Impact of health education intervention on the patients' adherence to malaria Artemisinin- based combination therapy in Kamuli District, Uganda

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Research Article

Keywords: Patients' adherence, Artemisinin-based combination therapy, Community health education, Uganda

Posted Date: May 9th, 2024

DOI: https://doi.org/10.21203/rs.3.rs-4262628/v1

Additional Declarations: No competing interests reported.

Abstract

Background

Global malaria control programmes such as approaches to community engagements to deliver malaria control interventions have been successful in controlling malaria. Malaria remains a disease of public health importance especially in African region and Uganda in particular. Strategies aimed at accelerating patients' adherence to prescribed Artemisinin-based combination therapy (ACT) treatment are needed in the fight to control and eradicate malaria. Previous studies have shown the power of health education in improving patients' adherence to ACT. The objective of this study was to establish the impact of a community health education intervention on the patients' adherence to malaria ACT treatment in Kamuli District, Uganda.

Methods

A pre-post-test intervention study without a control group was used to understand the impact of community health education training in improving patients' adherence to ACT. Equal number of 1266 patients were enrolled and assigned into any of the three arms equally (422) – no follow up, follow-up on day 2 and day 4 arm at pre-test and post-test phases. Mann-Whiteny U test was used to establish the impact of the community health education on patients' adherence to ACT. Statistical significance was established at $p < 0.05$.

Results

A total of 1688 patients were analyzed. At pre-test, the median age was 20 years with majority (64.3%) being females while patients' adherence was reported to be 588/844 (69.7%). At post-test, the median age was 21 years, majority (62.6%) females, and patients' adherence 700/844 (82.9%). A Mann-Whitney test showed a statistically significant difference in the patients' adherence to ACT of pre-test and post-test after the intervention (U = 308904, Z = -6.409, $p < 0.0001$), with higher adherence at post-test (mean = 900.5) than pre-test (mean = 788.5) and small effect (0.156).

Conclusion

Community health education as an intervention was effective in improving patient's adherence to ACT in Kamuli Division, Uganda. Although this approach could contribute to the effort of national malaria control and elimination strategy in Uganda, there is need to continuously educate communities about adherence to medicines as prescribed by health care workers since health behavior change takes time.

Background

Malaria is predominantly a disease of the World Health Organization (WHO) African Region, with an estimated 233 million cases in 2022 – accounting for almost 94% of the global malaria burden [1]. However, the WHO African Region registered a decrease in the malaria deaths from 604,000 in 2020 to 580,000 in 2022. In 2015, at the inception of the Global Technical Strategy for malaria 2016–2030 (GTS), there were 231 million malaria cases versus the global 249 million cases in 2022 [1, 2]. The region registered most of the averted malaria cases (82%) and deaths (94%) of the global 2.1 billion cases and 11.7 million malaria deaths between 2000–2022 [1]. The mixed achievements registered during this period require all stakeholders to fight back this old enemy. Malaria remains the most prevalent parasitic endemic disease of public health importance in Africa and Uganda in particular, yet its preventable, treatable and curable [1, 3, 4]. At the heart of this model (prevention, treatment and cure), is health education through appropriate behavioral change communication (BCC) to ensure that individuals, families, society, and heath professionals understand this strand, and patients' adhere to professionals' advice in regards to appropriate taking of artemisinin-based combination therapy (ACT) is important [2, 4–7]. Several studies have explored the patient, health system, socio-cultural, socio-economic, and community-related factors that affect patients' adherence to ACT [8–15]. For the drugs to be effective, the patient must correctly take the ACT as recommended by the healthcare professional [16, 17]. A baseline study in the area showed that patients' adherence to ACT was just above average (69.7%) [15], showing urgent need to scale it up if the area will contribute to national and international efforts in malaria eradication.

In a systematic review of existing interventions (packaging aids, visual media, combined visual media and verbal information, community education, medication supervision, and convenient regimen) aimed at exploring their effectiveness, the intervention shown to improve patients adherence to malaria treatment, with community education and visual media/verbal information combinations proving more useful [18]. In a health education interventional study with control group by Kroeger et al. (1996), an improvement in correct use of chloroquine in the treatment of malaria (26% in Ecuador, 85% in Colombia) was recorded. There was great patient satisfaction with education intervention through high and continuous attendance of monthly workshops. Further, there was knowledge gain among the intervention arm than in the control group. However, this study was done during the era of the non-efficacious ACT regimen. In a Cambodian health education intervention study aimed at improving compliance with a 7-day quinine plus tetracycline prescription in management of malaria, compliance rates improved from 0.5–20% in a group where there was

use of posters and video and another group of posters alone, compliance improved from 6–11% [20]. Further, the intervention improved the health seeking behaviors of patients, but not all completed the full malaria prescriptions bought. A cohort study that nested within a cluster randomized trial with community health workers (CHW) managing children aged 5 years and below with antimalarials and antibiotics revealed that adherence was the same in the intervention arm to antimalarials alone and antimalarials plus antibiotics but higher than adherence in the control arm of antimalarials only [21]. Though the study was testing the aspect of adding CHW prescribing antibiotics in addition to the antimalarials under the integrated community case management of illnesses (ICCM), it brings to light the idea of need to adequately counsel patients/ caregivers to understand the dosing regimens, what to do when a child vomits and/or when the child improves before completing the treatment, to benefit from the efficacious ACT treatment.

