information

No additional information is available for this paper.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper

Acknowledgments

References

[1] John, Jane Goudgeb, The Impact of Health Insurance on Health-Care Utilization and Out-Of-Pocket Payments in South Africa, Risk Insur., Geneva Pap, 2012.
[2] Sarah Breen Andrew, Agnes Binagwaho, Universal Health Coverage in Rwanda: a Report of Innovations to Increase Enrolment in Community-Based Health Insurance, 2012.

[3] Ministry of Health, Mutual Health Insurance Policy in Rwanda, 2016.

[4] Aimable, Sharing the burden of sickness: mutual health insurance in Rwanda, World Health Org. 86 (2008) 823–824.

[5] C.Mendola Bredenkamp, M. Gragnolati, Catastrophic and impoverishing effects of health expenditure: new evidence from the Western Balkans, Health Pol. Plann. 26 (4) (2011) 349–356.

[6] Watts, Crimmins, Populations at Special Health Risk: the Elderly, Int. Encycl. Public Health, 2008.

[7] USAID, African Strategies for Health, 2016.

[8] Aimable Twahirwa, http://www.nationalplanningcycles.org/Sharing the burden of sickness: mutual health insurance in Rwanda, Bull. World Health Organ. 86 (11) (2008) 823–824.

[9] WHO, World Health Organization Statistical Information System: Core Health Indicators, 2006.

[10] WHO and MOH, Health Financing Systems Review, Rwanda, 2008.

[11] MOH, Fourth Health Sector Strategic Plan: July 2018 – June 2024, 2018.

[12] Woldemichael, Daniel Zerfu Gurara, Abebe Shimeles, Community-Based Health Insurance and Out-Of-Pocket Healthcare Spending in Africa: Evidence from Rwanda, Afr. Dev. Bank Group, 2016, p. 9922.

[13] Benjamin Chemouni, The political path to universal health coverage: power, ideas and community-based health insurance in Rwanda, World Dev. 106 (2018) 87–98.

[14] NISR, Rwandan Standard Living Condition Survey, 2016 [Online]. Available: https://www.statistics.gov.rw/.

[15] Alypio Nyandwi, Stella Umuhoza, Parfait Uwaliraye, F. Sabine Musange, Towards Sustainability Of the Community-Based Health Insurance In Rwanda: Successes, Challenges, And Opportunities, 2021 [Online]. Available: https://sparc.africa/2021/09/towards-sustainability-of-the-community-based-health-insurance-in-rwanda-successes-challenges-and-opportunities/.

[16] Sarker Mahumud, I. Marufa, Ziaul, Distribution and determinants of out-of-pocket healthcare expenditures in Bangladesh, Pan Afr. Med. 37 (55) (2020).

[17] G. Emmanuel Gwindon, The impact of health insurance on health services utilization and health outcomes in vietman, Health Econ. Pol. Law 9 (2014) 359–382, https://doi.org/10.1017/S174413311400005X.

[18] N.T.T. Thuong, Impact of health insurance on healthcare utilization patterns in Vietnam : a survey based analysis with propensity score matching methods, BMC Open (2020), https://doi.org/10.1136/bmjopen-2020-0440062.

[19] John Ele-Ojo Ataguba, Jane Goudge, The impact of health insurance on health-care utilisation and out-of-pocket payments in South Africa, Int. Assoc. Study Insur. Econ. 37 (633–654) (2012) 37.

[20] C.C. Garg, A.K. Karan, Reducing out-of-pocket expenditures to reduce poverty: a disaggregated analysis at rural-urban and state level in India, Health Pol. Plann. 24 (2009) 116–128.

[21] R. Muremyi, D. Haughton, F. Niragire, I. Kabano, Determining Factors Influencing Out-Of-Pocket Health Care Expenditures in Low- and Middle-Income Countries: A Systematic Review, in: Springer Books Clint. Aigbavboa Joseph N Mojekwu Wellingt. Didibhuku Thwala Lawrence Atepor Emmanuel Adi Ed Sustain. Educ. Dev. – Sustain. Ind. Innov., 2023, pp. 441–450, https://doi.org/10.1007/978-3-031-25998-2_32.

[22] Charles Ruhara Mulindabigwi, Kioko Urbanus Mutuku, Effect of Health Insurance on demand for outpatient medical care in Rwanda: an application of the control function approach, Rwanda J (2016). http://doi.org/10.4314/rj.v3i1.6B.

