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<https://doi.org/10.1057/s41599-024-02767-2>

OPEN

Mobile money, medical cost anxiety and welfare of individuals within the reproductive age in Malaysia

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This study examines the association between mobile money, medical cost anxiety, and the welfare of households in Malaysia. The study made use of the data sourced from the Global financial survey conducted by the World Bank. The study applied the logit model and test of mean difference, probit and instrumental variable regressions to check for robustness. Findings show that mobile money has a positive and significant impact on the welfare of households in Malaysia. Mobile money enables households to access financial services easily and conveniently, which in turn leads to better financial management and increased household welfare. The study also finds that medical cost anxiety hurts household welfare. Households that are more anxious about medical costs tend to experience lower levels of welfare. The results of this study have significant implications for policymakers and financial service providers in Malaysia. To improve the welfare of households, policymakers should promote mobile money use and encourage financial inclusion. Financial service providers should also develop products and services tailored to the needs of households, especially those that are more vulnerable to medical cost anxiety. Additionally, policymakers should consider implementing policies that address rising healthcare costs and alleviate medical cost anxiety among households in Malaysia.

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Introduction

The financial sector plays a crucial role in household welfare as it provides access to business occasions, investment, savings, consumption smoothing, and insurance against sudden events (Apeti, 2023; Demirgüç-Kunt et al., 2008; Demirguc-Kunt and Klapper, 2012; Munyegera and Matsumoto, 2016; Okafor et al., 2023). However, in emerging nations, a huge portion of the population lacks access to basic financial services (Micah et al., 2021; Munyegera and Matsumoto, 2016). Deficiency of access to basic financial services limits the rural poor capacity to invest and participate in both formal and informal insurance procedures aimed at smoothing consumption and limiting poverty (Local Burden of Disease HIV Collaborators, 2021). These socioeconomic inequalities are reflected in health-care affordability as well, with the most prominent examples among the leading emerging BRICS (Jakovljevic, 2014) markets across the Global South nations (Jakovljevic et al., 2021). Most rapidly developing large emerging BRICS economies being the drivers of global real GDP growth (Jakovljevic et al., 2016), continue to shape the medical spending landscape worldwide.

The rapid development of mobile phone technologies has played a crucial role in mobile money emergence because it is an innovative and convenient financial service that enables users to conduct transactions through their mobile phones (Apeti, 2023; Kikulwe et al., 2014). In Malaysia, mobile money has become increasingly popular in recent years, particularly among rural populations (Demirgüç-Kunt et al., 2018). Indeed, according to the global Findex survey during 2014 and 2017, only 3% and 11% of people aged 15 years old and above have mobile money accounts (Demirgüç-Kunt et al., 2018). Also, in Malaysia in 2014 and 2017, only 3% in 2014 and 10% in 2017 of people aged 15 years old and above respectively paid utility bills using a mobile phone (Demirgüç-Kunt et al., 2018). This is because mobile money provides a suitable way for households to transfer money, pay bills, and access financial services without having to visit a physical bank branch (Apeti, 2023; Munyegera and Matsumoto, 2016). For agriculture households, this has significant implications for their overall welfare because mobile money adoption improves welfare (Islam et al., 2022; Kilombe et al., 2023; Tabetando et al., 2022).

Medical cost anxiety is a common problem among households in developing countries such as Malaysia, particularly those in rural areas (Houeninvo et al., 2023; Pradhan and Mukherjee, 2018). Indeed, Houeninvo et al. (2023) found in Benin that out-of-pocket health spending directs households to make additional spending on health care that in fine crowds out expenses in other essential goods such as education items. This is because healthcare costs can be expensive, and households may not have access to adequate insurance or savings to cover these costs (Houeninvo et al., 2023; Nghiem and Connelly, 2017; Nasir et al., 2022; Sui et al., 2021).

The estimate by Dieleman et al. (2017) recommends that worldwide health expenditure may perhaps increase from US\$8 trillion in 2018 to \$18 trillion in 2040 with a forecast of about 9% of the global GDP to be assigned to health in 2040, giving to the Institute for Health Metrics and Evaluation (IHME) (Zhou et al., 2020). As a result, households can wait to seek medical treatment or forego it wholly, which can lead to serious health consequences. A typical consequence of this side effect of the unaffordability of medical care is the so-called boomerang effect (Turabian, 2019). Namely, the patient comes back later with a far more severe, neglected disease stage when he or she is in acute need of expensive hospital admission and intensive care unit care (Tyrovolas et al., 2018).

At this time in most contemporary societies such life-saving care is not being denied but instead, it is provided at a much higher cost compared to initial screening or prevention (Sahoo et al., 2023). This cost burden is covered by public or state-owned health budgetary

allocations (Vuković et al., 2012) and remains a bottleneck inefficiency in so many low- and middle-income countries' health systems (Ranabhat et al., 2020). Mobile money can help alleviate medical cost anxiety by providing households with a convenient way to save money and access financial services (Sakyi-Nyarko et al., 2022). For example, households can use mobile money to set up savings accounts, which can be used to pay for medical expenses.

