

Mobile money use and social health insurance enrolment among rural dwellers outside the formal employment sector: Evidence from Kenya

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ABSTRACT

Background: The study set out to explore whether mobile money use (mobile phone-based financial service) increased the probability of rural dwellers outside the formal employment sector of being enrolled in Kenya's social health insurance, the National Hospital Insurance Fund (NHIF).

Methods: We used data from the 2015 FinAccess Household Survey and analysed responses of 4282 rural individuals outside the formal employment sector. A probit regression model was used and adjusted for mobile phone ownership, sex, age, age-squared, education, wealth quintile, bank account use, informal group membership, occupation, and health shocks.

Results: We found that 16.26% (95% CI, 14.58% to 18.10%) of mobile money users had NHIF cover as compared to 2.44% (95% CI, 1.83% to 3.23%) of non-users. Importantly, mobile money use increased the probability of being enrolled in NHIF by 4.6% (95% CI, 2.1% to 7.1%) after controlling for confounders. Access to mobile money was associated with reduced travel time and lower transport costs, which are likely to be key mechanisms for increasing NHIF enrolment.

Conclusion: By lowering transport costs and saving travel time, mobile money provides an easy means to pay social health insurance premiums thus incentivising its uptake among rural people outside of formal employment.

Keywords: Digital health, health insurance, digital financial services, mobile money, national hospital insurance fund.

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BACKGROUND

More than 61.2% (2 billion) of the world's employed population work in the informal sector.¹ Most of them are in low and middle-income countries with 85.8% of employment in Africa being informal.¹ More than two-thirds of the global population working in the informal sector are in rural rather than urban areas.¹ Furthermore, there are huge disparities in access to financial services between rural and urban dwellers especially for those in the informal sector. Financial institutions such as banks and health insurance companies are concentrated in urban areas.² Therefore, rural dwellers incur transport and opportunity costs when they travel long distances to access key financial services such as social health insurance.

Social health insurance is a prepayment scheme that offers financial protection to enrollees by distributing and sharing the risk of paying for large costs of care.^{3,4} It is important to the achievement of universal health coverage (UHC) as it ensures that enrollees do not experience financial hardship when accessing needed health services. For example, social health insurance enrollees in Ghana reduced their out of pocket health expenditure by 86% and were protected against catastrophic health expenses and impoverishment.⁵

However, social health insurance coverage in Sub-Saharan Africa is extremely low with 38% of the population in Ghana, 16% in Kenya, and 17% in Tanzania covered.^{6,7} Furthermore, coverage is lower among rural than urban residents⁸ and 60.46% of the Sub-Saharan African population live in rural areas.⁹ To compound the problem, those not working in the formal sector are usually left out of social health insurance schemes as most are only compulsory for those who are formally employed.

In Kenya, social health insurance is compulsory for those formally employed and voluntary for the rest.¹⁰ The National Hospital Insurance Fund (NHIF) is the main insurer covering 93.9% of the insured population.¹¹ However, only 19% of Kenyans have some form of health insurance (including private health insurance) with lower figures reported in rural (13.3%) than urban (29.2%) areas.¹¹ The formally employed pay NHIF monthly premiums through salary deductions from their employers according to their salary scale with premiums ranging from Kenya Shillings (KES) 150 (US \$ 1.5) to a maximum of KES 1,700 (US \$ 17) per month.¹⁰ Voluntary contributors pay a standard monthly premium of KES 500 (US \$ 5). Enrolees can seek health services at over 5000 accredited private, faith-based, and public health care providers for outpatient, inpatient, and specialised services.¹⁰

Kenyan citizens and residents aged 18 years and above are eligible to enrol in NHIF.¹⁰ Though enrolees can include their dependents in the cover. Enrolment can be done physically at 62 NHIF branches, 47 government service centres (known as Huduma centres), online, or through the mobile phone using unstructured supplementary service data (USSD) and applications. Then, for voluntary contributors, premiums can be paid using mobile money, online through digital wallets, or at branches of four approved banks i.e. Cooperative Bank, Equity Bank, Kenya Commercial Bank, and National Bank of Kenya. It is these voluntary contributors that we focussed on. More so, rural dwellers not employed in the formal sector.

One of the main challenges with voluntary health insurance is high transaction costs for enrolling and paying premiums especially in sparsely populated rural areas.¹² Approximately 74% of the Kenyan population reside in rural areas while 40.1% of rural dwellers live in poverty.^{11,13} Rural dwellers outside the formal sector are

disadvantaged as they have to travel long distances to insurance offices to register and pay premiums. This might deter them from enrolling in social health insurance or paying premiums. Therefore, mechanisms that can enable this segment of the population to easily pay premiums without incurring transport and opportunity costs would go a long way in boosting and maintaining enrolment in Kenya's NHIF.

One of the main challenges of achieving UHC is a large informal sector that does not have health insurance.¹⁴ Roughly 83.6% of employment in Kenya is in the informal sector with almost two thirds (64.5%) being in rural areas.⁷ To boost enrolment from those not in the formal sector, NHIF partnered with mobile money service operators to start collecting premium payments using mobile money in 2010.¹⁵ Mobile money is a service that enables users to send and receive remittances, purchase insurance, pay premiums, save, and take out credit through the mobile phone or application.¹⁶ It is available on very basic mobile phone devices, functions without internet access, and operates outside the conventional banking network. A good example is M-PESA¹⁷, which is available in Kenya and nine other countries.¹⁸ Mobile money users do their cash in cash out transactions at a mobile money agent where they can load (deposit) and convert (withdraw) virtual money to cash.¹⁹ These mobile money agents range from small kiosks in a village to large supermarkets in urban areas and earn commission for their services from mobile money provider companies.

