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Effects of health education using mobile technologies on caregivers' knowledge of routine growth monitoring for children aged 9 to 24 months in Kenya

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ABSTRACT

Routine growth monitoring (RGM) for 9 to 24-month-old children enables early detection of developmental problems for corrective interventions. Unfortunately, many caregivers cease active RGM activities once they exhaust the government-recommended vaccines. The study aimed to find out the effects of health education using mobile technologies on caregivers' knowledge of RGM. The study was quasi-experimental in design. Caregivers in interventional arm 1, received health education (HE) messages sent via a Short Text Message (STM). Caregivers in interventional arm 2, received HE messages using Voice Calls (VC). Control arms received the usual care. Post-intervention results revealed that there was an increase in the number of respondents who knew the importance of RGM for their children. Post-intervention analysis showed that caregivers in intervention arms 1 and 2 were more presumably to know when their children should be taken for RGM (OR = 3.000; 95% CI: 2.098 – 4.29), what is done during RGM visits to a child welfare clinic, the benefits of RGM, and problems associated with failure to engage in RGM compared to those in the control arm and at the beginning of the study. Health education using mobile technologies improved caregivers' knowledge of routine growth monitoring.

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Caregivers' knowledge; Routine growth monitoring; Health education; Child welfare clinic; Mobile technologies

SUBJECTS
Allied Health; Health Conditions; Allied Health

1. Introduction

Early detection of developmental problems in children usually occurs during the first five years of life. Timely detection of abnormalities in growth among children instigates corrective interventions to achieve full growth potential. Periodic measurement of children under five years is of utmost importance since it allows monitoring and comparison to assess any deviations and thus predict alterations in the child's development (Amira et al., 2012). Routine growth monitoring offers healthcare providers opportunities to discuss; healthy eating and active living with children and their caregivers (Inka et al., 2016; Debuo et al., 2017). Nutrition counseling is emphasized during welfare child clinics targeted at decreasing overnutrition and undernutrition in children below five years (UNICEF/WHO/World Bank Group, 2012).

Globally, 26% of children below five years are stunted, 16% are underweight, 8% are wasted and 7% are underweight (UNICEF/WHO/World Bank Group, 2018). Nutritional stunting affects more than 80% of children below five years old in developing countries (Sajady et al., 2018). Growth stunting is experienced most often among children with poor nutritional status in their first two years of life (Liu et al., 2014). Growth monitoring of children who were aged below five years in Thailand occurred only in three instances namely; when a child was ill, during vaccination in a public health office, or visits conducted in the villages by Village Health Volunteers (Roesler et al., 2018).

Comparing the growth pattern of children with WHO's growth standards through measurement of their weight and length indicates a child's growth

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consistencies raising a concern about a growth issue that needs attention. There are serious lifelong effects when a child's growth rate falls below what's appropriate for their age in 0–24 months (World Health Organization, 2013).

Daniel, et al., 2017 note that 53% of caregivers in Southern Ethiopia were not knowledgeable about GM. In Ghana, 40% of the mothers had poor knowledge of RGM (Debuo et al., 2017). Further, over 30% of the caretakers didn't comprehend the meaning of RGM while about 18.7% of them could interpret the normal, static, upward, and decline growth curves (Debuo et al., 2017). In another study, Banda (2012) found that 92% of the caretakers of under-five children were not so knowledgeable about the significance of GM. Caretakers of children 12–23 months old in Zambia and Ethiopia showed meager knowledge of feeding practices (Banda 2012; Bilal et al., 2014). More than half of the caregivers were unable to understand and interpret the growth charts (Debuo et al., 2017; Ben-Joseph et al., 2009). Debuo, (2017), indicated that interventions to lower mortality rates, infectious diseases, and malnutrition under-five years were possible in cases where routine growth monitoring was consistently done. In Ghana, most mothers (98.1%) thought that having their children's weight measured in a clinic every month was important (Gyampoh et al., 2014).

A study conducted in Kiambu County, Kenya found that there was low awareness of the importance and utilization of growth monitoring clinic services among children aged 12–59 months (Kithinji et al., 2017).

Low-and-middle-income countries (LMIC) have reported improved access to and usage of mobile phones (Felicie et al., 2016; Labrique and Agarwal, 2014; Sanou, 2014). Mobile health utilizes the Internet, voice calls, and text messaging (Lee et al., 2014). The usefulness of mobile health applications has been realized in offering educational information, promoting a change of behaviors, monitoring, data gathering, and reporting, managing human resources, and chronic diseases (Marcolino et al., 2018; Felicie et al., 2016; Fortuin et al., 2016). The main aim of this study was to establish the effects of health education using mobile health on caretakers' knowledge of RGM among children aged 9–24 months in Kenya.

2. Methodology

The study was a quasi-experimental design conducted between April 2019 and March 2020. The study respondents were selected from six health facilities. Six health facilities were selected purposively due to their high population of under-five children visiting child health clinics. The 6 health facilities were randomized by use of simple random sampling to assign two health facilities for each of the three study arms. The 1st interventional arm encompassed Tinga Sub-County Hospital and Nyamira County Referral Hospital; the 2nd interventional arm consisted of Nyamusi Sub-County Hospital and Borabu Sub-County Hospital and the 3rd arm which was a control included Ekeronyo Sub-County Hospital and Keroka Sub-County Hospital. The respondents to the study were recruited during their 9th- visit to the child clinic. All the study respondents with 9-month-old children were recruited during the 9th visit to the child clinic for the measles vaccine until the correct sample was arrived at. The study used a formula by Charan and Biswas (2013) to get a sample size of 180 participants. The respondents who accessed a mobile phone in their household were recruited to take part in the study. At the beginning and end of the study all the selected caregivers in the three study arms were interviewed about their socio-demographic and economic characteristics; their knowledge of the meaning of routine growth monitoring (RGM), what is done during RGM, the benefits of RGM, and health problems likely to be encountered out of failure to attend RGM. The purpose of the interview was to establish the caregivers' knowledge of RGM before the commencement and after the interventions as well as for those who didn't receive any intervention. Likewise, the study wanted to find out the most effective intervention for STM and VC. Those respondents in the intervention arms were requested to indicate the language of communication during health education messaging using STM and VC. For the 1st interventional arm, caregivers received health education messages that were sent via a Short Text Message (STM). The messages were sent to the participants monthly for a period of nine months. For the 2nd interventional arm, respondents received health education messages through Voice Calls (VC) that lasted for not more than two minutes. The voice call was also done once monthly for nine months. The health education messages using both the STM and VC were done instantaneously before the appointment date. Caregivers in the control arm did not receive the health education messages using STM or VC. All caregivers in the study (both in intervention and control arms) got the usual care. The researchers then followed up the interventional arms for 9 months from the 10th month after recruitment.

Semi-structured questionnaires were used to collect data from the 180 caregivers who were involved in the study. The key Informant Interview guide was used to collect key information from 6 professional nurses. One nurse from each of the involved health facilities was selected randomly to take part in the key informant interview. Analysis of the quantitative data collected was done using Statistical Package for Social Sciences (SPSS) version 2. The relationship between dependent and independent variables was tested using the chi-square test and Odds Ratio which was deemed significant when the p-value was less than 0.05 at a 95% confidence level. Content analysis was done for qualitative data. Results were then presented as narrations or direct quotes which were then triangulated with the quantitative data. Ethical clearance was obtained from the Kenyatta University Ethics and Review Committee. A research permit was sought from the National Commission for Science, Technology, and Innovation (NACOSTI). Informed consent was sought from all caregivers who participated in this study before going on the study research.