Mobile money can also be used to access insurance products, which can provide households with financial protection in the event of a medical emergency. Thus, according to Nghiem and Connelly (2017), health care is a necessity, not a luxury good as some other studies in this field found. So, there is a need for government to put in place health insurance accessible to their population, especially the poorest (Wu et al., 2023). In addition to reducing medical cost anxiety, mobile money can also improve the overall welfare of households in Malaysia. This is because mobile money can improve access to financial services, which can help households manage their finances more effectively.

For example, households can use mobile money to pay bills, transfer money, and access credit, which can help them to invest in their farms and improve their livelihoods. Furthermore, mobile money can also help to enhance financial inclusion among agricultural households in Malaysia. This is because mobile money is often more accessible and affordable than traditional banking services (Apeti, 2023). As a result, households that were before disqualified from the formal financial sector can now access a range of financial services, which can help to increase their overall welfare (Jakovljevic et al., 2023).

By reducing medical cost anxiety and improving access to financial services, mobile money can help households manage their finances more effectively and improve their livelihoods. As such, mobile money is expected to continue to play a key role in the development of rural communities in Malaysia. The objective of this paper is to analyse the effects of mobile money and medical cost anxiety on household welfare in Malaysia. On the other hand, the paper tends to answer the following research questions:

- i. *What is the impact of mobile money on household welfare?*
- ii. *How does anxiety associated with medical costs influence household welfare?*
- iii. *How does mobile money moderate the impact of anxiety associated with medical costs on household welfare?*

This study focused on Malaysia. Focusing the study on Malaysia offers a compelling rationale due to the country's unique position as a hub of mobile money innovation and its diverse healthcare landscape. One convincing reason to concentrate on Malaysia is the country's robust adoption of mobile money services and its progressive strides in healthcare accessibility and affordability. Also, Malaysia's diverse population and multi-faceted healthcare system create an opportunity to analyse the interplay between mobile money, medical cost anxiety, and various welfare indicators within and outside the reproductive age group, allowing for nuanced insights that could inform not only local policy but potentially broader regional strategies. The rest of the paper is organised as follows: next to the introduction section, we have the literature review section. Then, the third section is devoted to the methodology and the final section concludes and provides some policy recommendations.

Literature review

Several studies around the world have examined the mobile money impact on household welfare (Apeti, 2023; Islam et al., 2022; Kikulwe et al., 2014; Kilombe et al., 2023; Munyegera and Matsumoto, 2016; Riley, 2018; Suri and Jack, 2016; Tabetando

et al., 2022). For example, Suri and Jack (2016) analysed in Kenya the long-run impacts of mobile money and found a positive influence on households by taking out of poverty, 2% of Kenyans. The author’s findings are explained by fluctuations in financial behaviour–growing financial resilience and savings–and efficient labour sharing after a change from agriculture to business.

Basing their studies on Ugandan rural households, Munyegera and Matsumoto (2016) found that mobile money adoption improves households’ welfare via its capacity to ease remittances. Apeti (2023) found in developing countries that nations with mobile money demonstrate smaller consumption instability. Riley (2018) found in Tanzania that next to a village-level precipitation shock, it’s only mobile money users can avoid a decrease in their consumption. For the author the remittances received by households allow them to smooth consumption. Kikulwe et al. (2014) analysed in Kenya the impacts of mobile money technology on smallholder farm households’ welfare and showed that mobile money use improves household income via remittances received from relatives and friends.

Kilombele et al. (2023) showed in Tanzania that mobile money use increases maize productivity and in turn reduces poverty likelihood because in farmers who use mobile money services maize productivity is increased by about 124 kg/acre, indicating a reduction of their poverty likelihood by nearly 25%. Tabetando et al. (2022) found in Uganda that mobile money adoption improves farm welfare by 13% through the increase of the probability of using chemical fertiliser on maize plots by 11%. Islam et al. (2022) found in Bangladesh that every 1 billion Taka (approximately US\$ 11.76 million) rise in mobile money transactions through the bKash system in 2015 is linked with a 0.71% drop in the poverty rate.

Medical cost anxiety which refers to the fear of not being able to afford medical treatment or healthcare services is a common issue among households in Malaysia due to rising healthcare costs. Indeed, according to statistics from the Global Findex survey undertaken in 2021, only 19% of the Malaysian population aged 15 years and above are not worried at all about not being able to pay for medical costs in case of a serious illness or accident while 40% are very worried and 40% are somewhat worried. These statistics showed that medical cost anxiety is a significant issue that affects the financial well-being and quality of life of households in Malaysia. In this situation, mobile money has the potential to reduce medical cost anxiety and improve the welfare of households in Malaysia because according to the global Findex survey, the percentage of the Malaysian population aged 15 years and above who have mobile money accounts experienced an increase, moving from 3% in 2014 to 11% in 2017 and 28% in 2021.

Indeed, mobile money improves welfare by providing a means of payment for medical bills that is affordable and accessible, mobile money services can help alleviate financial stress and anxiety among households. Policymakers in Malaysia should consider promoting mobile money services to improve the financial well-being of households and reduce medical cost anxiety. By doing so, they can ensure that all households in Malaysia have access to affordable and accessible healthcare services. This study complements the extant literature by showing that mobile money can improve the welfare of individuals within the reproductive¹ through the provision of a means of payment for medical bills that is affordable and accessible and that reduces medical cost anxiety.