Globally, two thirds of those without bank accounts own a mobile phone.² Mobile financial services such as mobile money, are extending financial services to those left out of formal banking systems especially rural populations, the poor, and those outside the formal sector. In 2018, there were 866 million mobile money accounts worldwide and 45.7% of them were in Sub Saharan Africa.²⁰ In Kenya, a survey

conducted in 2018 found that 79.4% of the adult population had a mobile money account.²¹

Mobile money has improved payment practices as it reduces transaction costs over long distances.^{19,22} Therefore, using mobile money might be an incentive for rural populations outside the formal sector to enrol in NHIF and maintain their enrolment status. We hypothesised that mobile money use increases the probability of individuals living in rural Kenya and outside of the formal employment sector to enrol in NHIF.

METHODS

Data source and study design

We used data collected as part of the 2015 FinAccess Household Survey.²³ This was a Kenyan nationally representative survey conducted by the Central Bank of Kenya, Kenya National Bureau of Statistics, and the Financial Sector Deepening Trust that measured access to and demand for financial services among Kenyans aged 16 years and above.²⁴

The study was a cross-sectional survey that used a multi-stage stratified cluster sampling design. First, 834 clusters were selected as primary sampling units (PSU), using probability proportional to size (PPS), from a national sampling frame. The sampling frame, called the Fifth National Sample Survey and Evaluation Program (NASSEP V), was designed by the Kenya National Bureau of Statistics according to Kenya's population census. Furthermore, there was stratification by urban and rural areas and 47 counties resulting in 92 strata.

The second stage involved selecting 14 households in each cluster. In the final stage, one individual aged 16 years old and above, was randomly selected per household using a Kish grid. If the selected individual was not present, the interviewers did not substitute, but came back a second or third time till they found them. Objectives of the survey were first explained to the respondents and oral informed consent sought thereafter. One on one computer assisted personal interviewing (CAPI) in local languages including English and Swahili was used. Data was collected between 18th August 2015 and 15th October 2015. Finally, 8665 interviews in 820 clusters were conducted. One person was interviewed per household. Data was collected on socio demographic characteristics, access and use of financial services including mobile money, and social health insurance enrolment. An 87% response rate was achieved from a target of 10,008 interviews in 834 clusters.²⁴

For this study, we selected a sub sample of respondents who were not in formal sector employment, aged 18 years and over, and living in rural areas. We focused on this group because Kenya's social health insurance, the NHIF, is mandatory for those in formal employment but voluntary for the rest. Formal sector employees contribute through salary deductions. The rest voluntarily enrol and pay premiums. Those outside the formal employment sector included self-employed, farmers, casual workers and the unemployed. We used the term 'outside the formal employment sector' rather than 'informal sector' as the unemployed were also included. Out of the 8665 survey respondents, 4282 individuals fell into this category.

Characteristics of study respondents

Mobile money use was treated as the main independent variable. From the survey, information was collected on whether the respondent reported themselves to be a

registered mobile money user (Table 1). This was coded as zero for non-user and one for user. The outcome variable was NHIF enrolment. Respondents were asked whether they were currently enrolled in NHIF in their own name (i.e. principal member). The response had three categories: currently, used to, and never. The outcome variable was transformed into a binary variable where the 'used to have' and 'never had' categories were merged into a 'no' category and 'currently have' was coded as 'yes'.

Table 1: Characteristics of study respondents

Variable	Combined		Mobile money users		Mobile money non- users		P-Value
	Proportion	N	Proportion	N	Proportion	N	
Mobile money use							
Non-user	42.89%	1837					
User	57.11%	2446					
		4282					
NHIF enrolment							
No	89.67%	3840	83.74%	2048	97.56%	1792	<0.001
Yes	10.33%	443	16.26%	398	2.44%	45	<0.001
		4282		2446		1837	
Mobile savings and credit account use							
Non-user	91.90%	3936	86.33%	2112	99.32%	1824	<0.001
User	8.10%	347	13.67%	334	0.68%	12	<0.001
		4282		2446		1837	
Bank account use							
No	82.06%	3514	72.71%	1778	94.50%	1736	<0.001
Yes	17.94%	768	27.29%	667	5.50%	101	<0.001
		4282		2446		1837	
Age (Years) - Mean (SD)	41.02 (17.40)	4282	39.74 (15.31)	2446	42.72 (19.58)	1837	<0.001
Wealth Quintile							
Poorest	37.53%	1607	21.44%	524	58.96%	1083	<0.001
2nd Poorest	25.21%	1080	26.84%	656	23.05%	423	0.011
Middle	21.09%	903	27.59%	675	12.43%	228	<0.001
2nd Wealthiest	12.04%	516	17.76%	434	4.41%	81	<0.001
Wealthiest	4.13%	177	6.37%	156	1.14%	21	<0.001
		4282		2446		1837	
Informal group membership							
No	60.16%	2576	47.60%	1164	76.88%	1412	<0.001
Yes	39.84%	1706	52.40%	1282	23.12%	425	<0.001
		4282		2446		1837	