3. Results

3.1. Socio-demographic and socio-economic characteristics of the study participants

The results showed that many of the respondents were aged between 23–27 years old in the intervention arm 1 (HE using STM) 20 (33.3%), intervention arm 2 (HE using VC) 23 (38.3%), and, control arm 24 (40%). The study did not show any significant statistical association in the age distribution of the caregivers between intervention arm 1 and control arm ($p = 0.243$), intervention arm 2 and control arm ($p = 0.751$), intervention arm 1 and intervention arm 2 ($p = 0.566$) (Table 1). The study showed that 80% of the respondents in all three study arms were married. No significant association in the distribution of marital status of the caregivers between intervention arm 1 and control arm ($\chi^2 = 0.069$; df = 1; $p = 0.793$), intervention arm 2 and control arm ($p = 0.362$), intervention 1 and intervention arm 2 ($p = 0.239$) (Table 1). The study revealed that all the caregivers in both the intervention arms and the control arm were female (100%). Among the children in intervention arm 1

Table 1. Socio-demographic and economic characteristics of the study participants.

	Intervention arm 1			Intervention arm 2			Control arm		
Variable	HE using STM ($n = 60$)	Control ($n = 60$)	Significance	HE using VC ($n = 60$)	Control ($n = 60$)	Significance	HE using STM ($n = 60$)	HE using VC ($n = 60$)	Significance
Age (years)									
<18	3(5%)	0(0%)	$p = 0.243$*	1(1.7%)	0(0%)	$p = 0.751$*	3(5%)	1(1.7%)	$p = 0.566$*
18-22	11(18.3%)	14(23.3%)		13(21.7%)	14(23.3%)		11(18.3%)	13(21.7%)	
23-27	20(33.3%)	24(40%)		23(38.3%)	24(40%)		20(33.3%)	23(38.3%)	
28-32	17(28.3%)	14(23.3%)		18(30%)	14(23.3%)		17(28.3%)	18(30%)	
33-37	6(10%)	8(13.3%)		5(8.3%)	8(13.3%)		6(10%)	5(8.3%)	
38-42	3(5%)	0(0%)		0(0%)	0(0%)		3(5%)	0(0%)	
Marital status									
Married	51(85%)	52(86.7%)	χ^2=0.069; df = 1; $p = 0.793$	56(93.3%)	52(86.7%)	$p = 0.362$*	51(86.7%)	56(93.3%)	$p = 0.239$*
Single	9(15%)	8(13.3%)		4(6.7%)	8(13.3%)		9(13%)	4(6.7%)	
Education Level									
Primary	18(30%)	21(35%)	χ^2=3.026; df = 4; $p = 0.553$	27(45%)	21(35%)	χ^2=3.642; df = 4; $p = 0.457$	18(30%)	27(45%)	χ^2=2.934; df = 3; $p = 0.402$
Secondary	30(50%)	25(41.7%)		23(38.3%)	25(41.7%)		30(50%)	23(38.3%)	
Tertiary/College	12(20%)	14(23.3%)		10([16].7%	14(23.3%)		12(20%)	10(16.7%	
Occupation									
Peasant Farmer	24(40%)	24(40%)	$p = 0.149$*	21(35%)	24(40%)	$p = 0.025$*	24(40%)	21(35%)	$p = 0.495$*
Housewife	20(33.3%)	25(41.7%)		25(41.7%)	25(41.7%)		20(33.3%)	25(41.7%)	
Self-employed	12(20%)	4(6.7%)		13(21.7)	4(6.7%)		12(20%)	13(21.7)	
Employed	4(6.7%)	7(11.7%)		1(1.7%)	7(11.7%)		4(6.7%)	1(1.7%)	
Monthly Income									
< 5000	28(46.6%)	24(40%)	$p = 0.852$*	25(41.7%)	24(40%)	χ^2=0.911; df = 3; $p = 0.823$	28(46.6%)	25(41.7%)	$p = 0.862$*
5000–10, 000	6(10%)	6(10%)		9(15%)	6(10%)		6(10%)	9(15%)	
10,000 and above	4(6.7%)	6(10%)		5(8.3%)	6(10%)		4(6.7%)	5(8.3%)	
Dependant/None	22(36.7%)	24(40%)		21(35%)	24(40%)		22(36.7%)	21(35%)	
Gender of child									
Male	30(50%)	26(43.3%)	χ^2=0.536; df = 1; $p = 0.464$	33(55%)	26(43.3%)	χ^2=1.634; df = 1; $p = 0.201$	30(50%)	33(55%)	χ^2=0.301; df = 1; $p = 0.583$
Female	30(50%)	34(56.7%)		27(45%)	34(56.7%)		30(50%)	27(45%)	

Key: * Fisher's exact test.
HE: health education.
STM: short text message.
VC: voice call.

(HE using STM), the proportion of male children was equal to that of females 50%. In intervention arm 2 (HE using VC), 33(55%) of the children were male and 27(45%) were female while in control arm 26(43.3%) were male and 34(56.7%) females. There was no significant statistical association in the distribution of gender of the children between intervention arm 1 and control arm (χ^2 = 0.536; df = 1; p=0.464), intervention arm 2 and control arm (χ^2 = 1.634; df = 1; p=0.201), intervention arm 1 and intervention arm 2 (χ^2 = 0.301; df = 1; p=0.583) (Table 1). The study indicated that of the respondents in intervention arm 1 (HE using STM), those with primary education qualifications were 18(30%), those with secondary education 30(50%), and 12(20%) had tertiary education. In intervention, arm 2 (HE using VC), caregivers with primary education were 27(45%), those with secondary education were 23(38.3%), and 10(16.7%) with tertiary education. Caregivers in the control arm indicated that 21(35%) had attained a primary level of education, 25(41.7%) secondary, and 14(23.3%) tertiary education. The study didn't show a significant statistical association in the proportion of caregivers at all education levels in intervention arm 1 and control arm (χ^2= 3.026; df = 4; p=0.553), intervention arm 2 and control arm (χ^2 = 3.642; df = 4; p=0.457), intervention arm 1 and intervention arm 2 (χ^2 = 2.934; df = 3; p=0.402) (Table 1). Among the caregivers in intervention arm 1 (HE using STM), peasant farmers were 24(40%), housewives were 20(33.3%), self-employed were 12 (20%), and salaried workers were 4(6.7%). In intervention arm 2 (HE using VC), 21(35%) were housewives, 25(41.7%) peasant farmers, 13(21.7%) self-employed and 1(1.7%) salaried worker. In the control arm, 24(40%) were housewives, 25(41.7%) peasant farmers, 4(6.7%) self-employed and 7(11.7%) salaried workers. The study showed no significant statistical association in the proportion of respondents with different occupations in the intervention arm 1 and control arm (p=0.149), intervention arm 2 and control arm (p=0.025), intervention arm 1 and intervention arm 2 (p=0.495) (Table 1). Many of the study respondents were either dependants or earned a monthly income of less than Kshs 5,000. In intervention, arm 1 (HE using STM), those who earned less than Kshs 5,000 were 28(46.6%), and dependents were 22(36.7%). In intervention, arm 2 (HE using VC), those who earned less than Kshs 5,000 were 25(41.7%) and dependants were 21(35%) and in the control arm, those who earned a monthly income of less than Kshs 5,000 were 24(40%) who were equal with were dependants (24(40%)). The study did not indicate a significant association in the participants' monthly income between intervention arm 1 and control arm (p=0.852), intervention arm 2 and control arm (χ^2 = 0.911; df = 3; p=0.823), intervention arm 1 and intervention arm 2 (p=0.862) (Table 1).