Methodology

Data and sources. Data used in this study was sourced from the Global Financial Index 2021 which provides approximately 300 indicators on topics such as account ownership, payments, saving, credit, and financial resilience. Findex data is described for all

indicators by nation, region, and income group. Data is also included sum by gender, income (adults living in the richest 60% and poorest 40% of households), labour force involvement (adults in or out of the workforce), age (young and older adults), and rural and urban residence. This study is based in Malaysia which is located in Southeast Asia.

Econometric approach. In this current study which analyses the link between mobile money, medical cost anxiety, and the welfare of households in Malaysia, the dependent variable is welfare. Generally, to capture welfare, the literature used per capita consumption expenditure (Chakrabarty and Mukherjee, 2022), and income per capita (Nguyen and Nguyen, 2019; Tabetando et al., 2022) but in this study, welfare is captured by income quintile, measured as 1 = households within the richest fourth 20% and fifth 20%; and 0 = household within the poorest 20%, second 20% and middle 20%. This gives a binary character to the dependent variable and leads us to run a logit regression approach to make inferences about welfare status in Malaysian households. Due to its wide use to measure the determinants of poverty status in developing countries (Islam et al., 2022; Nguyen and Nguyen, 2019), this paper used logit models to analyse the between mobile money, medical cost anxiety, and the welfare of households in Malaysia. The logit model is specified as:

$$\ln \left[\frac{P_j}{(1 - P_j)} \right] = \delta_0 + \sum_{i=1}^n \delta_i X_{ij} + \mu_j \tag{1}$$

Where, P_j is the probability that the j th household is within the richest fourth 20% and fifth 20%, δ_0 and δ_i are the parameters to be estimated, μ_j is the random error, and X_{ij} are the explanatory variables defined in Table 1. The empirical model used to investigate the association between mobile money, medical cost anxiety, and the welfare of households in Malaysia is derived from Munyegera and Matsumoto (2016), Kilombele et al. (2023) and Sakyi-Nyarko et al. (2022) studies and is described as follows:

$$E(WF_i|X_i) = \alpha_0 + \alpha_1 ANX_i + \alpha_2 MM_i + \alpha_3 LOC_i + \alpha_4 EMP_i + \alpha_5 EDUC_i + \epsilon_i \tag{2}$$

Where $E(WF_i|X_i)$ denote the expected state of welfare of the household i conditioned on X variables such as cost of medical services (ANX_i), and mobile money (MM), among others. The interest variables are ANX_i and MM_i are which interest variables and refer to financially worried: bills associated with medical costs and access and usage of mobile devices of the household i , respectively. LOC_i , EMP_i and $EDUC_i$ are the control variables and represent the location, employment status and educational level of household i , respectively. $\alpha_0, \dots, \alpha_5$ are the parameters to be estimated and ϵ_i is the error term. All estimation variables used, and their measurements are summarised in Table 1. To capture the interaction or moderate the impact of mobile money on anxiety associated with medical costs, we present Eq. (3)

$$E(WF_i|X_i) = \alpha_0 + \alpha_1 ANX_i + \alpha_2 MM_i + \alpha_3 LOC_i + \alpha_4 EMP_i + \alpha_5 EDUC_i + \alpha_6 (ANX_i * MM_i) + \epsilon_i \tag{3}$$

Results and discussion

Summary statistics of variables. Table 2 reports the descriptive statistics of all the variables used for aggregate, within the reproductive age and not within the reproductive age. For the aggregate, the mean of the full sample for the households within the richest fourth 20% and fifth 20% (WF) is 0.448. To consider the gender dimension, we computed the descriptive statistics for all the variables for males and females. The mean of males and females within the richest fourth 20% and fifth 20% is 0.434 and

Table 1 Variables description and measurement.

Variables	Definition	Measurement
WF	The welfare of the household	Income Quintile of the household; 1 = households within the richest Fourth 20% and fifth 20%; and 0 = households within the Poorest 20%, Second 20% and Middle 20%
ANX	Anxiety associated with medical cost	Financially worried: bills associated with medical cost. 1 = Very worried and somewhat worried, and 0 = Not worried at all)
LOC	Location of the household	1 = urban residents, and 0 = rural residents
EMP	The employment status of the respondents	1 = in the workforce, 0 = out of the workforce
EDUC	The educational level of the respondents	Educated and non-education 0 = completed secondary school or less (non-educated) 1 = completed secondary, tertiary education or more (educated)
MM	Mobile money	Access and usage of mobile device, eg phone, etc in payment of purchases including those associated with medical bills.

Source: Authors using the Global Financial Index (2021).

Note: reproductive age = 15-49 years (WHO, 2021).

0.465, respectively. For anxiety associated with medical costs, 0.71 (total) of the households are very worried and somewhat worried while 0.708 and 0.712 of males and females are respectively very worried and somewhat worried.

