

Research Article

Sociodemographic Moderation of Behavioral and Technological Determinants of Electronic Community Health Information System Use in Western Kenya

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Abstract

Background: Digital Health System (DHS) adoption and use remain a challenge globally, especially in low- and middle-income countries due to infrastructural and user related barriers. In Kenya, electronic Community Health Information Systems (eCHIS) was introduced to improve community health data reporting, yet its utilization varies. This study examined how sociodemographic factors moderate behavioral and technological determinants of eCHIS use in Western Kenya. **Objective:** To examine how age, gender, and education level influence the relationship between behavioral and technological factors and the use of eCHIS among Community Health Promoters (CHPs) in Western Kenya. **Methods:** A cross-sectional study of 310 CHPs in Western Kenya was conducted using stratified random sampling. Data were collected via a structured Kobo Collect questionnaire guided by the Technology Acceptance Model and Theory of Planned Behavior. Descriptive statistics and Spearman's correlation assessed relationships, while predictive margins in STATA version 18 examined sociodemographic moderation effects. **Results:** The study showed a predominantly female sample (81.3%) with most respondents having secondary education. All behavioral and technological constructs were strongly associated with behavioral intention ($r > 0.5$), but weakly linked to actual eCHIS use ($r < 0.2$). The results of the moderation analysis revealed that age negatively affects the attitudes towards eCHIS while females are more vulnerable to the effects of social norms. Furthermore, the level of education positively influences the perceived behavioral control and increases system use. While the results reveal that both the behavioral and technological predictors have strong influence on the intention to use eCHIS, its actual use seems to depend on sociodemographic characteristics, indicating an evident intention - behavior gap. Therefore, interventions designed specifically for different age, gender, and educational groups should be considered for promoting the use of eCHIS in Western Kenya.

Keywords

Social Demographic Moderation, Behavioral Determinants, Technological Determinants, Electronic Community Health Information Systems, Systems Use

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1. Introduction

The swift evolution of digital health technologies has greatly changed the way that healthcare is delivered around the globe, with eHealth Information Systems (eHIS) becoming key facilitators in improving efficiencies, evidence-based practices, and service delivery. This includes the use of the electronic eCHIS whose aim is to improve the capturing, reporting, and analysis of community health information. The worldwide increase in the use of digital health technologies has been driven by factors such as the need for timely health data, better patient outcomes, and the attainment of universal health coverage [1]. In spite of this progress, the gap between the uptake and sustained implementation of digital health technologies is a critical concern, especially between rich countries and developing countries.

Globally, the empirical literature suggests that factors like perceived usefulness, perceived ease of use, user attitudes, and perceived behavior control have a significant impact on the adoption of digital health information systems. These factors can be addressed through the effective combination of the Technology Acceptance Model and Theory of Planned Behavior. Recent findings suggest that while developed nations have made considerable progress in adopting and implementing e-health systems, developing and middle-income countries continue to experience challenges in closing the availability adoption gap owing to their infrastructural limitations [1, 2]. Furthermore, the intention-adoption gap remains prevalent across the world, since positive user intentions do not always result in adoption.

From a regional perspective, within the context of sub-Saharan Africa, there have been notable efforts towards adopting digital health strategies by respective governments aiming to strengthen their Primary Health Care (PHC) frameworks and improve health data collection. Countries like Kenya, Uganda, and Tanzania have implemented various applications for eHealth and mHealth technologies to assist Community Health Workers (CHWs) in providing health services. In the region, research shows that despite the health workers being optimistic about digital technologies, their utilization has been hindered by certain structural and organizational barriers. However, the implementation and continued use of these digital technologies have been inconsistent due to the following issues: lack of digital skills among health workers, inadequate training on digital technology, poor internet access, and heavy workload [3].

The government of Kenya has made great efforts to invest in digital health through measures like the Kenya Health Information System (KHIS) and distribution of eCHIS in communities. These platforms have been established to improve data collection and analysis, improve reporting accuracy, and facilitate decision making within the entire health care system. However, despite these efforts, there is an observed variance in terms of the use and application of eCHIS among the CHPs in different geographic regions. It has been established from

empirical research that variables such as age, gender, educational level, and digital skills influence the adoption and continuous use of such platforms [4]. Challenges such as lack of infrastructure, exposure to technology, and adequate training have continued to undermine proper use of eCHIS in the semi-urban regions such as Western Kenya.