It is important to note that respondents in the intervention arms 1, 2, and the control arm exhibited similar socio-demographic characteristics at the baseline with no significant statistical differences among them. That indicated that all caregivers had the same features and consequently wouldn't affect successive findings in the study.

3.2. Caregivers' knowledge of RGM at the beginning of the study

All the caregivers were interviewed to assess their understanding of the meaning of Routine Growth Monitoring, when children should be taken for RGM, what is done at the RGM clinic, the benefits of RGM, and health problems likely to be encountered out of failure to attend RGM. After the assessment (results provided in Sections 3.2.1– 3.2.5) those in interventional arms 1 and 2 received STM or VC touching the meaning of Routine Growth Monitoring, when children should be taken for RGM, what is done at the RGM clinic, the benefits of RGM, and health problems likely to be encountered out of failure to attend RGM. The STM and VC were based on little knowledge of the RGM.

3.2.1. Meaning of RGM

The study showed that caregivers who understood the meaning of RGM were 118(65.6%) and the other 62(34.4%) did not know its meaning. Among participants in the Intervention Arm, 1 (HE using STM) 42(70%) knew the meaning of RGM. In the intervention, Arm 2 (HE using VC), 39(65%) understood the meaning and in the control arm, 37(61.7%) understood the meaning of RGM (Figure 1).

One of the Nurses in one of the health facilities reported that '*Regular growth monitoring is that consistent measurement of children below 5 years of their height, weight, and head circumference to ensure normalcy in growth.*' Another male Nurse reported, '*You will be able to tell of their malnutrition and health issues.*' The head nurse in one of the facilities said that *'it must be regular meaning every month for children who are below five years'*

Table 2 presents the association of socio-demographic and economic characteristics and caregivers' knowledge of the meaning of RGM. There was

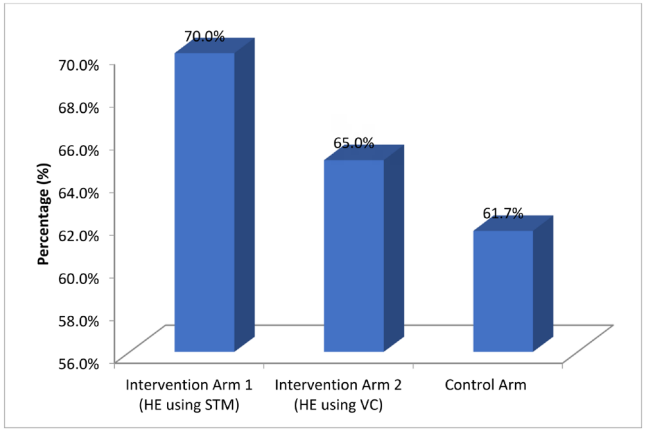

Figure 1. Proportion of caregivers who knew that children should be taken for RGM.

Table 2. Association between socio-demographic/economic characteristics and meaning of RGM.

		Meaning of RGM		
Variable		Aware	Not aware	Significance
Age (Years)	Below 18	2(1.7%)	2(3.2%)	$p=0.897$*
	18–22	24(20.3%)	14(22.6%)	
	23–27	44(37.3%)	23(37.3%)	
	28–32	32(27.1%)	17(27.4%)	
	33–37	13(11.1%)	6(9.7%)	
	38–42	3(2.5%)	0(0%)	
Marital status	Married	105(89.2%)	54(87.1%)	$\chi^2=0.140$; df = 1; $p=0.708$
	Single	13(1.1%)	8(12.9%)	
Education level	Primary	27(22.9%)	38(61.3%)	$\chi^2=29.238$; df = 4;
	Secondary	61(51.7%)	17(27.4%)	
	Tertiary	18(15.3%)	7(11.3%)	$p<0.001$
Occupation	Peasant Farmer	36(30.5%)	33(53.2%)	$p=0.003$*
	Housewife	47(39.8%)	23(37.1%)	
	Self-employed	23(19.5%)	6(9.7%)	
	Employed	12(10.2%)	0(0%)	
Monthly income	< 5000	42(35.6%)	35(36.5%)	$p=0.015$*
	5000–10,000	15(12.7%)	6(9.7%)	
	10,000 and above	14(11.9%)	1(1.6%)	
	Dependant/ None	47(39.2%)	20(32.3%)	
Gender of child	Male	59(50%)	30(48.4%)	$\chi^2=0.142$; df = 1; $p=0.837$
	Female	59(50%)	32(51.6%)	
Residence	Urban	51(43.1%)	15(24.2%)	$\chi^2=6.332$; df = 1; $p=0.012$
	Rural	67(56.8%)	47(75.8%)	

Key: * Fisher's exact test.

a significant association between caregivers' knowledge of the meaning of RGM and their level of education (χ^2 = 29.238; df = 4; $p<0.0001$), occupation ($p=0.001$), monthly income ($p=0.015$), residence (χ^2 = 6.332; df = 1; $p=0.012$). The rest of the socio-demographic characteristics didn't show any association (Table 2).

3.2.2. Caregivers' knowledge of when children should be taken to welfare clinic for RGM

Table 3 presents the proportion of caregivers who knew when children should be taken to a welfare clinic for RGM. About 28(66.7%) of caregivers in intervention arm 1 knew that children should visit the child clinic for RGM during immunization, 16(38.1%) said monthly, and 5(11.9%) said that when children are sick. Among intervention arm 2, some caregivers 22(59.2%) knew that children should visit the child clinic for RGM monthly, 17(43.6%) during immunization, and 10(25.6%) of them mentioned that it is when they are sick. Among the control arm, 21(56.7%) of caregivers knew that children should be taken for RGM monthly, 15(40.5%) of them indicated that children should be taken for RGM during immunization and 8(21.6%) said that children should visit clinic for RGM when sick.

As shown in Table 3, there was no statistically significant difference in the proportion of caregivers in intervention arm 1 compared to those in the control arm with the knowledge that children should be taken for RGM monthly (χ^2 = 1.008; df = 1; $p=0.315$), when sick ($p=0.362$) as well as during immunization (χ^2 = 3.589; df = 1; $p=0.058$) (Table 3). Likewise, the study found no statistically significant difference between the proportion of caregivers in intervention arm 2 and those in the control arm with the knowledge that children should be taken for RGM monthly (χ^2 = 0.147; df = 1; $p=0.702$), when sick (χ^2 = 0.261; df = 1; $p=0.609$) as well as during immunization (χ^2 = 0.170; df = 1; $p=0.680$). Further, the study did not get any statistical difference in the proportion of caregivers in intervention arm1 and intervention arm 2 with the knowledge that children should be taken for RGM monthly (χ^2 = 1.915; df = 1; $p=0.166$), when sick ($p=0.153$*) as well as during immunization (χ^2 = 3.589; df = 1; $p=0.058$) at the baseline.