For the aggregate, the percentage of households who have access to and usage of mobile devices in payment of purchase including those associated with medical bills is 0.225. This percentage is 0.236 for males while it is 0.212 for females. For the full sample, about 0.74 of the households are urban residents. About 0.755 males are urban residents while 0.723 females are urban residents. About 0.643 of the aggregate are in the workforce with 0.524 for the male sample and 0.784 for the female sample. Concerning the educational level of the respondents, 0.834 of the aggregate are educated with 0.815 for the male sample and 0.856 for the female sample.

Within the reproductive age, the mean of the full sample for the households within the richest fourth 20% and fifth 20% (WF) is 0.459. To consider the gender dimension, we computed the descriptive statistics for all the variables for males and females. The mean of males and females within the richest fourth 20% and fifth 20% is 0.449 and 0.471, respectively. For anxiety associated with medical costs, 0.753 (total) of the households are very worried and somewhat worried while 0.747 and 0.761 of males and females are respectively very worried and somewhat worried. Within the reproductive age, the percentage of households who have access to and usage of mobile devices in payment of purchase including those associated with medical bills is 0.288. This percentage is 0.301 for males while it's about 0.273 for females. For the full sample, about 0.761 of the households are urban residents. About 0.769 males are urban residents while 0.751 females are urban residents. About 0.755 of the aggregate are in the workforce with 0.657 for the male sample and 0.872 for the female sample. Concerning the educational level of the respondents, about 0.923 of the aggregate are educated with 0.919 for the male sample and 0.929 for the female sample.

Not within the reproductive age, the mean of the full sample for the households within the richest fourth 20% and fifth 20% (WF) is 0.427. To consider the gender dimension, we computed the descriptive statistics for all the variables for males and females. The mean of males and females within the richest fourth 20% and fifth 20% is 0.403 and 0.453, respectively. For anxiety associated with medical costs, 0.628 (Total) of the households are very worried and somewhat worried while 0.634 and 0.621 of males and females are respectively very worried and somewhat worried. Not within the reproductive age, the percentage of households who have access to and usage of mobile devices in payment of purchase including those associated with medical bills is 0.107. This percentage is 0.113 for

males while it's about 0.099 for females. For the full sample, about 0.700 of the households are urban residents. About 0.726 males are urban residents while 0.671 of females are urban residents. About 0.432 of the aggregate are in the workforce with 0.269 for the male sample and 0.621 for the female sample. Concerning the educational level, about 0.666 of the aggregate are educated with 0.618 for the male sample and 0.720 for the female sample.

Logit regression results. Table 3 reported the estimated results with the logit model. The probability of the Chi² shows that the models' specification (aggregate, within the reproductive age and not within the reproductive age) as soon models specification for the total, male and female are globally significant at 1%. The outcome showed that anxiety associated with medical costs decreases the welfare of Malaysian households for the aggregate, within the reproductive age and not within the reproductive age as soon as for the total, male–female samples. For aggregate, a rise of one unit of anxiety associated with medical costs worsens the welfare of Malaysian households of 0.748, 0.697 and 0.796 for the total, male and female, respectively. Similarly, within the reproductive age, an increase of one unit of anxiety associated with medical cost lessens Malaysia households' welfare by 0.852 (total), 0.755 (male) and 0.987 (female) while not within the reproductive age, only the findings of the female are significant, meaning that one unit increase of anxiety associated with medical cost decrease female, not within the reproductive age welfare of 0.377.

The main hypothesis in this paper is that mobile money can moderate the impact of anxiety orchestrated by medical costs by improving access to financial services helping households manage their finances more effectively and improving their livelihoods. From Table 3, medical cost anxiety is significantly and negatively related to welfare. Without the interaction value of medical cost anxiety and mobile money, medical cost anxiety decreases welfare by 0.748 (total), 0.697 (male) and 0.796 (female) for the aggregate, 0.852 (total), 0.755 (male) and 0.987 (female) within the reproductive age and finally by 0.377 (female) not within the reproductive age. This implies that anxiety about medical costs is harmful to individuals' welfare in Malaysia and so needs mobile money access and usage to move this negative effect to a positive one.

The outcomes showed that the interaction value of medical cost anxiety and mobile money is positively associated with welfare. Indeed, one unit increase in interaction value enhances the total sample and female sample for an aggregate of 0.587 and 0.736, respectively. Similarly, one unit increase in interaction value improves the full sample and female male sample within the reproductive age welfare of 0.554 and 0.714, respectively. The implication of the outcome is that mobile money access and usage

Table 2 Summary statistics of variables.