Occupation							
Farming	49.51%	2120	47.79%	1169	51.80%	951	0.027
Self Employed/ Business	16.16%	692	20.15%	493	10.85%	199	<0.001
Casual worker and other occupations	18.05%	773	18.14%	444	17.94%	330	0.889
Unemployed	16.27%	697	13.92%	341	19.40%	356	<0.001
		4282		2446		1837	
Education							
None	29.52%	1264	12.92%	316	51.62%	948	<0.001
Primary	47.84%	2049	54.58%	1335	38.88%	714	<0.001
Secondary	19.25%	824	27.03%	661	8.89%	163	<0.001
Tertiary	3.38%	145	5.46%	134	0.62%	11	<0.001
		4282		2446		1837	
Sex							
Male	46.11%	1975	49.56%	1212	41.52%	763	<0.001
Female	53.89%	2308	50.44%	1234	58.48%	1074	<0.001
		4282		2446		1837	
Religion							
Christianity	80.16%	3433	88.84%	2173	68.59%	1260	<0.001
Islam	17.14%	734	9.18%	225	27.73%	509	<0.001
Other religion	0.96%	41	0.79%	19	1.20%	22	0.197
No religion	1.74%	75	1.19%	29	2.47%	45	0.004
		4282		2446		1837	
Marital status							
Single	14.68%	628	15.38%	375	13.75%	252	0.147
Divorced/Separated/Widowed	17.68%	756	15.10%	369	21.11%	387	<0.001
Married/Living with partner	67.64%	2892	69.52%	1697	65.15%	1194	0.006
		4275		2441		1833	
Exposure to information							
No	35.98%	1541	22.67%	554	53.71%	986	<0.001
Yes	64.02%	2742	77.33%	1891	46.29%	850	<0.001
		4282		2446		1837	
Health shocks							
No	92.83%	3975	91.57%	2240	94.49%	1736	<0.001
Yes	7.17%	307	8.43%	206	5.51%	101	<0.001
		4282		2446		1837	
Travel time to the nearest mobile money agent							
Less than 10 minutes	25.68%	1022	30.99%	741	17.70%	281	<0.001
10 to 30 minutes	46.03%	1831	49.00%	1171	41.55%	660	<0.001
30 minutes or more	28.29%	1126	20.01%	478	40.76%	648	<0.001
		3979		2390		1589	
Travel costs to the nearest mobile money agent							
No monetary costs	74.96%	3093	80.84%	1952	66.67%	1141	<0.001
Monetary costs involved	25.04%	1033	19.16%	462	16.66%	571	<0.001
		4126		2414		1712	

Travel time to the nearest bank branch							
Less than 10 minutes	6.84%	260	6.69%	155	7.07%	104	0.692
10 to 30 minutes	34.63%	1313	39.13%	908	27.53%	405	<0.001
30 minutes or more	58.53%	2220	54.18%	1257	65.39%	963	<0.001
		3793		2321		1472	
Travel costs to the nearest bank branch							
No monetary costs	23.26%	932	20.64%	493	27.14%	439	<0.001
Monetary costs involved	76.74%	3072	79.36%	1895	72.86%	1177	<0.001
		4004		2388		1616	
Mobile phone ownership							
No	33.16%	1420	4.76%	117	70.99%	1304	<0.001
Yes	66.84%	2862	95.24%	2329	29.01%	533	<0.001
		4282		2446		1837	

SD denotes standard deviation. N denotes number of observations. Adjusted Wald test was used to compare between mobile money users and non-users. T-test was used to compare the differences in means. Wealth quintile is a composite variable derived from the wealth index which measures living standards in the households. The variable was constructed using information collected on assets, sanitation facilities, household building materials, and water source. Travel time and costs to the nearest mobile money agent and bank branch were self-reported. Health shocks variable denoted whether the respondent's household had experienced large medical costs due to a family member's ill-health in two years preceding the survey. Exposure to information variable denoted whether the respondent had watched television, listened to radio, or read newspapers in the seven days preceding the survey.

NHIF coverage was very low as only 10.33% of the respondents were enrolled

(Table 1). Furthermore, only 3.38% of the respondents had some form of tertiary education while almost two thirds came from the bottom two wealth quintiles.

However, 66.84% owned a functional mobile phone while 57.11% were registered mobile money users. Finally, women accounted for a slight majority of the rural population.

Comparisons between mobile money users and non-users (Table 1) revealed statistically significant differences. Users were more likely to be wealthier, be members of informal financial groups, have primary level education, have been exposed to information, and own mobile phones. In comparison, non-users were more likely to be poorer, not be members of informal financial groups, have no education, be unexposed to information, and not own mobile phones. Importantly,

16.26% of mobile money users were enrolled in NHIF as compared to 2.44% of non-users ($P < 0.001$).