3.2.3. Knowledge of what is done during RGM visit

As presented in Table 4, there was no significant difference in the proportion of caregivers in intervention arm 1 compared to those in the control

Table 3. Proportion of caregivers' knowledge of when children should be taken for RGM at the beginning of the study.

	Intervention arm1			Intervention arm 2			Control arm		
Variable	HE using STM (n = 42)	Control (*n* = 37)	Significance	HE using VC (*n* = 39)	Control (*n* = 37)	Significance	HE using STM (*n* = 42)	HE using VC (*n* = 39)	Significance
Monthly	15(35.7%)	20(54.1%)	χ^2 = 1.008; df = 1; *p* = 0.315	22(56.4%)	20(54.1%)	χ^2=0.147; df = 1; *p* = 0.702	15(35.7%)	22(56.4%)	χ^2=1.915; df = 1; *p* = 0.166
When sick	4(9.5%)	8(21.6%)	*p* = 0.362*	10(25.l6%)	8(21.6%)	χ^2=0.261; df = 1; *p* = 0.609	4(9.5%)	10(25.6%)	*p* = 0.153*
During immunization	27(64.3%)	17(45.9%)	χ^2=3.589; df = 1; *p* = 0.058	17(43.6%)	17(45.9%)	χ^2=0.170; df = 1; *p* = 0.680	27(64.3%)	17(43.6%)	χ^2=3.589; df = 1; *p* = 0.058

Key: * Fisher's exact test.
HE: health education.
STM: short text message.
VC: voice call.
A Nurse in one of the facilities reported that *'Once a caregiver comes to the clinic for the first time, we inform her when to come nex'. 'First-time caregivers have little understanding as to when they should take their babies for regular growth monitoring clinic',* said a Nurse at the MNCH clinic.

Table 4. Caregivers' knowledge of what is done during RGM visit.

	Intervention Arm 1			Intervention Arm 2			Control Arm		
Variable	HE using STM (*n* = 42)	Control (*n* = 37)	Significance	HE using VC(*n* = 39)	Control (*n* = 37)	Significance	HE using STM (*n* = 42)	HE using VC (*n* = 39)	Significance
Weight measured	42 (100%)	37 (100%)	χ^2=0.926; df = 1; *p* = 0.336-	39 (100%)	37 (100%)	χ^2=0.144; df = 1; *p* = 0.705	42 (100%)	39 (100%)	χ^2=0.342; df = 1; *p* = 0.559
Height measured	41 (97.6%)	37 (100%)	χ^2=0.586; df = 1; *p* = 0.444	38 (97.4%)	37 (100%)	χ^2=0.036; df = 1; *p* = 1.000	41 (97.6%)	38 (97.4%)	χ^2=0.333; df = 1; *p* = 0.564
Detection of malnutrition	8 (19%)	9 (24.3%)	χ^2=0.069; df = 1; *p* = 0.793	2 (5.1%)	9 (24.3%)	*p* = 0.053*	8 (19%)	2 (5.1%)	*p* = 0.095*
Detection of poor health	6 (14.3%)	7 (18.9%)	χ^2=0.086; df = 1; *p* = 0.769	2 (5.1%)	7 (18.9%)	*p* = 0.163*	6 (14.3%)	2 (5.1%)	*p* = 0.272*
Taught hygiene practices	4 (9.5%)	1 (2.7%)	*p* = 0.364*	1(2.6%)	1 (2.7%)	*p* = 1.000*	4 (9.5%)	1(2.6%)	*p* = 0.364*
Taught feeding practices	4 (9.5%)	1 (2.7%)	*p* = 0.364*	1(2.6%)	1 (2.7%)	*p* = 1.000*	4 (9.5%)	1(2.6%)	*p* = 0.364*
Head circumference measured	4 (9.5%)	1 (2.7%)	*p* = 0.364*	0(0%)	1 (2.7%)	*p* = 1.000*	4 (9.5%)	1(2.6%)	*p* = 0.364*
Taught signs of abnormality in children	3 (7.1%)	0 (0%)	*p* = 0.079*	1 (2.6%)	0 (0%)	*p* = 1.000*	3 (7.1%)	1 (2.6%)	*p* = 0.619*
Taught signs of sickness in children	3 (7.1%)	1 (2.7%)	*p* = 0.619*	0 (0%)	1 (2.7%)	*p* = 1.000*	3 (7.1%)	0 (0%)	*p* = 0.244*
Taught home remedy for a sick child	0 (0%)	1 (2.7%)	*p* = 1.000*	1 (2.6%)	0 (0%)	*p* = 1.000*	0 (0%)	1 (2.6%)	*p* = 1.000*
Vitamin A supplementation	0 (0%)	1 (2.7%)	*p* = 1.000*	3 (7.7%)	0 (0%)	*p* = 0.244*	0 (0%)	3 (7.7%)	*p* = 0.244*
Child vaccination	1 (2.4%)	0 (0%)	p = 1.000*	5 (12.8%)	0 (0%)	*p* = 0.057*	1 (2.4%)	5 (12.8%)	*p* = 0.207*

Key:* Fisher's exact test.
HE: health education.
STM: short text message.
VC: voice call.

arm who knew that: weight was measured (χ^2 = 0.926; df = 1; *p* = 0.336), Height measured (χ^2 = 0.586; df = 1; *p* = 0.444), malnutrition was detected (χ^2 = 0.069; df = 1; *p* = 0.793), poor health was detected (χ^2 = 0.086; df = 1; *p* = 0.769), there are lessons on feeding practices (*p* = 0.364*), lessons on hygiene practices (*p* = 0.364*), Head circumference measured (*p* = 0.364*), teaching on signs of abnormality in children (*p* = 0.079*), teachings on signs of sickness in children (*p* = 0.619*), lessons on home remedy for a sick child (*p* = 1.000*), vitamin A supplementation (*p* = 1.000*), and Child vaccination (*p* = 1.000*). From the analysis of the baseline results, the proportion of caregivers in intervention arm 1 was significantly different compared to those in the control arm. The analysis demonstrated that at baseline caregivers' knowledge in both arms was nearly the same.

For the case of those in intervention arm 2 compared to those in the control arm, the study did not exhibit any statistical difference in proportion between the two arms with regards to their knowledge that: weight is measured (χ^2 = 0.144; df = 1; p=0.705), Height is measured (χ^2 = 0.036; df = 1; p=1.000), malnutrition is detected (p=0.053*), poor health is detected (p=0.163*), there are lessons on feeding practices (p=1.000*), lessons on hygiene practices (p=1.000*), Head circumference is measured (p=1.000*), lessons on signs of abnormality in children (p=1.000*), lessons on signs of sickness in children (p=0.619*), lessons on home remedy for a sick child (p=1.000*), vitamin A supplementation (p=0.244*), and Child vaccination (p=0.057*). From the analysis of the baseline results, the proportion of caregivers in intervention arm 2 was significantly different compared to those in the control arm. The analysis demonstrated that at baseline caregivers' knowledge in both arms was nearly the same.