Variable	Aggregate	Within the reproductive age				Not within the reproductive age													
		2		3		5		6		7		8		9		10			
		Total	Male	Female	Mean [SD]	Total	Male	Female	Mean [SD]	Total	Male	Female	Mean [SD]	Total	Male	Female	Mean [SD]	Total	Male
WF	0.448 (0.498)	0.434 (0.496)	0.465 (0.499)	0.459 (0.499)	0.449 (0.498)	0.471 (0.500)	0.427 (0.495)	0.403 (0.492)	0.453 (0.499)										
ANX	0.71 (0.453)	0.708 (0.455)	0.712 (0.453)	0.753 (0.431)	0.747 (0.435)	0.761 (0.427)	0.628 (0.484)	0.634 (0.483)	0.621 (0.487)										
MM	0.225 (0.418)	0.236 (0.425)	0.212 (0.409)	0.288 (0.453)	0.301 (0.459)	0.273 (0.446)	0.107 (0.309)	0.113 (0.317)	0.099 (0.300)										
LOC	0.74 (0.439)	0.755 (0.431)	0.723 (0.448)	0.761 (0.427)	0.769 (0.421)	0.751 (0.433)	0.700 (0.459)	0.726 (0.447)	0.671 (0.471)										
EMP	0.643 (0.479)	0.524 (0.499)	0.784 (0.412)	0.755 (0.430)	0.657 (0.475)	0.872 (0.335)	0.432 (0.496)	0.269 (0.445)	0.621 (0.487)										
EDUC	0.834 (0.372)	0.815 (0.388)	0.856 (0.352)	0.923 (0.266)	0.919 (0.274)	0.929 (0.257)	0.666 (0.472)	0.618 (0.487)	0.720 (0.450)										

Source: Authors' computation.

Table 3 Logit regression.

Variable	Aggregate	Within the reproductive age				Not within the reproductive age			
		Total		Female		Total		Female	
		Total	Male	Female	Mean [SD]	Total	Male	Female	Mean [SD]
ANX	-0.748*** (0.000)	-0.697*** (0.001)	-0.796*** (0.000)	-0.852*** (0.000)	-0.755*** (0.004)	-0.987*** (0.001)	-0.510 (0.043)	-0.377*** (0.000)	
MM	0.577*** (0.000)	0.799*** (0.000)	0.341 (0.170)	0.622*** (0.001)	0.855*** (0.001)	0.361 (0.198)	0.731 (0.072)	0.698*** (0.000)	
LOC	0.460 (0.004)	0.704*** (0.002)	0.214 (0.364)	0.335 (0.097)	0.614 (0.033)	0.089 (0.760)	0.676 (0.016)	0.368*** (0.000)	
EMP	0.361 (0.014)	0.322 (0.098)	0.367 (0.148)	0.407 (0.040)	0.383 (0.120)	0.335 (0.375)	0.530 (0.033)	0.531*** (0.000)	
EDU	1.257*** (0.000)	1.043*** (0.000)	1.592*** (0.000)	1.201*** (0.003)	1.153 (0.041)	1.279 (0.030)	1.399*** (0.000)	1.884*** (0.000)	
interaction	0.587*** (0.001)	0.405 (0.123)	0.736*** (0.001)	0.554*** (0.004)	0.355 (0.224)	0.714*** (0.005)	0.680 (0.113)	0.736 (0.190)	
Constant	-1.473*** (0.000)	-1.562*** (0.000)	-1.497*** (0.000)	-1.395*** (0.002)	-1.716*** (0.007)	-1.023 (0.142)	-1.769*** (0.000)	-2.062*** (0.000)	
Log-likelihood	-626.109	-333.525	-289.931	-416.803	-221.432	-193.192	-109.959	-93.967	
Pseudo R ²	0.089	0.1007	0.0835	0.0747	0.0960	0.0593	0.1345	0.1527	
Prob > chi ²	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	

Source: Authors' computation.

Note: p-values are in (). *** means significance at 1%.

help to moderate the impact of anxiety orchestrated by medical costs and improve Malaysian households' welfare.

The findings are consistent with Munyegera and Matsumoto (2016) and Kilombe et al. (2023) who found in Uganda and Tanzania that mobile money improves welfare. Similarly, Wang et al. (2022) study in rural China showed that mobile money usage significantly increased farmers' welfare. This is similar to Jakovljevic et al. (2023). Similar outcomes are found by Peprah et al. (2020) in Ghana. The outcomes are also reinforced by Sakyi-Nyarko et al. (2022) who showed that being on a higher financial inclusion raises the likelihood of never going without medicine or medical treatment when needed by approximately 8%.

For the control variables inserted in the model, the outcomes showed that males located in urban areas for the aggregate increased welfare by 0.704 while the welfare of females not within the reproductive age improved by 0.368. This finding is similar to Nguyen and Nguyen (2019) and Sakyi-Nyarko et al. (2022) who found that location improves individual welfare. The outcome also showed that for females in the workforce not within the reproductive age welfare is improved by 0.531, indicating employment plays a crucial role in welfare improvement by improving wages to individuals to satisfy their needs. The outcomes are consistent with Tran (2015) and Nguyen and Tran (2018) who found that wage employment improves household welfare in Vietnam.

Finally, the results found that educational level improves Malaysian households' welfare. Indeed, for the aggregate, one unit increase in educational level increases welfare by 1.257 (Total), 1.043 (Male) and 1.592 (Female). One unit increase in full sample educational level within the reproductive age increases welfare by 1.201 while this increases full sample, male sample and female sample not within the reproductive age welfare by 1.399, 1.167 and 1.884, respectively. The implication is that educational level allows individuals to access job opportunities, which can help them to satisfy their needs and in turn improve their welfare. This outcome is similar to Kilombe et al. (2023) who found that educational level decreases poverty, improving welfare and Nguyen and Nguyen (2019) and Sakyi-Nyarko et al. (2022) who found that educational level improves welfare in Ghana and Vietnam, respectively.