Data Analysis

Probit model

We used probit regression to model the association between mobile money use and NHIF enrolment among rural individuals outside the formal sector in Kenya. We specified the probit model as follows:

$$NHIFenrolment_i = \alpha + \beta_1 MMuse_i + \beta_2 X_i + \varepsilon_i \quad (1)$$

where $NHIFenrolment_i$ was the probability of individual i being enrolled in NHIF, α was the intercept, β_1 was the slope parameter while β_2 was a vector of slope parameters, $MMuse_i$ was the independent variable which took the form of one if individual i was a registered mobile money user and zero otherwise, and X_i was a vector of controls which consisted of the following characteristics of individual i , namely, mobile phone ownership, sex, age, age-squared, education, wealth quintile, bank account use, informal group membership, occupation, and health shocks. These controls were selected according to literature on mobile money^{22,25-31} and social health insurance³²⁻³⁸. We added a dummy variable for mobile phone ownership in our model so as to disentangle the money payment system (mobile money) from the cell phone.³¹ Age-squared was included to check for the quadratic effect of age. ε_i was the error term. Finally, we also tested for interactions between mobile money use and health shocks, and mobile money and sex.

Potential mechanisms and bivariate probit model

The main mechanisms through which mobile money use may affect NHIF enrolment are through a reduction in travel time (convenience) and lowering of transport costs

to premium payment points. The main channels for paying premiums were mobile money and banks. Therefore, we used Munyegera and Matsumoto's³⁰ approach by assuming that the decision to adopt and use mobile money was enhanced by the proximity to a mobile money agent while the decision to adopt and use a bank account was triggered by the proximity to a bank branch. We argue that, the closer an individual was to a mobile money agent or bank branch the more likely they were to adopt and use mobile money or a bank account respectively since travel time and costs are barriers to uptake of these financial services in rural areas.

To test these assumptions, we estimated the joint probability of being a mobile money and bank user using a bivariate probit model assuming the decision to adopt and use these two services were correlated. Therefore, a bivariate probit was appropriate as we had two binary outcomes and the same set of covariates. We specified the model as follows;

$$MMUse_i = \alpha_1 + \beta_{11} MMAgentTT_{i1} + \beta_{12} MMAgentTC_{i1} + \beta_{13} BankTT_{i1} \\ + \beta_{14} BankTC_{i1} + \beta_{15} X_{i1} + \varepsilon_{i1}$$

$$BankUse_i = \alpha_2 + \beta_{21} MMAgentTT_{i2} + \beta_{22} MMAgentTC_{i2} + \beta_{23} BankTT_{i2} \\ + \beta_{24} BankTC_{i2} + \beta_{25} X_{i2} + \varepsilon_{i2}$$

(2)

where $MMUse_i$ and $BankUse_i$ were the joint probability of individual i being a mobile money and bank user, α_1 and α_2 were the intercepts, β_{11} to β_{24} were the slope parameters while β_{15} and β_{25} were vectors of slope parameters, $MMAgentTT_{i1}$, $MMAgentTT_{i2}$, $BankTT_{i1}$, and $BankTT_{i2}$ were independent variables for the self-reported travel time to the nearest mobile money agent and bank branch respectively which took the form of zero if it would take individual i 'less than 10 minutes', one '10 to 30

minutes', and two '30 minutes or more' to travel, $MMAgentTC_{i1}$, $MMAgentTC_{i2}$, $BankTC_{i1}$, and $BankTC_{i2}$ were self-reported travel costs to the nearest mobile money agent and bank branch respectively which took the form of zero if it would cost individual i 'no monetary costs', and one if 'monetary costs were involved' to travel, and X_{i1} and X_{i2} were vectors of controls which consisted of the following characteristics of individual i , namely, mobile phone ownership, sex, age, age squared, education, wealth quintile, informal group membership, occupation, and health shocks. Finally, ε_{i1} and ε_{i2} were the error terms which were assumed to be correlated.

In all analyses (including descriptive statistics), we accounted for the data's complex survey design using 'svy' commands on Stata 15.1 and incorporated clustering, stratification, and weighting.³⁹ The sub-sample of rural individuals outside the formal sector was specified using 'subpop' command.⁴⁰ Furthermore, single unit was centred to ensure that strata with single sampling unit were centred at overall mean instead of strata mean.

RESULTS

Mobile money and NHIF enrolment

Mobile money use was significantly associated with a 4.6% increase in the probability of being enrolled in NHIF (Table 2). This was after adjusting for mobile phone ownership, sex, age, age squared, education, wealth quintile, bank account use, informal group membership, occupation, and health shocks.

Table 2: Probit model estimates for the association between mobile money and NHIF enrolment

NHIF enrolment

Variable	Coeff.	P-Value	M.E	P-Value
Mobile money use				
Non- user	0 (Ref.)			
User	0.357 (0.104)	0.001	0.046 (0.013)	<0.001
Mobile phone ownership				
No	0 (Ref.)			
Yes	0.041 (0.116)	0.725	0.006 (0.016)	0.722
Sex				
Male	0 (Ref.)			
Female	-0.060 (0.062)	0.332	-0.008 (0.009)	0.337
Age (Years)				
	0.013 (0.010)	0.184	0.002 (0.001)	0.187
Age squared				
	-0.0001 (0.0001)	0.359	-0.00001 (0.00001)	0.360
Education				
None	0 (Ref.)			
Primary	0.341 (0.111)	0.002	0.039 (0.011)	0.001
Secondary	0.562 (0.123)	<0.001	0.073 (0.015)	<0.001
Tertiary	0.983 (0.167)	<0.001	0.161 (0.034)	<0.001
Wealth Quintile				
Poorest	0 (Ref.)			
2nd Poorest	0.324 (0.097)	0.001	0.037 (0.011)	0.001
Middle	0.354 (0.110)	0.001	0.042 (0.013)	0.002
2nd Wealthiest	0.717 (0.113)	<0.001	0.105 (0.018)	<0.001
Wealthiest	0.790 (0.143)	<0.001	0.120 (0.027)	<0.001
Bank account use				
No	0 (Ref.)			
Yes	0.699 (0.081)	<0.001	0.121 (0.017)	<0.001
Informal group membership				
No	0 (Ref.)			
Yes	0.156 (0.077)	0.042	0.022 (0.011)	0.040
Occupation				
Farming	0 (Ref.)			