Although there are considerable benefits associated with the use of digital healthcare information management platforms like eCHIS in improving access to healthcare services internationally, experience from a regional/local context demonstrates that such initiatives are significantly reliant on contextual conditions. Understanding how behavioral determinants interact with sociodemographic characteristics is therefore essential for improving adoption and sustained use, particularly in resource constrained settings. This study addresses this gap by integrating behavioral and technological models to better understand the drivers of eCHIS utilization.

2. Materials and Methods

2.1. Study Design

Cross-sectional study design was used to assess sociodemographic moderation of behavioral and technological determinants of eCHIS use in Western Kenya.

2.2. Setting

The study was done in Vihiga County of Western Kenya with the aim of providing empirical evidence on the effectiveness, usability and challenges of using digital community health interventions in the context of inadequate resources and existing gaps in timely community health data reporting using paper-based protocol.

Community Health Promoters use eCHIS application embedded in smart phone/tablets to register households, capture individuals' health related information, community-based events, monitor health trends and to report timely.

During households' registration, CHPs captures demographics characteristics, Maternal and Child Health (MCH) information, child's age specific immunization status, chronic diseases follow up, nutritional indicators and referrals to the next level (Level II) through the eCHIS platforms for continuum of health care. The system has been designed to schedule follow up visits, track defaulters, identify at risk clients, and receive technology drive signals for health interventions.

Use of eCHIS in Western Kenya has enhanced community health data accuracy, reduced bulky paper-based reporting protocols, enhanced real time reporting, and supports decision making. Coordinators and team leads can monitor performance and ensure continuity of services through the DHS.

2.3. Population

The population for this study were the CHPs who are the systems end user of the electronic reporting protocol at the lowest stratum (Level I) of service delivery, and who frequently interact with the systems on daily bases.

2.4. Sample Size Determination and Sampling Techniques

2.4.1. Sample Size Determination

Krejcie and Morgan (1970) standard sample size determination table was adopted to obtain the sample size of the study [5]. According to the Krejcie and Morga (1970), a total population size of 1291 CHPs using eCHIS, corresponds to a recommended sample size of 297 respondents. Therefore the sample size was 310 CHPs. This is after finite population correction and 10% inclusion of non- response rate.

2.4.2. Sampling Techniques

Simple random sampling was adopted under a stratified sampling technique to select study participants from distinct Community Health Units (CHU).

2.5. Data Collection and Management

A structured interviewer administered data collection tool was coded in Kobo Collect. To ensure that all necessary information was correctly captured and entered, data was monitored and evaluated on a daily basis through the storage and monitoring server. Data was transferred to an excel worksheet after the data collection exercise, it was then exporting into STATA version 18 for descriptive analysis.

2.6. Data Analysis

Descriptive statistics, frequencies and proportions were used to summarize study respondents both social demographic characteristics and study variables. Spearman's rank correlation analysis was performed to assess the relationships between behavioral and technological construct, behavioral intention and actual use of eCHIS. Further, predictive margins analysis was conducted to study the moderating influence of social demographic variables (age, sex and level of education) on the interaction between the constructs and utilization of eCHIS. For all construct analysis, the level of statistical significance was set at a $P \leq 0.05$.

2.7. Validity and Reliability

Pre-testing of the tool was done in Kisumu County prior to administration to the final study. A total of 31 CHPs which represents a 10% of the total study participants were adequate for piloting [6]. A general Cronbach alpha of 0.9 from the pilot

study was realized. This was considered as acceptable level of internal consistency for the study [7].

Context and face validity were approved by the supervisors and UEAB Institutional Research Ethics Committee (IREC) review board. Research Assistance (RA) were intensively trained for two days on data collection and entry methodology using Kobo Collect an offline data collection tool.