The result of the interaction shows that access to mobile money significantly moderates the impact of medical costs on welfare by 0.587 (for all households) and 0.736 (female), while it has no significant moderation when it comes to male-headed households. This is also the same for the households within the reproductive age. On the other hand, for those not within the reproductive age, mobile money has no moderate power on medical cost anxiety. This result suggests that for people who are not in the reproductive age range, the use of mobile money does not seem to significantly affect how worried they are about the costs of medical care. In other words, the presence or absence of mobile money usage does not appear to be strongly linked to their level of anxiety about covering medical expenses.

This observation could be important for policymakers, healthcare providers, and financial institutions, as it indicates that the impact of mobile money on medical cost anxiety may not be uniform across different age groups. Understanding these dynamics can help tailor interventions and support mechanisms to better address the specific needs and concerns of different demographic segments.

Robustness: mean difference, probit and instrumental variable regression. To check for the robustness of our logit outcomes reported in Table 3, we apply the test of mean difference, probit regression and instrumental variable regression. Table 4 reported

Table 4 Test of mean difference.

Variable	Reproductive age group (15–49 years)													Non-reproductive age group (50 years +)					
	Total sample			Male			Female			Total			Male			Female			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	
ANX	0.858 [0.727]	0.131*** (5.215)	0.861 [9.699]	0.161*** (4.28)	0.856 [0.753]	0.1034 (3.075)	0.915 [0.76]	0.155*** (5.556)	0.910 [0.735]	0.175*** (4.092)	0.918 (0.781)	0.137 [3.734]	0.758 [0.662]	0.096* (1.98)	0.772 [0.63]	0.142* (1.99)	0.747 [0.693]	0.054*** (0.813)	
MM	0.150 [0.317]	0.225*** (6.395)	0.155 [0.276]	-0.1218*** (-3.213)	0.1465 [0.353]	-0.206*** (-5.77)	0.206 [0.383]	0.287*** (-5.05)	0.216 [0.335]	-0.119** (-2.314)	0.198 [0.425]	-0.22*** [4.75]	0.050 [0.182]	-0.13*** (-4.02)	0.050 [0.182]	-0.13** (-4.02)	0.054 [0.20]	-0.145** (-3.150)	
LOC	0.682 [0.81]	-0.127*** (-4.61)	0.677 [0.775]	0.042** (-2.323)	0.687 [0.842]	-0.1552 (-0.227)	0.714 [0.816]	-0.10*** (-3.087)	0.726 [0.778]	-0.052 (-1.041)	0.704 [0.85]	-0.15*** (-3.29)	0.628 [0.797]	-0.17*** (-3.44)	0.591 [0.767]	-0.176** (-2.396)	0.657 [0.826]	-0.169** (-2.565)	
EMP	0.583 [0.716]	-0.133*** (-4.409)	0.743 [0.830]	-0.088** (-2.293)	0.456 [0.612]	-0.1567*** (-3.658)	0.711 [0.806]	-0.095** (-2.844)	0.847 [0.90]	-0.0528 (-1.361)	0.918 [0.78]	0.137*** (3.73)	0.357 [0.534]	-0.17*** (-3.334)	0.556 [0.698]	-0.141 (-1.85)	0.198 [0.373]	-0.388*** (-4.0)	
EDUC	1.876 [2.26]	-0.384*** (-9.49)	1.869 [2.263]	-0.393*** (-6.939)	0.736 [0.919]	-0.183*** (-5.587)	0.602 [0.725]	-0.122** (-2.445)	2.039 [2.383]	-0.343** (-7.263)	2.006 [2.357]	-0.35*** (-5.05)	0.356 [0.53]	-0.18*** (-3.33)	0.556 [0.698]	-0.141* (-1.85)	0.198 [0.373]	-0.175** (-2.67)	

Note: CG means control group, TG means treatment group and their values are contained in square brackets. For example, anxiety associated with medication cost (ANX) = 1 (treatment group) if the households are worried about this, and 0 (control group) if otherwise. Location (LOC) applies 1 = urban residents (treatment group), and 0 = rural residents (control group). Employment status of the respondents, 1 = in the workforce (treatment group), 0 = out of the workforce (control group); education (EDUC) 1 if educated (treatment group) and 0 if non-education (control group), mobile money (MM), 1 if used mobile money (treatment group), and 0 if did not use mobile money (control group). Diff represents the mean difference (CG-TG), 7-stat is in brackets (), ***, ** and * means that the absolute values are significant at 1%, 5% and 10%, respectively. Source: Authors' computation.

the outcomes of the test of mean difference and revealed the mean difference between the households who are worried about medical cost anxiety and those who are not worried about medical cost anxiety significantly differ for total and males both in the total sample and the reproductive age group and positive and significant for total, male and female in the non-reproductive age group. It implies that those who are pricked by medical cost anxiety have lower welfare outcomes compared to those who are not worried.