Self Employed/ Business	0.009 (0.087)	0.921	0.001 (0.013)	0.921
Casual worker and other occupations	-0.182 (0.108)	0.092	-0.025 (0.014)	0.082
Unemployed	-0.371 (0.097)	<0.001	-0.046 (0.011)	<0.001
Health shocks				
No	0 (Ref.)			
Yes	0.048 (0.102)	0.637	0.007 (0.015)	0.644
Constant	-2.820 (0.227)	<0.001		
Observations (N)	4282			
F - statistic	28.70			

Dependent variable is NHIF enrolment. Probit model coefficients (Coeff.), average marginal effects (M.E), and Taylor linearised standard errors in parentheses are reported.

However, we did not find any statistically significant interactions between mobile money and health shocks and sex.

Possible mechanisms

We estimated the joint probability of being a mobile money and bank account user to ascertain the role played by travel time and costs in the interdependent decision of using these two financial services (Table 3). We found that any form of travel costs to the nearest mobile money agent as compared to no monetary costs was significantly associated with a decreased probability of being a mobile money user after adjusting for mobile phone ownership, sex, age, age squared, education, wealth quintile, bank account use, informal group membership, occupation, health shocks, and travel time and costs to the nearest bank branch. Additionally, a longer travel time to a mobile money agent as compared to a shorter travel time was associated with a decreased probability of being a mobile money user. Therefore,

travel time and costs to a mobile money agent significantly influenced the decision to be a mobile money user. On the contrary, travel time and costs to the nearest bank branch did not seem to be significantly associated with an individual's decision to be a mobile money user.

Table 3: Bivariate probit model estimates for the joint outcome of being a mobile money and bank account user

Variable	Mobile money use		Bank account use	
	1	2	1	2
	Coeff.	P-Value	Coeff.	P-Value
Travel time to the nearest mobile money agent				
Less than 10 minutes	0 (Ref.)		0 (Ref.)	
10 to 30 minutes	-0.159 (0.075)	0.034	-0.015 (0.070)	0.831
30 minutes or more	-0.220 (0.091)	0.016	0.100 (0.105)	0.339
Travel costs to the nearest mobile money agent				
No monetary costs	0 (Ref.)		0 (Ref.)	
Monetary costs involved	-0.279 (0.077)	<0.001	-0.015 (0.080)	0.854
Travel time to the nearest bank branch				
less than 10 minutes	0 (Ref.)		0 (Ref.)	
10 to 30 minutes	0.165 (0.142)	0.245	-0.168 (0.110)	0.125
30 minutes or more	0.162 (0.140)	0.246	-0.175 (0.119)	0.140
Travel costs to the nearest bank branch				
No monetary costs	0 (Ref.)		0 (Ref.)	
Monetary costs involved	0.139 (0.076)	0.069	0.003 (0.076)	0.968
Mobile phone ownership				
No	0 (Ref.)			
Yes	2.026 (0.067)	<0.001	0.443 (0.095)	<0.001
Sex				
Male	0 (Ref.)			
Female	-0.203 (0.061)	0.001	-0.402 (0.060)	<0.001
Age (Years)				
	0.058 (0.009)	<0.001	0.048 (0.010)	<0.001
Age Squared				
	-0.001 (0.0001)	<0.001	-0.0004 (0.0001)	<0.001

Education				
None	0 (Ref.)			
Primary	0.547 (0.076)	<0.001	-0.009 (0.088)	0.922
Secondary	0.728 (0.097)	<0.001	0.302 (0.099)	0.002
Tertiary	1.323 (0.232)	<0.001	1.034 (0.147)	<0.001
Wealth Quintile				
Poorest	0 (Ref.)			
2nd Poorest	0.325 (0.072)	<0.001	0.199 (0.094)	0.034
Middle	0.453 (0.075)	<0.001	0.449 (0.093)	<0.001
2nd Wealthiest	0.484 (0.102)	<0.001	0.800 (0.100)	<0.001
Wealthiest	0.465 (0.167)	0.006	1.165 (0.123)	<0.001
Informal group membership				
No	0 (Ref.)			
Yes	0.351 (0.064)	<0.001	0.194 (0.060)	0.001
Occupation				
Farming	0 (Ref.)			
Self Employed/ Business	0.180 (0.086)	0.038	0.331 (0.077)	<0.001
Casual worker and other occupations	-0.033 (0.081)	0.679	-0.052 (0.080)	0.517
Unemployed	-0.028 (0.079)	0.725	-0.075 (0.092)	0.416
Health shocks				
No	0 (Ref.)			
Yes	0.079 (0.097)	0.416	-0.060 (0.101)	0.555
Constant				
	-3.191 (0.241)	<0.001	-2.674 (0.237)	<0.001
Rho			0.276 (0.044)	
Observations (N)			3739	
F - statistic			44.23	

Dependent variables are mobile money use (1) and bank account use (2). Bivariate probit model coefficients (Coeff.) and Taylor linearised standard errors in parentheses are reported. Rho is the correlation coefficient

Overall, travel time and costs to the nearest mobile money agent and bank branch were not significantly associated with an individual's decision to be a bank account user (Table 3 column 2).