2.8. Ethical Consideration

Ethical approval for the study was obtained from the Institutional Research Ethics Committee of the University of Eastern Africa, Baraton (Approval No. UEAB/ISERC/03/07/2025). A research permit was subsequently secured from the National Commission for Science, Technology and Innovation (NACOSTI) under license number NACOSTI/P/25/4178176. Permission to conduct the study was also granted by the Vihiga County Ministry of Health (Ref. No. VCHS/CDH/DPH/01/8/2025).

The study adhered to the ethical principles of the Declaration of Helsinki, including respect for autonomy, beneficence, and justice. The participants were given full information about the study and gave consent before participating in it. They were made aware that they had the option not to participate or even leave the study whenever they wished to do so without facing any consequences. The data collected was safely stored in a computer that had passwords for access.

3. Results

The sample consisted of 310 CHPs. Table 1 shows that, out of which females accounted for 81.3%, and males for 18.7%. In terms of educational level, the majority had attained secondary education (37.1%), while 31.3% did not complete secondary education and 12.6% had tertiary education. There was also a group with low or very low levels of education.

Table 2 shows the average TAM score was 2.5 (SD = 0.2), while the TPB score was 2.8 (SD = 0.2). The mean age of respondents was 47.5 years (SD = 9.5), and ranged from 27 to 76 years.

Correlation matrix in Table 3 suggests that although respondents may intend to use the system ($r > 0.5$), intention does not strongly translate into actual utilization ($r < 0.2$).

Table 1. Socio-demographics Characteristics on Categorical Variables.

Study Variables	n	%
Gender of Respondent		
Male	58	18.7
Female	252	81.3
Education Level		

Study Variables	n	%
None	1	0.3
Primary not complete	8	2.6
Primary complete	50	16.1
Secondary not complete	97	31.3
Secondary complete	115	37.1
Tertiary	39	12.6

Table 2. Descriptive analysis on Continuous Variables.

Study Variables	n	Mean	Std. Dev.	Min	Max
TAM	310	2.5	0.2	1.3	2.7
TPB	310	2.8	0.2	1.4	3.0
Age	310	47.5	9.5	27	76

Table 3. Correlation Matrix of TPB and TAM Variables.

Study Variables	Attitude	SN	PBC	PU	PEU	BI	Utilization
Attitude	1						
SN	0.695	1					
PBC	0.532	0.641	1				
PU	0.651	0.668	0.609	1			
PEU	0.609	0.705	0.672	0.704	1		
BI	0.809	0.637	0.533	0.585	0.548	1	
Utilization	-0.055	0.107	0.034	0.120	0.120	0.055	1

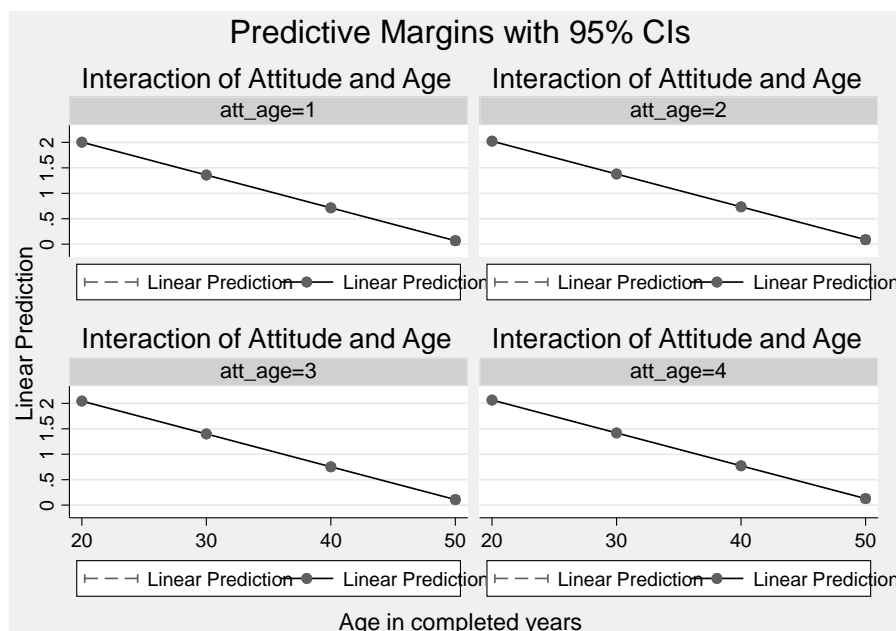


Figure 1. Predictive Margins Plots for attitude and age.