The mean difference between the households who used mobile money and those who did not use mobile money is positive and significant for total and negative and significant for males and females both in the total sample and the reproductive age group and negative and significant for total, male and female in the non-reproductive age group. The mean difference between the households who live in urban areas and those who live in rural areas is negative and significant for total and positive and significant for males in the total sample, both negative and significant for total and female in the reproductive age group and for total, male and female in the non-reproductive age group.

The mean difference between the households in the workforce and those out of the workforce is negative and significant both for total, male and female in the total sample, negative and significant for total and positive and significant for female in the reproductive age group and finally, negative, and significant bot for total and female in the non-reproductive age group. The mean difference between educated respondents and non-educated respondents is negative and significant both for total, males and females in the total sample, the reproductive age group and the non-reproductive age group.

The outcomes using probit regression (Table 5) and instrumental variable regression (Table 6) revealed that medical cost anxiety reduces Malaysian households' welfare not only for total, males and females in the aggregate but also for total, males and females within the reproductive age and for total in not within the reproductive age. As found in Table 3, the outcome also indicated that the association of mobile money with medical cost anxiety (interaction value) help to moderate the impact of anxiety orchestrated by medical cost and improve Malaysian households' welfare. Similarly, as found in Table 3, the control variables such as location, employment status and education level, inserted in the probit and instrumental variable regression improve Malaysian households' welfare. All the outcomes found for probit and instrumental variable regressions are consistent with the outcomes found using logit regression. This indicates that outcomes are robust.

Conclusion

Medical cost anxiety refers to the fear of not being able to afford medical treatment or healthcare services, which is a common issue among households in Malaysia due to rising healthcare costs. This situation reduces individuals' welfare in Malaysia. Thus, to cope with this, mobile money which is a financial service that allows users to achieve several transactions, including sending and receiving money, paying bills, and purchasing goods and services, using their mobile phones is essential to reduce medical cost anxiety and in turn improves individuals' welfare.

This study examines the association between mobile money, medical cost anxiety, and the welfare of households in Malaysia. To achieve this purpose, this paper uses data from the World Bank Global financial survey conducted among households in Malaysia, and the logit model to analyse the data and test mean difference, probit and instrumental

Table 5 Probit regression.

Variable	Aggregate			Within the reproductive age			Not within the reproductive age		
	Total	Male	Female	Total	Male	Female	Total	male	Female
	1	2	3	4	5	6	7	8	9
ANX	-0.517** (0.000)	-0.585*** (0.000)	-0.427*** (0.004)	-0.638*** (0.000)	-0.698*** (0.001)	-0.569*** (0.006)	-0.303* (0.059)	-0.384 (0.105)	-0.2075 (0.352)
MM	0.302*** (0.004)	0.165 (0.209)	0.423*** (0.003)	0.2959** (0.012)	0.1703 (0.337)	0.4229** (0.008)	0.471* (0.056)	0.4697 (0.210)	0.482 (0.147)
LOC	0.3061*** (0.002)	0.1819 (0.205)	0.432*** (0.002)	0.223* (0.073)	0.0983 (0.586)	0.3696** (0.034)	0.454** (0.006)	0.2865 (0.248)	0.5653** (0.015)
EMP	0.1955** (0.030)	0.2053 (0.182)	0.1650 (0.169)	0.2117* (0.081)	0.2885 (0.222)	0.1593** (0.001)	0.314** (0.035)	0.244 (0.273)	0.3636 (0.112)
EDU	0.485*** (0.000)	0.6045*** (0.000)	0.3915 (0.002)	0.4995 (0.001)	0.5810*** (0.000)	0.4163*** (0.005)	0.5383*** (0.000)	0.7031*** (0.000)	0.451*** (0.005)
interaction	0.367** (0.001)	0.253 (0.123)	0.4602** (0.001)	0.346*** (0.004)	0.2225 (0.223)	0.446*** (0.005)	0.4254 (0.111)	0.3949 (0.340)	0.4605 (0.189)
Constant	-1.140*** (0.000)	-1.205*** (0.000)	-1.148*** (0.000)	-1.077** (0.000)	-1.127*** (0.009)	-1.086*** (0.002)	-1.449*** (0.000)	-1.5451 (0.000)	-1.458 (0.000)
Log-likelihood									
Pseudo R ²	0.1016	0.1072	0.1027	0.1003	0.0999	0.1069	0.1241	0.1414	0.1135
Prob > chi ²	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Note: p-values are in (). ***, ** and * means that the absolute values are significant at 1%, 5% and 10%. Source: Authors' computation.

Table 6 Instrumental variable regression.