[23] Priyanka Saksena, Adélio Fernandes Antunes, Ke Xu, Laurent Musango, Carrin Guy, Impact of Mutual Health Insurance on Access to Health Care and Financial Risk Protection in Rwanda World Health Report, World Health Organ., 2010.

[24] Roger Muremyi, Dominique Haughton, Ignace Kabano, François Niragire, Prediction of out-of-pocket health expenditures in Rwanda using machine learning techniques, Pan Afr. Med. 37 (2020) 357, https://doi.org/10.11604/pamj.2020.37.357.27287.

[25] Andinet Woldemichael, Daniel Zerfu Gurara, Woldemichael, Community-Based Health Insurance and Out-Of-Pocket Healthcare Spending in Africa: Evidence from Rwanda, Inst. Study Labor, 2016.

[26] Ruhara Mulindabigwi Charles, Urbanus Mutuku Kioko, Effect of Health Insurance on Demand for Outpatient Medical Care in Rwanda: an Application of the Control Function Approach, Rwanda J., 2016.

[27] Aimable, Sharing the burden of sickness: mutual health insurance in Rwanda, World Health Org. 86 (2008) 823–824.

[28] HDI, Human Development Repport Office, latest-human-development-index-ranking, 2020 [Online]. Available: http://hdr.undp.org/en/content.

[29] NISR, Rwandan Standard Living Condition Survey, 2016 [Online]. Available: https://www.statistics.gov.rw/.

[30] MoH, Rwandan Ministry of Health, 2018.

[31] RSSB, Rwanda Social Security Board, 2019.

[32] WHO, Medical Services Definition, 2018 [Online]. Available: https://www.lawinsider.com/dictionary/medical-services.

[33] Yuanyuan Wenjuan, Ping Jun, Liangfei, The impact of medical insurance payment systems on patient choice, provider behavior, and out-of-pocket rate: fee-for-service versus diagnosis-related groups, J. Decis. Sci. Inst. (2023), https://doi.org/10.1111/deci.12593.

[34] WHO, 'Can People Afford to Pay for Health Care? New Evidence on Financial Protection in Europe', WHO Regional Office for Europe, Regional Office for Europe, 2018 [Online]. Available: www.euro.who.int/en/health-topics/Health-systems/healthsystems-financing/universal-health-coverage-financialprotection.

[35] M.I. Nakovics, et al., Determinants of healthcare seeking and out-of-pocket expenditures in a 'free' healthcare system: evidence from rural Malawi, Health Econ. Rev. 10 (1) (2020) 14, https://doi.org/10.1186/s13561-020-00271-2.

[36] J.L. Rickard, C.L. Ngarambe, B. Smart, R. Riviello, J.P. Majyambere, Risk of catastrophic health expenditure in Rwandan surgical patients with peritonitis, World J. Surg. 42 (6) (2018) 1603–1609, https://doi.org/10.1007/s00268-017-4368-x.

[37] O'Connell, A. Ann, Logistic Regression Models for Ordinal Response Svariables, Sage Publ., 2006.

[38] A.N. Mulaga, M.S. Kamndaya, S.J. Masangwi, Examining the incidence of catastrophic health expenditures and its determinants using multilevel logistic regression in Malawi, journal.pone. (2021), https://doi.org/10.1371/0248752.

[39] W.G. Manning, Health insurance and the demand for medical care: evidence from a randomized experiment, Am. Econ. Rev. 77 (3) (1987) 251–277.

[40] Basant Kumar panda, Sanjay K. Mohanty, Different methods of population aging and household use in India, Int. Aging (2021).

[41] Mwale Hanawi, Kamninga, The effects of health insurance on health-seeking behaviour: evidence from the Kingdom of Saudi Arabia, Risk Manag. Healthc. Pol. (2020) 595–607, https://doi.org/10.2147/RMHP.S257381.

[42] Ministry of Finance and Economic Planning, Population and Human Settlement Census, Kigali, 2002.

[43] J.B. Ndikubwimana, M.P. Dusingize, in: H. Musahara (Ed.), Vision 2020 Umurenge Programme (VUP) and its Financial Direct Support Component to the Poor as Strategy for Poverty Reduction in Rwanda: Challenges and Opportunities, Inclusive Growth and Development Issues in Eastern and Southern Africa, OSSREA, Addis Ababa, 2016, pp. 176–193.