DISCUSSION

The study set out to explore whether mobile money use was associated with NHIF enrolment among rural individuals outside the formal employment sector in Kenya. Using a probit model, we found that mobile money use significantly increased the probability of being enrolled in NHIF by 4.6%. Access to mobile money was associated with reduced travel time and lower transport costs, which are likely to be key mechanisms for increasing NHIF enrolment.

Slightly more than half (57.11%) of the rural population outside the formal employment sector were registered mobile money users in our study. This was consistent with a study conducted in rural Kenya by Geng et al.⁴¹ who found that 55.8% of respondents (dairy farmers) had used mobile money. Rural dwellers still lag behind their urban counterparts in access to financial services such as mobile money. Moreover, we found significant differences between mobile money users and non-users. Users were wealthier, educated, owned mobile phones and used bank accounts. Non-users on the other hand were poorer, less educated, a majority did not own mobile phones and bank accounts. These findings were consistent with

many mobile money studies across Sub-Saharan Africa and Asia that found that users were well off than non-users in urban and rural settings.^{19,27,42,43} Though a Ghanaian study found that financial status did not influence an individual's decision to use mobile money.⁴⁴ Overall, non-mobile money users were financially excluded and this might have worsened inequalities.

Mobile money use increased the probability of being enrolled in NHIF with the underlying mechanisms being the convenience offered by access to mobile money such as reduced travel time and lowered transport costs. By adopting mobile money, rural dwellers gain access to a technology that provides a faster, secure, and less costly way of making payments and transferring money. Therefore, mobile money users enjoy the benefits of low transaction costs when paying premiums, convenience (do not have to travel to banks to queue and make payments), and reduction in transportation costs. In Ghana, Boaheng et al.⁴⁵ found that urban and rural informal sector workers were more likely than unemployed to pay their social health insurance premiums using mobile money. The benefits provided by the technology might have reduced the drop-out rate from NHIF thereby increasing mobile money users' probability of being enrolled in NHIF. Non-mobile money users do not enjoy these benefits. Travel time and costs to bank branches and insurance offices might therefore have deterred them from enrolling in NHIF or incentivised them to drop out of the social health insurance scheme. In some cases, may be transport costs might have been way higher than the amount of premium to be paid which might also be compounded by loss of earnings due to time off work. The benefits, such as lower transaction and transport costs, that access to mobile money provides have been reported in studies conducted in Kenya.^{19,22} In rural Uganda, Munyegera and Matsumoto³⁰ found that access to mobile money reduced the

distance and costs of using financial services. Though these studies did not focus on mobile money's effect on social health insurance enrolment, they did provide general evidence of the benefits of mobile money use.

Furthermore, NHIF coverage among rural populations outside the formal employment sector was very low at a paltry 10.33%. From a UHC perspective, NHIF coverage may need to be extended to the informal sector by probably making it compulsory rather than voluntary. Voluntary health insurance may not be a route to achieve UHC.^{3,12} Compulsory means that it may have to not only cover the formally employed but all residents of a country. Having the formally employed as compulsory members of the NHIF and the rest as voluntary, widens the coverage gap between these groups. Though mobile money use seemed to increase the probability of being enrolled in NHIF among rural dwellers outside the formal sector, other problems such as unaffordability of premiums might have greatly played a role in the low enrolment numbers among this group as others might have dropped out. Incomes of rural dwellers are way lower than their urban counterparts and irregular.⁴⁶ However, mobile money use may provide additionally benefits such as increase in remittance from social networks, savings, and credit which may in turn improve household welfare and reduce poverty.^{26,30,47} For example, Suri and Jack⁴⁸ found that M-PESA increased consumption thereby lifting 2% of Kenyan households out of poverty. In rural Bangladesh, Lee et al.⁴³ found that mobile money use reduced poverty as it enabled users to reduce borrowing, increase savings and consumption. Nonetheless, those outside the formal sector, both urban and rural, may have to be made compulsory NHIF enrolees. This may be funded from public sources such as general taxes.

Limitations

Though the best procedures were followed to ensure the appropriate analysis of the data, some limitations were present. Unobserved characteristics that confound the relationship between mobile money and NHIF enrolment might still exist even though we adjusted for known characteristics. The use of an instrumental variable method would have addressed mobile money's potential endogeneity. Previous studies have used geographical proximity to a mobile money agent as an instrumental variable.^{22,28,29} We had data on self-reported travel time and travel costs to the nearest mobile money agent. However, we could not use these variables as instruments as mobile money agent rollout (positioning) might not have been random. Agents might have self-selected themselves into densely populated regions and urban areas to maximize on business opportunities. Therefore, without credible and exogenous instruments, we can only claim an association based on our probit and bivariate probit models.