The overall correlation among all the variables in Table 3 indicate that any improvement in a single construct is associated with improvement in other variables. The strongest relationship is shown between behavioral intention and individual attitude ($r=0.809$). The relationship suggest that attitude is a

significant predictor of behavioral intention to use eCHIS among the study respondents in Western Kenya.

From Figure 1, it can be observed that the attitude level decreases as age increases since all the slopes of the plots are negative. The implication is that age has a moderating effect

on attitude level, and therefore, the interaction between age and attitude explains the level of decrease of attitude.

It can be seen from Figure 2 that social norms influence gender in generating varied results at various levels. Overall,

it is found that there is a greater sensitivity of women in responding to communal norms as their margins of prediction are slightly larger compared to men whose effects are either non-existent or weak. Programs need to take into account the gender differences and adjust interventions accordingly.

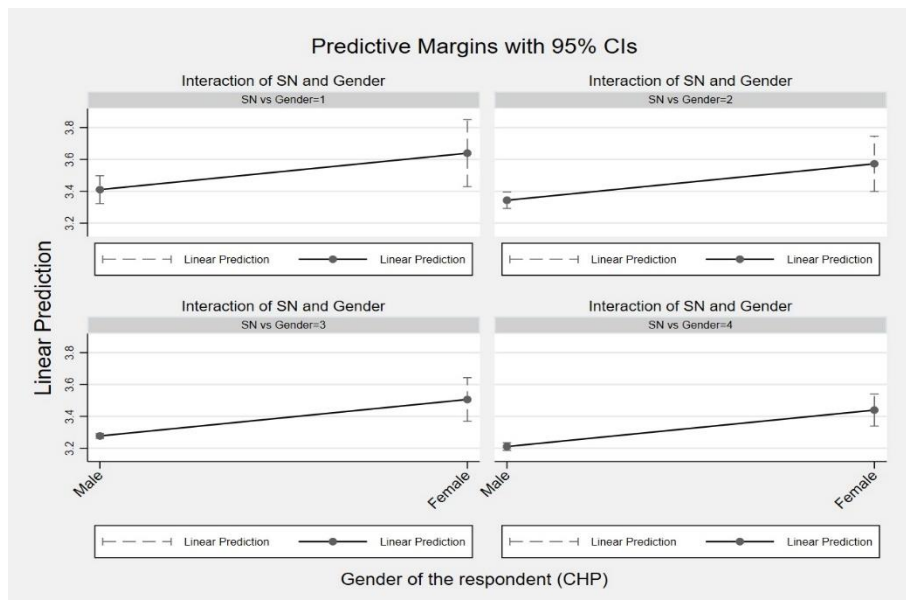


Figure 2. Predictive Margins Plots for gender and social norm (SN).

However, the impact that education makes on Perceived Behavior Control (PBC) depends on the type of PBC as shown in Figure 3. People who have attained high educational qualifications find themselves better able to cope with tasks and behaviors compared to those who have received little or no education at all.