Variable	Aggregate			Within the reproductive age			Not within the reproductive age		
	Total	Male	Female	Total	Male	Female	Total	male	Female
	1	2	3	4	5	6	7	8	9
ANX	-0.1846*** (0.000)	-0.248*** (0.001)	-0.198** (0.006)	-0.225*** (0.000)	-0.248*** (0.001)	-0.1985** (0.006)	-0.1071* (0.052)	-0.1335 (0.100)	-0.0748 (0.330)
MM	0.1137*** (0.002)	0.064 (0.319)	0.1597** (0.006)	0.1111** (0.009)	0.064 (0.319)	0.1597** (0.006)	0.168** (0.045)	0.1621 (0.199)	0.180 (0.120)
LOC	0.1083*** (0.002)	0.0340 (0.600)	0.1324** (0.028)	0.081* (0.063)	0.0340 (0.600)	0.132** (0.028)	0.1528** (0.006)	0.0959 (0.253)	0.1851 (0.016)
EMP	0.069** (0.02)	0.098 (0.236)	0.0587 (0.273)	0.074* (0.085)	0.0986 (0.201***)	0.058 (0.236)	0.110** (0.034)	0.090 (0.240)	0.1218 (0.137)
EDU	0.1684*** (0.000)	0.201*** (0.000)	0.1422*** (0.001)	0.1723*** (0.000)	0.2010*** (0.000)	0.142*** (0.001)	0.187*** (0.000)	0.2454*** (0.000)	0.1546** (0.005)
interaction	0.1457*** (0.001)	0.1008 (0.122)	0.1819*** (0.001)	0.1376*** (0.004)	0.0885 (0.224)	0.1766 (0.005)	0.1684 (0.108)	0.156 (0.339)	0.1818 (0.184)
Constant	0.0869 (0.169)	0.0810 (0.416)	0.0947 (0.243)	0.4296*** (0.000)	0.1110 (0.456)	0.1152 (0.345)	0.984 (0.141)	-0.0386 (0.782)	0.0047 (0.969)
R ²	0.2148	0.1294	0.1580	0.1294	0.1286	0.1382	0.1580	0.1803	0.1431
Prob > F	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***

Note: p-values are in (), ***, ** and * means that the absolute values are significant at 1%, 5% and 10%. Source: Authors' computation.

variable regressions to check for robustness. The results found that medical cost anxiety decreases individuals' welfare while its association with mobile money has a positive and significant influence on households' welfare.

Furthermore, the result of the interaction shows that access to mobile money significantly moderates the impact of medical costs on welfare by 0.587 (for all households) and 0.736 (for females), while it has no significant moderation when it comes to male-headed households. This is also the same for the households within the reproductive age. On the other hand, for those not within the reproductive age, mobile money has no moderate power on medical cost anxiety. This result suggests that for people who are not in the reproductive age range, the use of mobile money does not seem to significantly affect how worried they are about the costs of medical care. In other words, the presence or absence of mobile money usage does not appear to be strongly linked to their level of anxiety about covering medical expenses.

The findings from this study have significant implications for policymakers and financial service providers in Malaysia. To promote the welfare of households, policymakers should promote the use of mobile money and encourage financial inclusion. Financial service providers should also develop products and services tailored to the needs of households, especially those that are more vulnerable to medical cost anxiety. Furthermore, policymakers should consider implementing policies that address rising healthcare costs and alleviate medical cost anxiety among households in Malaysia. The implementation of these policies will allow to achievement Sustainable Development Goal (SDG 3) which concerns good health and well-being.

This study is not without limitations. One of the limitations is that the study focused on a single country and on one section (2021) of the global financial survey, which is unable to account for long-term changes in mobile money adoption and medical cost anxiety impact on the welfare of households over time. As a recommendation, there is a need for long-term studies that track changes in mobile money adoption and medical cost anxiety over time can provide insights into the dynamic nature of this relationship. Longitudinal data would help in capturing changes and trends that might not be observable in a single cross-sectional study.

Data availability

The datasets analysed during the current study are available from the corresponding author upon reasonable request.

Received: 26 September 2023; Accepted: 26 January 2024;

Published online: 12 February 2024

Note

1 According to the World Health Organization (WHO), reproductive age is explained as the stage between 15 and 49 years for females, during which they are considered to be at risk of pregnancy. For males, reproductive age is generally considered to extend from the onset of puberty to old age, as sperm production can continue throughout their lives (WHO, 2021).

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Acknowledgements

This research was financially supported by the Dato' Low Tuck Kwong International Energy Transition Grant under Grant No 202204002ETG.

Author contributions

Romanus Osabohien conceived the idea, composed the introduction, curated the data, conducted the analysis, and authored the initial draft of the manuscript. Armand Fréjus Akpa conceptualised the idea, authored the literature section, and conducted the interpretation of the results and discussion of the findings. Amar Hisham Jaaffar supported the discussion, contributed to the conclusion, supervised, and extensively edited and reviewed the manuscript. Mihajlo Jakovljevic provided oversight for the work, contributed to the conclusion, and extensively reviewed and edited the manuscript. All authors contributed to the writing of the paper.

Competing interests

The authors declare no competing interests.

Ethical approval

Ethical approval was not required as the study did not involve human participants.

Informed consent

Informed consent was not required as the study did not involve human participants.

Additional information

Supplementary information The online version contains supplementary material available at <https://doi.org/10.1057/s41599-024-02767-2>.

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