Strengths

Despite the limitations, we do add to the limited literature on mobile money's association with social health insurance enrolment. Using data from a nationally representative survey, we provided insights on how access to mobile money may have increased the probability of being enrolled in NHIF as the technology lowered transport costs and reduced travel time.

CONCLUSIONS

In conclusion, we have shown that mobile money use among rural dwellers outside the formal employment sector was associated with an increase the probability to enrol in NHIF. By lowering transport costs and saving travel time, mobile money

provides an easy means to pay social health insurance premiums thus incentivising its uptake among rural people outside of formal employment.

DECLARATIONS

Ethics approval and consent to participate

Not applicable as the study used a publicly available dataset

Consent for publication

The authors give consent to publish the findings of the study

Availability of data and material

The dataset analysed during the current study is available in the Harvard Dataverse repository, <https://doi.org/10.7910/DVN/QUTLO2>

Competing interests

The authors declare that they have no competing interests

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Authors' contributions

MO conceptualised the study. MO, TC, and AS analysed the data and interpreted the results. MO wrote the first draft. All authors revised the manuscript.

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REFERENCES

1. International Labour Organisation. *Women and Men in the Informal Economy: A Statistical Picture*. Geneva 2018.
2. Demirguc-Kunt A, Klapper L, Singer D, Ansar S, Hess JR. *The Global Findex Database 2017 : Measuring Financial Inclusion and the Fintech Revolution*. Washington DC: The World Bank; 2017.
3. Cotlear D, Nagpal S, Smith O, Tandon A, Cortez R. *Going universal: how 24 developing countries are implementing universal health coverage from the bottom up*. The World Bank; 2015.
4. Saksena P, Hsu J, Evans DB. Financial Risk Protection and Universal Health Coverage: Evidence and Measurement Challenges. *PLOS Medicine*. 2014;11(9):e1001701.
5. Aryeetey GC, Westeneng J, Spaan E, Jehu-Appiah C, Agyepong IA, Baltussen R. Can health insurance protect against out-of-pocket and catastrophic expenditures and also support poverty reduction? Evidence from Ghana's National Health Insurance Scheme. *International Journal for Equity in Health*. 2016;15(1):116.
6. Fenny AP, Yates R, Thompson R. Social health insurance schemes in Africa leave out the poor. *International Health*. 2018;10(1):1-3.
7. Kenya National Bureau of Statistics. *Economic Survey 2019*. Nairobi: Kenya National Bureau of Statistics; 2019.
8. Amu H, Dickson KS, Kumi-Kyereme A, Darteh EKM. Understanding variations in health insurance coverage in Ghana, Kenya, Nigeria, and Tanzania: Evidence from demographic and health surveys. *PLOS ONE*. 2018;13(8):e0201833.

9. World Bank. Sub-Saharan Africa. 2019; <https://data.worldbank.org/region/sub-saharan-africa>. Accessed 14 August, 2019.
10. National Hospital Insurance Fund. NHIF profile. 2019; http://www.nhif.or.ke/healthinsurance/uploads/NHIF_Profile.pdf. Accessed 14 August, 2019.
11. Kenya National Bureau of Statistics. *2015/16 Kenya Integrated Household Budget Survey (KIHBS): Basic report*. Nairobi: Kenya National Bureau of Statistics;2018.
12. Meessen B. The Role of Digital Strategies in Financing Health Care for Universal Health Coverage in Low- and Middle-Income Countries. *Global Health: Science and Practice*. 2018;6(Supplement 1):S29-S40.
13. World Bank. Kenya. 2019; <https://data.worldbank.org/country/kenya>. Accessed 14 August, 2019.
14. Umeh CA. Challenges toward achieving universal health coverage in Ghana, Kenya, Nigeria, and Tanzania. *The International Journal of Health Planning and Management*. 2018;33(4):794-805.
15. Haas S, Heymann M, Riley P, Taddese A. *Mobile Money for Health*. Bethesda: Health Finance and Governance Project;2013.
16. GSMA. *State of the Industry Report on Mobile Money Decade Edition: 2006 - 2016*. London2017.
17. Hughes N, Lonie S. M-PESA: Mobile Money for the “Unbanked” Turning Cellphones into 24-Hour Tellers in Kenya. *Innovations: Technology, Governance, Globalization*. 2007;2(1-2):63-81.
18. Vodafone. Vodafone marks 10 years of the world's leading mobile money service, M-Pesa. 2017;

<http://www.vodafone.com/content/index/media/vodafone-group-releases/2017/m-pesa-10.html>. Accessed 14 August, 2019.