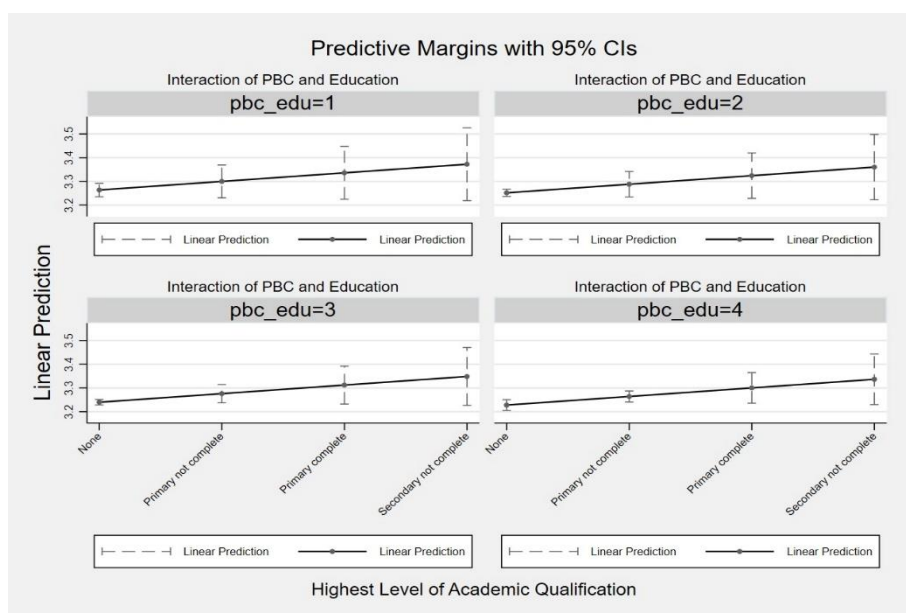


Figure 3. Predictive Margins Plots for education and perceived Behavioral Control (PBC).

4. Discussion

In particular, the present research evaluates the impact of sociodemographic features on the behavioral and technology related determinants of eCHIS adoption in Western Kenya drawing on the theoretical insights derived from both Technology Acceptance Model and the Theory of Planned Behavior constructs. The current study findings correspond to the existing theoretical predictions while disclosing additional context driven peculiarities similar but still somewhat different to those observed worldwide and regionally.

First, one should note a prevalence of female respondents (81.3%), which may be attributed to the nature of the healthcare workforce in Africa as women make up most of the frontline health workers in sub-Saharan Africa. Such demographics have been noted in various African countries like Uganda, Tanzania, and Ethiopia in connection with the use of digital technologies by CHW [3, 8]. In contrast, more evenly distributed gender ratios are observed in the application of digital technologies in more developed economies like Europe and North America [9].

Descriptive statistics demonstrates moderate average values for both Technology Acceptance Model and Theory of Planned Behavior variables, namely, a score of 2.5 and 2.8, respectively. Thus, people express somewhat cautious support toward eCHIS. This finding is consistent with other studies conducted in LMICs where digital technologies require adjustment due to infrastructural and usability problems [10]. However, a higher level of mean values can be seen globally, especially in Scandinavian countries where long term efforts to establish the eHealth system are associated with increased trust [11].

The correlations between the main variables perceived usefulness (PU), perceived ease of use (PEOU), perceived behavioral control (PBC), subjective norm (SN), attitudes and behavioral intention (BI) are extremely high ($r > 0.5$). Such a finding is consistent with results obtained for a range of settings, in particular, for some Asian and Latin American settings where combined TAM-TPB model predictions are confirmed. In those cases, as well as in the current study, intention to use a technological product is mainly determined by both subjective-cognitive (PU, PEOU, PBC) and social (SN) factors [12]. In addition, the correlation between attitude and behavioral intention ($r = 0.809$) in the current study can be seen as especially strong; this finding reflects the role of attitude as an important mediator.

However, there is also another side to this matter. The correlation of all these variables with the actual use of eCHIS is weak ($r < 0.2$). As a consequence, we face a considerable discrepancy between intention to use the product and behavior associated with its practical application (intention-behavior gap). This problem has frequently been mentioned in relation to developing countries, where some structural problems like poor connectivity, lack of technical support, and increased workload make it very difficult to implement good intentions

despite a positive attitude toward eCHIS [13]. Unlike studies conducted in developed nations, such gaps may arise because of less favorable conditions. The correlation matrix reveals strong interrelationships among TAM and TPB constructs, particularly between PEOU and PU ($r = 0.704$) and between SN and PEOU ($r = 0.705$). These findings are consistent with global evidence indicating that ease of use enhances perceived usefulness, while social environments shape user perceptions of technology. In collectivist societies, including many African and Asian contexts, social norms tend to exert stronger influence compared to individualistic societies, where personal attitudes and perceived utility dominate decision making [14, 15]. The strong SN - attitude relationship observed in this study supports this regional pattern.