As presented in Table 4, the study exhibited no significant statistical difference between the proportion of caregivers in intervention arm 1 and intervention arm 2 in regards to their knowledge that: weight is measured (χ^2 = 0.342; df = 1; p=0.559), Height is measured (χ^2 = 0.333; df = 1; p=0.564), malnutrition is detected (p=0.095*), poor health is detected (p=0.272*), there are lessons on feeding practices (p=0.364*), lessons on hygiene practices (p=0.364*), Head circumference is measured (p=0.364*), lessons on signs of abnormality in children (p=0.619*), lessons on signs of sickness in children (p=0.244*), lessons on home remedy for a sick child (p=1.000*), vitamin A supplementation (p=0.244*), and Child vaccination (p=0.207*). From the analysis of the baseline results, the proportion of caregivers in intervention arm 1 was not significantly different from those in intervention arm 2. The analysis demonstrated that at baseline caregivers' knowledge in both arms was nearly the same.

3.2.4. Knowledge of the benefits of RGM

The caregivers were interviewed at baseline to establish whether they understood the benefits of RGM to the children. As shown in Table 5, there was no statistical difference in the proportion of caregivers in intervention arm 1 and those in the control arm with knowledge of benefits that RGM creates an opportunity to: uptake all vaccines (χ^2 = 0.302; df = 1; p=0.583), learn feeding practices (χ^2 = 0.391; df = 1; p=0.532), Learn healthy lifestyle (χ^2 = 0.745; df = 1; p=0.388), identify an abnormality in children (χ^2 = 0.960; df = 1; p=0.327), as well as to know child's progress in health matters (p=1.000*). The study found no statistical difference in the proportion of caregivers in the intervention arm 2 and those in the control arm with knowledge of benefits that RGM creates an opportunity to: uptake all vaccines (χ^2 = 0.534; df = 1; p=0.465), learn feeding practices (χ^2 = 0.048; df = 1; p=0.827), Learn healthy lifestyle (χ^2 = 0.519; df = 1; p=0.471), identify an abnormality in children (χ^2 = 0.069; df = 1; p=0.793), as well as to know child's progress in health matters (p=0.119*). Further, the study did not find any statistical difference in the proportion of caregivers in intervention arm 1 and intervention arm 2 with knowledge on benefits: uptake of all vaccines (χ^2 = 1.634; df = 1; p=0.201), learn feeding

Table 5. Proportion of caregivers with knowledge of the benefits of RGM.

	Intervention arm 1			Intervention arm 2			Control arm		
Variable	HE using STM (n=42)	Control (n=37)	Significance	HE using VC (n=39)	Control (n=37)	Significance	HE using STM (n=42)	HE using VC (n=39)	Significance
Uptake of all vaccine	34 (81%)	31 (83.8%)	χ^2=0.302; df = 1; p=0.583	27 (69.2%)	31 (83.8%)	χ^2=0.534; df = 1; p=0.465	34 (81%)	27 (69.2%)	χ^2=1.634; df = 1; p=0.201
Learn feeding practices	17 (40.5%)	14 (37.8%)	χ^2=0.391; df = 1; p=0.532	13 (33.3%)	14 (37.8%)	χ^2=0.048; df = 1; p=0.827	17 (40.5%)	13 (33.3%)	χ^2=0.711; df = 1; p=0.528
Learn healthy lifestyle	16 (38.1%)	12 (32.4%)	χ^2=0.745; df = 1; p=0.388	9 (23.1%)	12 (32.4%)	χ^2=0.519; df = 1; p=0.471	16 (38.1%)	9 (23.1%)	χ^2=2.476; df = 1; p=0.116
Identify abnormality in children	12 (28.6%)	8 (21.6%)	χ^2=0.960; df = 1; p=0.327	9 (23.1%)	8 (21.6%)	χ^2=0.069; df = 1; p=0.793	12 (28.6%)	9 (23.1%)	χ^2=0.519; df = 1; p=0.471
To know a child's progress in health matters	1(2.4%)	0 (0%)	p=1.000*	5 (12.9%)	0 (0%)	p=0.119*	1 (2.4%)	5 (12.8%)	p=0.207*

Key:* Fisher's exact test.
HE: health education.
STM: short text message.
VC: voice call.

practices (χ^2 = 2.476; df = 1; p=0.116), Learn healthy lifestyle (χ^2 = 0.519; df = 1; p=0.471), identify an abnormality in children (χ^2 = 0.519; df = 1; p=0.471), as well as to know child's progress in health matters (p=0.207*). The study clearly showed that caregivers who were recruited in the three arms of this study were not significantly different in terms of knowledge of the benefits of RGM at baseline.

3.2.5. Caregivers' knowledge of health problems likely to be encountered out of failure to attend RGM

Figure 2 presents the proportion of caregivers with knowledge of health problems likely to be encountered out of failure to attend RGM. About 31(73.8%) of the caregivers from intervention arm 1, 29(74.4%) from the intervention arm 2, and 27(73%) from the control arm stated that there is a possibility of developing health problems among children who don't undergo RGM. The health problems expected by the respondents included measles disease {intervention arm 1, 23(54.8%); intervention arm 2, 19(65.5%) and control arm 15(55.6%)}, malnourishment {intervention arm 1 (34%), intervention arm 2(27%) and control arm (39%) and poliomyelitis disease {intervention arm 1 (30%), intervention arm 2 (45%) and control arm (25%)} (Figure 2).

3.3. Caregivers' knowledge of routine growth monitoring at the end of the study

3.3.1. Meaning of RGM

Analysis of results showed a tremendous improvement in the proportion of caregivers 154(85.6%) who knew what RGM meant after the health education intervention using STM and VC interventions compared with 118(65.6%) caregivers at the beginning of the study. The number of respondents who did know what RGM meant reduced from 62(34.4%) at the baseline to 26(14.4%) at the end of the study. Further analysis revealed that all the caregivers 60(100%) who received HE using STM as well as all caregivers 60(100%) who received HE using VC knew the meaning of RGM which was an improvement of 30% and 35% respectively at the end of the study.

3.3.2. Caregivers' knowledge of when children should be taken for RGM

Post-intervention results revealed that all the caregivers 60 (100%) who received HE using STM and all 60 (100%) of those who received HE using VC were aware that children should be taken for RGM. This was an improvement of 30% and 35% from the initial 42(70%) and 39(65%) respectively at the baseline. The analysis demonstrated that after health education using STM and VC, the proportion of caregivers with the knowledge that children should be taken for RGM monthly grew to 60(100%) in both intervention arms 1 and 2. In the control arm, the proportion of caregivers who correctly knew when children should be taken for RGM remained low. The study observed a significant statistical difference in the proportion of caregivers who received HE using STM and those in the control arm with the knowledge that children should be taken for RGM (OR = 3.000; 95% CI: 2.098 – 4.291; χ^2 = 60.000; df = 1; p<0.001). The same statistical difference was observed with the proportion of caregivers who received HE using VC and those in the control arm (OR =3.000; 95% CI: 2.098 – 4.291; χ^2 = 60.000; df = 1; p<0.001) (Table 6). Caregivers who received health education using STM and VC were more likely to know when their children

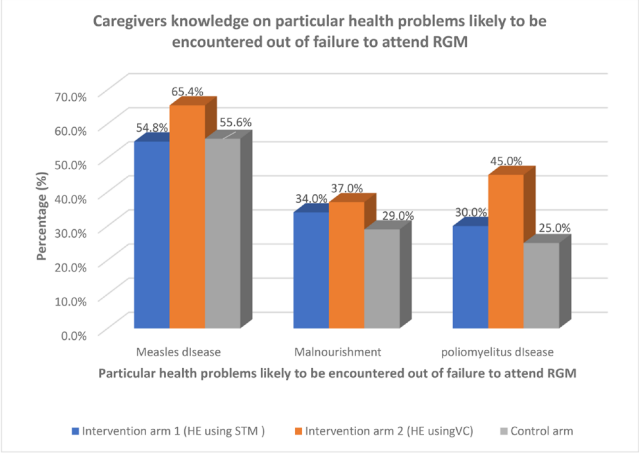

Figure 2. Proportion of caregivers who knew health problems likely to be encountered out of failure to attend RGM.

should be taken for RGM compared to those who were in the control arm.