19. Jack W, Suri T. Mobile Money: The Economics of M-PESA. *National Bureau of Economic Research Working Paper Series*. 2011;No. 16721.
20. GSMA. *2018 State of the Industry Report on Mobile Money*. London: GSMA;2019.
21. Central Bank of Kenya, Financial Sector Deepening Kenya, Kenya National Bureau of Statistics. *2019 FinAccess Household Survey*. Nairobi: Financial Sector Deepening Kenya;2019.
22. Jack W, Suri T. Risk Sharing and Transactions Costs: Evidence from Kenya's Mobile Money Revolution. *American Economic Review*. 2014;104(1):183-223.
23. Central Bank of K, Kenya FSD, Kenya National Bureau of S. FinAccess Household Survey 2015. In: Kenya FSD, ed. V4 ed: Harvard Dataverse; 2016.
24. Central Bank of Kenya, Financial Sector Deepening Kenya, Kenya National Bureau of Statistics. *FinAccess Household Survey 2015*. Nairobi: Financial Sector Deepening Kenya;2016.
25. Suri T, Jack W, Stoker TM. Documenting the birth of a financial economy. *Proceedings of the National Academy of Sciences*. 2012;109(26):10257-10262.
26. Ahmed H, Cowan BW. Mobile Money and Healthcare Use: Evidence from East Africa. *National Bureau of Economic Research Working Paper Series*. 2019;No. 25669.
27. Aker JC, Mbiti IM. Mobile Phones and Economic Development in Africa. *Journal of Economic Perspectives*. 2010;24(3):207-232.

28. Ky S, Rugemintwari C, Sauviat A. Does Mobile Money Affect Saving Behaviour? Evidence from a Developing Country. *Journal of African Economies*. 2018;27(3):285-320.
29. Munyegera GK, Matsumoto T. Mobile Money, Remittances, and Household Welfare: Panel Evidence from Rural Uganda. *World Development*. 2016;79(Supplement C):127-137.
30. Munyegera GK, Matsumoto T. ICT for financial access: Mobile money and the financial behavior of rural households in Uganda. *Review of Development Economics*. 2018;22(1):45-66.
31. Aker JC, Boumniel R, McClelland A, Tierney N. Payment Mechanisms and Antipoverty Programs: Evidence from a Mobile Money Cash Transfer Experiment in Niger. *Economic Development and Cultural Change*. 2016;65(1):1-37.
32. Oraro T, Wyss K. How does membership in local savings groups influence the determinants of national health insurance demand? A cross-sectional study in Kisumu, Kenya. *International Journal for Equity in Health*. 2018;17(1):170.
33. Kimani JK, Ettarh R, Kyobutungi C, Mberu B, Muindi K. Determinants for participation in a public health insurance program among residents of urban slums in Nairobi, Kenya: results from a cross-sectional survey. *BMC Health Services Research*. 2012;12(1):66.
34. Maina JM, Kithuka P, Tororei S. Perceptions and uptake of health insurance for maternal care in rural Kenya: a cross sectional study. *The Pan African Medical Journal*. 2016;23:125.
35. Adewole DA, Adebayo AM, Udeh EI, Shaahu VN, Dairo MD. Payment for Health Care and Perception of the National Health Insurance Scheme in a

- Rural Area in Southwest Nigeria. *The American journal of tropical medicine and hygiene*. 2015;93(3):648-654.
36. Herberholz C, Fakihammed WA. Determinants of Voluntary National Health Insurance Drop-Out in Eastern Sudan. *Applied Health Economics and Health Policy*. 2017;15(2):215-226.
 37. Mathauer I, Schmidt J-O, Wenyaa M. Extending social health insurance to the informal sector in Kenya. An assessment of factors affecting demand. *The International Journal of Health Planning and Management*. 2008;23(1):51-68.
 38. Khalid M, Serieux J. Uptake of voluntary health insurance and its impact on health care utilization in Ghana. *Health policy and planning*. 2018;33(7):861-869.
 39. StataCorp. *Stata Statistical Software: Release 15*. College Station, TX: StataCorp LLC; 2017.
 40. Heeringa SG, West BT, Berglund PA. *Applied Survey Data Analysis*. 2nd ed. New York: Chapman and Hall/CRC; 2017.
 41. Geng X, Janssens W, Kramer B, van der List M. Health insurance, a friend in need? Impacts of formal insurance and crowding out of informal insurance. *World Development*. 2018;111:196-210.
 42. Mbiti I, Weil DN. Mobile Banking: The Impact of M-Pesa in Kenya In: Edwards S, Johnson S, Weil DN, eds. *African Successes: Modernization and Development*. Vol 3. Chicago: University of Chicago Press; 2016:p247-293.
 43. Lee JN, Morduch J, Ravindran S, Shonchoy AS, Zaman H. *Poverty and Migration in the Digital Age: Experimental Evidence on Mobile Banking in Bangladesh*. IGC Working Paper C-89233-BGD-1; 22 September 2018 2018.

44. Apiors EK, Suzuki A. Mobile Money, Individuals' Payments, Remittances, and Investments: Evidence from the Ashanti Region, Ghana. *Sustainability*. 2018;10(5):1409.
45. Boaheng JM, Amporfu E, Ansong D, Osei-Fosu AK. Determinants of paying national health insurance premium with mobile phone in Ghana: a cross-sectional prospective study. *International Journal for Equity in Health*. 2019;18(1):50.
46. Okungu VR, McIntyre D. Does the Informal Sector in Kenya Have Financial Potential to Sustainably Prepay for Health Care? Implications for Financing Universal Health Coverage in Low-Income Settings. *Health Systems & Reform*. 2019:1-13.
47. Kikulwe EM, Fischer E, Qaim M. Mobile Money, Smallholder Farmers, and Household Welfare in Kenya. *PLOS ONE*. 2014;9(10):e109804.
48. Suri T, Jack W. The long-run poverty and gender impacts of mobile money. *Science*. 2016;354(6317):1288-1292.