The results of the moderation analysis emphasize the impact of sociodemographic factors on the connections. Older age showed a negative connection with attitude, meaning that people aged older were not as positively inclined towards eCHIS as younger individuals. This aligns with empirical data from other parts of the world where there is a negative correlation between the level of digitalization and age because of poor digital literacy and unwillingness to adapt to technology [16]. Yet, this impact tends to be greater in developing nations.

Gender differences in the relationship between social norms and behavioral consequences reveal a slight tendency toward increased responsiveness to social pressure in females. This result agrees with regional data from sub-Saharan African and South Asian countries, where social norms determine the health-related behaviors of women [17]. On the contrary, the role of gender in the acceptance and use of digital health solutions is not significant in developed countries [18]. The minor distinctions obtained within this study confirm the existence of the effect; however, it is necessary to consider other intersecting variables.

Education positively moderates the relationship between perceived behavioral control and usage intention. Thus, users with more education report a higher sense of confidence in the operation of eCHIS. This trend is common for LMICs and developed countries because education is strongly linked to digital self-efficacy and literacy [19]. It is possible that the education gap might be wider in LMICs compared to wealthier countries, increasing technological inequalities. For users with low levels of education, additional barriers could include poor navigation skills and difficulties in comprehending digital content.

Overall, the results show that, despite some divergence, there is also considerable convergence with other parts of the world. While the theoretical propositions of TAM and TPB are generally consistent globally, their power and implementation through behavior vary considerably due to local conditions. In the case of Western Kenya, structural obstacles seem to undermine the link between intention and behavior, which is typical for similar contexts but uncommon for affluent countries.

5. Conclusions

Finally, this research adds to the wider body of literature on digital health by illustrating how, while behavioral and technical factors influencing the utilization of eCHIS may be well grounded from a theoretical perspective, they are limited by various sociodemographic and contextual considerations in practice. The implementation of an intended plan continues to pose challenges that require more than just personal interventions.

6. Policy and Practice

On the basis of practical considerations, this discussion reinforces the importance of having strategies that consider the environment where interventions will be implemented. Interventions in LMICs would need to have more focus on infrastructure building, training, and user focused design than those in the best practice model used in other regions of the world. Age based training, gender related interventions, and educational approaches are particularly important.

7. Limitation

The current research is constrained by its focus on Western Kenya, limiting the ability of the results to be generalized to other settings with different infrastructural and socio-economic environments. Additionally, the cross-sectional approach and utilization of self-reported information may lead to biases, thus preventing causal inference. In addition, other variables that were not measured could have impacted the link between intention and eCHIS utilization.

Abbreviations

BI	Behavioral Intention
CHP	Community Health Promoter
CHU	Community Health Unit
eCHIS	Electronic Community Health Information System
DHS	Digital Health Systems
eHIS	Electronic Health Information System
IREC	Institutional Research Ethics Committee
KHIS	Kenya Health Information System
LMICs	Low- and Middle-Income Countries
MCH	Maternal and Child Health
NACOSTI	National Commission for Science, Technology and Innovation
PBC	Perceived Behavioral Control
PEOU / PEU	Perceived Ease of Use
PHC	Primary Health Care
PU	Perceived Usefulness
RA	Research Assistant
SD	Standard Deviation

SN	Subjective Norms / Social Norms
TAM	Technology Acceptance Model
TPB	Theory of Planned Behavior
UEAB	University of Eastern Africa, Baraton

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Author Contributions

Albert Kirwa: Conceptualization, Data curation, Formal Analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Software, Validation, Visualization, Writing – original draft, Writing – review & editing

Rose Nyamwamu Wangui: Conceptualization, Investigation, Methodology, Supervision, Validation, Writing – review & editing

Poornima Ramasamy: Conceptualization, Investigation, Methodology, Supervision, Validation, Writing – review & editing

Data Availability Statement

The data is available from the corresponding author upon reasonable request.

Conflicts of Interest

The authors declare no conflicts of interest.

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