3.3.3. Knowledge of what is done during RGM visit

Post-intervention analysis of knowledge on what is done during the RGM visit showed that all caregivers 60(100%) who received HE using STM, all 60(100%) who received HE using VC as well as those in the control arm 34(100%) knew that the weight and height of children are measured. There were significantly more caregivers among those who received health education using STM compared to those in the control who knew that the following activities are done during RGM visits: lessons on feeding practices (OR = 59.000; 95% CI: 8.44 – 412.147: $p < 0.001$*), detection of poor health OR = 8.286; 95% CI: 4.124 – 16.649; $p < 0.001$*), lessons on hygiene practices (OR = 50.000; 95% CI: 7.136–350.330: $p < 0.001$*), detection of malnutrition (OR = 1.700; 95% CI: 0.849–3.404: $\chi^2 = 2.342$; df = 1; $p = 0.126$), lessons on signs of sickness in children (OR = 38.000; 95% CI: 5390–267.913: $p < 0.001$*), Head circumference measured (OR = 9.000; 95% CI:1.176-68.854; $p < 0.001$*) lessons on home remedy for a sick child (OR = 2.000; 95% CI:0.186–21.473; $p < 0.001$*) Vitamin A supplementation (OR = 15.00; 95% CI:5.820–38.660; $p < 0.001$*), and Child vaccination (OR = 15.00; 95% CI:5.820–38.660; $p < 0.001$* (Table 7). The analysis demonstrates that those who received health education using STM were more likely to know what is done during an RGM visit compared to those who did not.

The study demonstrated significantly a higher proportion of caregivers among those who received health education using VC compared to those in the control as indicated: taught feeding practices (OR = 52.881; 95% CI: 7.555 – 370.135: $p < 0.001$*), detection of poor health (OR = 7.000; 95% CI: 3.454–14.188; $\chi^2 = 59.063$; df = 1; $p < 0.001$), Taught hygiene practices (OR = 29.000; 95% CI: 4.080 – 206.105: $p < 0.001$*), detection of malnutrition (OR = 1.900; 95% CI: 0.965-3.739: $\chi^2 = 3.683$; df = 1; $p = 0.055$), taught signs of sickness in children (OR = 12.000; 95% CI: 1.610–89.414: $p = 0.002$*), Head circumference measured (OR = 7.000; 95% CI:0.888–55.170; $p = 0.061$*) Taught home remedy for a sick child (OR = 10.000; 95% CI:1.321–75.704; $p = 0.008$*), Vitamin A supplementation (OR = 15.00; 95% CI:5.820–38.660; $p < 0.001$*), and Child vaccination (OR = 15.00; 95% CI:5.820–38.660; $p < 0.001$*) (Table 7). The analysis demonstrated that those who received health education using VC were more likely to know what is done during RGM visits compared to those who did not.

3.3.4. Knowledge of the benefits of RGM

As presented in Table 8, post-intervention interviews were done with the caregivers in all three study arms to establish their knowledge of the benefits of RGM. Uptake of all vaccines was cited as one of the benefits of RGM by all caregivers 60(100%) who received HE using STM, all 60 (100%) who received health education using VC, and 34 (56.7%) by those in the control. Analysis of knowledge on other benefits of RGM revealed that there were significantly more caregivers 59(98.3%) among those who received HE using STM compared to caregivers 14(41.2%) in the control arm who knew that education on feeding practices (OR = 4.214; 95% CI: 2.661– 6.675: $\chi^2 = 29.253$; df = 1; $p < 0.001$) is a benefit.

A significant majority of caregivers 59(98.3%) among those who used HE using STM compared to none 0 (0.0%) in the control arm, mentioned the child's progress in health as another benefit (OR = 0.017; 95% CI: 0.002 – 0.116; $p < 0.001$*). Significantly more caregivers 57(95%) among those who received HE using STM compared to those in the control arm 13(38.2%) knew that learning a healthy lifestyle is a

Table 6. Caregivers' knowledge of when children should be taken for RGM.

Variable	HE using STM (n = 60)	Control (n = 34)	Odds Ratio (OR)	95% Confidence Interval (CI)		Significance	HE using VC (n = 60)	Control (n = 34)	Odds Ratio (OR)	95% Confidence Interval (CI)		Significance
				Lower	Upper					Lower	Upper	
Monthly	60(100%)	20(58.8%)	3.000	2.098	4.291	χ^2=60.000; df = 1; $p < 0.001$	60(100%)	20(58.8%)	3.000	2.098	4.291	χ^2=60.000; df = 1; $p < 0.001$
When a child is sick	0(0%)	9(26.5%)	1.176	1.058	1.308	$p = 0.003$*	0(0%)	9(26.5%)	1.176	1.058	1.308	$p = 0.003$*
During immunization	0(0%)	17(50%)	1.364	1.171	1.588	$p < 0.0001$*	0(0%)	17(50%)	1.364	1.171	1.588	$p < 0.0001$*

Key: * Fisher's exact test.
HE: health education.
STM: short text message.
VC: voice call.

Table 7. Caregivers' knowledge of what is done to children aged between 10 –24 months during RGM.

	Intervention Arm 1						Intervention Arm 2					
				95% CI						95% CI		
Variable	HE using STM (n = 60)	Control (n = 34)	OR	Lower	Upper	Significance	HE using VC (n = 60)	Control (n = 34)	OR	Lower	Upper	Significance
Weight measured	60 (100%)	34 (100%)	1.765	1.414	2.202	χ^2=33.191; df = 1; p < 0.001	60 (100%)	34 (100%)	1.765	1.414	2.202	χ^2=33.191; df = 1; p < 0.001
Height measured	60 (100%)	34 (100%)	1.765	1.414	2.202	χ^2=33.191; df = 1; p < 0.001	60 (100%)	34 (100%)	1.765	1.414	2.202	χ^2=33.191; df = 1; p < 0.001
Taught feeding practices	59(98.3%)	1 (2.9%)	59.000	8.446	412.147	p < 0.001*	52 (86.7%)	1 (2.9%)	52.881	7.555	370.135	p < 0.001*
Detection of poor health	58 (96.7%)	7 (20.6%)	8.286	4.124	16.649	p < 0.001*	49 (81.7%)	7 (20.6%)	7.000	3.454	14.188	χ^2=59.063; df = 1; p < 0.001
Taught hygiene practices	50 (21.4%)	1 (2.7%)	50.000	7.136	350.330	p < 0.001*	29 (2.6%)	1 (2.7%)	29.000	4.080	206.105	p < 0.001*
Detection of malnutrition	17 (28.3%)	10 (29.4%)	1.700	0.849	3.404	χ^2=2.342; df = 1; p = 0.126	19 (31.7%)	10 (29.4%)	1.900	0.965	3.739	χ^2=3.683; df = 1; p = 0.055
Taught signs of sickness in children	38 (63.3%)	1 (2.9%)	38.000	5.390	267.913	p < 0.001*	12 (20%)	1 (2.9%)	12.000	1.610	89.414	p = 0.002*
Head circumference measured	9 (15%)	1 (2.9%)	9.000	1.176	68.854	p = 0.017*	7 (11.7%)	1 (2.9%)	7.000	0.888	55.170	p = 0.061*
Taught home remedy for a sick child	2 (3.3%)	1 (2.9%)	2.000	0.186	21.473	p = 1.000*	10 (16.7%)	1 (2.9%)	10.000	1.321	75.704	p = 0.008*
Vitamin A supplementation	60 (100%)	4 (11.7%)	15.000	5.820	38.660	p < 0.001*	60 (100%)	4 (11.7%)	15.000	5.820	38.660	p < 0.001*
Child vaccination	60 (100%)	4 (11.7%)	15.000	5.820	38.660	p < 0.001*	60 (100%)	4 (11.7%)	15.000	5.820	38.660	p < 0.001*

Key: * Fisher's exact test.
HE: health education.
STM: short text message.
VC: voice call.

Table 8. Caregivers' knowledge of the benefits of RGM.

Variable	HE using STM (n = 60)	Control (n = 34)	Odds Ratio (OR)	95% Confidence Interval (CI)		Significance	HE using VC (n = 60)	Control (n = 34)	Odds Ratio (OR)	95% Confidence Interval (CI)		Significance
				Lower	Upper					Lower	Upper	
Uptake of all vaccines	60 (100%)	34 (100%)	1.765	1.414	2.202	χ^2=33.191; df = 1; $p<0.001$	60 (100%)	34 (100%)	1.765	1.414	2.202	χ^2=33.191; df = 1; $p<0.001$
Learn feeding practices	59 (98.3%)	14 (41.2%)	4.214	2.661	6.675	χ^2=29.253; df = 1; $p<0.001$	57 (95%)	14 (41.2%)	4.071	2.564	6.464	χ^2=63.677; df = 1; $p<0.001$
To know a child's progress in health matters	59 (98.3%)	0 (0.0%)	0.017	0.002	0.116	$p<0.001$*	55 (91.7%)	0 (0.0%)	0.083	0.036	0.193	$p<0.001$*
Learn healthy lifestyle	57 (95%)	13 (38.2%)	4.385	2.701	7.119	χ^2=66.377; df = 1; $p<0.001$	50 (83.3%)	13 (38.2%)	3.846	2.346	6.305	χ^2=45.748; df = 1; $p<0.001$
Identify abnormality in children	36 (60%)	7 (20.6%)	4.971	2.408	10.262	χ^2=29.253; df = 1; $p<0.001$	29 (48.3%)	7 (20.6%)	4.005	1.906	8.413	χ^2=18.294; df = 1; $p<0.001$

Key: * Fisher's exact test.
HE: health education.
STM: short text message.
VC: voice call.

benefit (OR = 4.385; 95% CI: 2.701–7.119: χ^2 = 66.377; df = 1; $p<0.001$). It was established that significantly, more caregivers 36 (60%) among those who received HE using STM compared to those 7(20.6%) in the control arm cited that abnormality in children is identified during RGM visits at the health facility (OR = 4.971; 95% CI: 2.408–10.262: χ^2 = 29.253; df = 1; $p<0.001$. From the analysis of the post-intervention, there was a significantly increased proportion of caregivers who received HE using STM knowing the benefits of RGM compared to those who were in the control arm.

3.3.5. Caregivers' knowledge of health problems likely to be encountered from failure to attend RGM

Post-intervention analysis of the study findings revealed that entirely caregivers 60(100%) in study arms 1 and 2 who received health education reported that they were aware of health problems probably to be met due to failure to visit a child health clinic for routine growth monitoring clinic. The results demonstrated that health education intervention worked to increase the proportion of caregivers from 31(73.8%) of those in intervention arm 1 and 29(74.4%) of those in intervention arm 2 at the baseline to the current (all) caregivers at the endline (Table 9).

Table 9 presents the post-intervention analysis of the proportion of caregivers who knew of health problems possibly to be met due to failure to visit the child health clinic for RGM. The study established that a significant proportion of caregivers who received HE in intervention arm 1 compared to those who in the control arm were aware that measles (OR = 2.200; 95 CI: 1.615 –2.996; χ^2 = 33.750; df = 1; $p<0.001$), poliomyelitis as well as underweight/overweight (OR = 3.051; 95 CI: 1.876–4.963; χ^2 = 27.343; df = 1; $p<0.001$) and Flu (OR = 31.000; 95 CI: 4.371–219.839; χ^2 = 38.352; df = 1; $p<0.001$) are some of the health problems associated with failure to take children for RGM.

As presented in Table 9, the other health problems identified by a significantly big number of those who received health education compared to a small number of caregivers who did not receive any HE intervention include Tetanus (OR = 31.000; 95 CI: 4.371 - 219.839; χ^2 = 38.352; df = 1; $p<0.001$), Malnourishment (OR = 1.909; 95 CI: 1.011–3.605; χ^2 = 4.261; df = 1; $p=0.039$), Tuberculosis (OR = 17.000; 95 CI: 2.336–123.717; $p<0.001$*), Typhoid (OR = 17.000; 95 CI: 2.336–123.717; $p<0.001$*), Meningitis (OR = 16.000; 95 CI: 2.191–116.855; $p<0.001$*), Yellow fever (OR = 16.000; 95 CI: 2.191–116.855; $p<0.001$*) and Chicken Pox, Influenza, Hepatitis A &B with each (OR = 14.000; 95 CI: 1.900–103.132; $p<0.001$*). Study Participants who received health education compared to those who did not were more likely to know the health problem associated with failure to attend for RGM.

Endline analysis of results for caregivers in intervention arm 2 compared with that of the control arm, showed that a significantly high proportion of caregivers who received HE were aware that measles (OR = 2.240; 95 CI: 1.648–3.045; χ^2 = 36.505; df = 1; $p<0.001$), poliomyelitis as well as underweight/

Table 9. Caregivers' knowledge of health problems likely to be encountered out of failure to attend to RGM.

Variable	STM & HE ($n=60$)	Control ($n=34$)	OR	95% CI Lower	95% CI Upper	Significance	VC & HE ($n=60$)	Control ($n=34$)	OR	95% CI Lower	95% CI Upper	Significance
Measles	55(91.7%)	25(73.5%)	2.200	1.615	2.996	χ^2=33.750; df = 1; $p<0.001$	56(93.3%)	25(73.5%)	2.240	1.648	3.045	χ^2=36.505; df = 1; $p<0.001$
Poliomyelitis	42(70%)	14(41.2%)	3.051	1.876	4.963	χ^2=27.343; df = 1; $p<0.001$	36(60%)	14(41.2%)	2.571	1.555	4.252	χ^2=16.594; df = 1; $p<0.001$
Underweight/ overweight	42(70%)	14(41.2%)	3.051	1.876	4.963	χ^2=27.343; df = 1; $p<0.001$	17(28.3%)	14(41.2%)	1.214	0.660	2.235	χ^2=0.391; df = 1; $p=0.532$
Flu	31(51.7%)	1 (2.9%)	31.000	4.371	219.839	$p<0.001$*	13(21.7%)	1(2.9%)	13.000	1.755	96.272	$p=0.001$*
Tetanus	21(35%)	11(32.4%)	1.909	1.011	3.605	χ^2=4.261; df = 1; $p=0.039$	16(26.7%)	11(32.4%)	1.455	0.738	2.869	χ^2=1.195; df = 1; $p=0.274$
Malnourishment	21(35%)	11(32.4%)	1.909	1.011	3.605	χ^2=4.261; df = 1; $p=0.039$	12(20%)	11(32.4%)	1.091	0.523	2.277	χ^2=0.054; df = 1; $p=0.817$
Tuberculosis (TB)	17(28.3%)	2 (5.9%)	8.500	2.053	35.193	$p<0.001$*	25(41.7%)	2(5.9%)	12.500	3.098	50.443	$p<0.001$*
Typhoid	17(28.3%)	1(2.9%)	17.000	2.336	123.717	$p<0.001$*	12(20%)	1(2.9%)	12.000	1.610	89.414	$p=0.001$*
Meningitis	16(26.7%)	1(2.9%)	16.000	2.191	116.855	$p<0.001$*	9(15%)	1(2.9%)	9.000	1.176	68.854	$p=0.008$*
Yellow fever	16(26.7%)	1(2.9%)	16.000	2.191	116.855	$p<0.001$*	6(10%)	1(2.9%)	6.000	0.745	48.342	$p=0.051$*
Chicken Pox	14(23.3%)	1(2.9%)	14.000	1.900	103.132	$p<0.001$*	12(20%)	1(2.9%)	12.203	1.638	90.904	$p=0.001$*
Influenza	14(23.3%)	1(2.9%)	14.000	1.900	103.132	$p<0.001$*	8(13.3%)	1(2.9%)	8.000	1.032	62.008	$p=0.015$*
Hepatitis B	14(23.3%)	1(2.9%)	14.000	1.900	103.132	$p<0.001$*	6(10%)	1(2.9%)	6.000	0.745	48.342	$p=0.051$*
Hepatitis A	14(23.3%)	1(2.9%)	14.000	1.900	103.132	$p<0.001$*	4 (6.7%)	1 (2.9%)	4.000	0.460	34.750	$p=0.171$*

Key: * Fisher's exact test.
HE: health education.
STM: short text message.
VC: voice call.

overweight (OR = 2.571; 95 CI: 1.555– 4.252; χ^2 = 16.594; df = 1; $p<0.001$) and Flu (OR = 13.000; 95 CI: 1.755–96.272; $p=0.001$*) are some of the health problems associated with failure to take children for RGM.

Other health problems identified by a significantly high number of those who received health education compared to a significantly small number of caregivers who did not receive any HE intervention include Tetanus (OR = 1.455; 95 CI: 0.738–2.869; χ^2 = 1.195; df = 1; $p=0.274$), Malnourishment (OR = 1.091; 95 CI: 0.523–2.277; χ^2 = 0.054; df = 1; $p=0.817$), Tuberculosis (OR = 12.500; 95 CI: 3.098–50.443; $p<0.001$*), Typhoid (OR = 12.000; 95 CI: 1.610–89.414; $p=0.001$*), Meningitis (OR = 9.000; 95 CI: 1.176–68.854; χ^2 = 6.982; df = 1; $p=0.008$), Yellow fever (OR = 6.000; 95 CI: 0.745– 48.342; $p=0.051$*), Chicken Pox (OR = 12.000; 95 CI: 1.610–89.414; $p=0.001$*), Influenza (OR = 8.000; 95 CI: 1.032 – 62.008; p=0.015*), Hepatitis B (OR = 6.000; 95 CI: 0.745–48.342; p=0.051*), and Hepatitis A (OR = 4.000; 95 CI: 0.460–34.750; $p=-0.171$*). The analysis demonstrated that those who received HE in both interventional arms 1 and 2 were more likely to be aware of the health problems associated with failure to take a child for RGM.

4. Discussion

At baseline, the study found that 34.4% of the respondents from the three study arms did not know what RGM meant. This result concurs with the results of the same study done in Ghana which determined that 30% and more of the caretakers did not know what RGM meant (Debuo, 2017). However, the study findings contrast previous research in which more than 87.6% of the mothers had sound knowledge of routine GM (Bukari et al., 2020; Daniel et al., 2017). This result agrees with the results of comparable research done in other countries which indicated that more than 77% of the respondents showed that health workers mainly became the sources of information about their children (Seskute et al., 2018; Kundi et al., 2018). This, therefore, confirms that the healthcare provider's role is necessary to ensure that caregivers receive the correct information regarding RGM. There was a significant improvement in knowledge on when children should be taken for RGM among respondents who received HE using STM and VC with the majority reporting monthly. These results differed from the results of research done in Ethiopia which reported that 32.1% of caregivers indicated that GM was a monthly activity (Daniel, et al., 2017). Study analysis showed that over half of the caregivers knew the significance of RGM. These findings concurred with a similar study conducted in Zambia which indicated that most (92%) of the respondents of children knew the significance of GM (Banda, 2012). More analysis indicated that the utilization of all vaccines was the main benefit of RGM. Agbozo, et al. (2018) noted that understanding the growth status of a child was the most important advantage of visiting a child health clinic for RGM. The study found a significant statistical association between caregivers' level of education and knowledge of the meaning of RGM. This means that the more a caregiver is educated, the more likely they

are to attend RGM. Overall, the knowledge status of the caregivers significantly improved after HE used STM and VC. This finding is however inconsistent with the finding of a similar study done in Ethiopia which found that 53% of the mothers had poor knowledge of RGM (Daniel, et al., 2017).

5. Conclusion

Training of caregivers improved their knowledge of RGM. There is a need to regularly train and remind caregivers to improve their knowledge of RGM. The study is important in promoting sound child growth and development which starts by educating the caregivers on RGM and its importance.

Ethical approval

The Kenyatta University Ethical Review Committee granted ethical approval for the study (Reference: KU/ERC/APPROVAL/VOL.1 (222)). National Commission for Science,

Technology and Innovation provided the permit for the study (reference: NACOSTI/P/19/11505/28484). All participants gave informed verbal consent before taking part in the study.

Authors' contributions

The study conception and design were led by Justus O. S. Osano. Data analysis was done Justus O. S. Osano. The original manuscript draft was prepared by Edna N. Osano. The manuscript was reviewed by Justus O. S. Osano. Both authors participated in the final editing and approved the manuscript for submission.

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Data availability statement

Inquiries regarding the data should be directed to the corresponding author of this study.

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