In a Ugandan randomized controlled trial establishing the impact of packaging and messaging on adherence to malaria treatment, stickers with short, targeted messages on the packages increased adherence by 9% and reduced untaken pills by 29% [22]. The current practice of boosting adherence through pictorial instructions did not show any impact relative to the standard control package in the study. A systematic review and meta-analysis by Yakasai et al., (2015) highlighted the urgent need for education programmes to improve on the knowledge and counter the beliefs commonly held in society regarding the benefits, and demerits of non-adherence to ACT treatment, for it to have any public health benefits in the management of malaria [24]. There seem to be little evidence to-date to support that assertion. As a country, we seem to be losing the battle despite concerted global, regional, and national efforts instituted so far. At the same time, very few studies have evaluated the impact of community health education by delivering lectures and participatory methods for the prevention and enhancement of patients' adherence to prescribed ACT. So, the current study was undertaken to establish the impact of a community health education intervention on the patients' adherence to malaria ACT by using a pre-post-test intervention study in Kamuli District, Uganda.

Materials and Methods

Design

A pre-post-test intervention study without a control group using mixed approaches was used to understand the impact of the community health education training in improving patients' adherence to ACT. To establish the impact of such an intervention, participants were assessed prior to the intervention to determine the baseline knowledge, their adherence level and factors influencing their adherence to ACT before the training in a longitudinal study [15]. The Analysis, Design, Development and Implementation (ADDIE) model was adopted at the intervention phase. Then, a post-test longitudinal study to determine if the intervention improved community knowledge and adherence to malaria ACT treatment. Pre-test data was collected in March and April 2023, education intervention carried out in May 2023, and post-test data collected in February and March 2024.

Study area

The study was conducted in Kamuli District, Uganda. The district is rural and malaria transmission occurs throughout with a mean prevalence of 24.2% (Fig. 1) climaxing after March/April and August/November rains. The study focused on public health facilities as they manage more patients compared to private facilities [25, 26], and from health facility level III and above in line with the national implementation of the test and treat policy [27]. The district is served by one public hospital, two Health Centre (HC) IV's, and 12 HC III's. The community education trainings were based at all public health facilities lasting two days at each facility, and one day at 27 parishes within the community.

Sample

Study population and eligibility criteria

The study population were patients diagnosed at outpatient departments (OPD) at public healthcare facilities. The eligibility criteria at pre-test and post-test did not change and these have been reported elsewhere [15]. Facility administrators were also enrolled as key informants.

Sample size

The study was powered to determine the impact of the community education training on patients' adherence to malaria ACT in Kamuli District, Uganda. The study enrolled a total of 2,532 participants with equal numbers (1,266) each time. The quantitative sample size was calculated based on the formula $n = Z^2 * P(1-P)/e^2$ [28], assuming a 95% CI, allowable error of 5% and a 46.5% patients' adherence level to ACT [9]. The final sample size was calculated as follows: $n = (1.96^2 * 0.465 * 0.535)/0.05^2$, n = 383. We also considered a loss to follow up of 10% and design effect of three arms (n = 10% * 383 * 3, n = 1266 participants). However, at all times, the no follow-up arm was not studied as it masked the intention to follow-up, and these were removed from the final analysis and hence the final minimum sample size analyzed was N = 1,688.

Thirty key informants were enrolled into the study based on the concept of information power [29].

Sampling and data collection procedures

The pre-test and post-test procedures were same, and these have been detailed somewhere else [15]. The key informants were purposely and appointments scheduled to enroll them into the study.

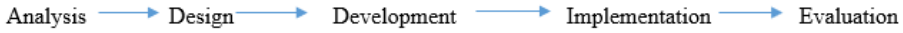
Data collection strategy

Stage I: Baseline stage

At the baseline stage, a longitudinal study was done to understand the level of patients' adherence to ACT treatment and the influencing factors. This relied on ex-post facto information. Baseline data was collected in the months of March and April 2023. This helped in the designing, tailoring and refining of the community health education intervention.

Stage II: Health Education Intervention programme

Education interventions are useful in improving patients' knowledge, and subsequently their adherence to ACT treatment. If one is properly educated on proper use of ACT treatment, common misconceptions may be dispelled, and behavior may subsequently be improved. The "ADDIE" instructional model [30], was adopted, and it has five steps:



The model is based on analysis of patients' needs, design of appropriate training intervention, development of materials for instruction, conduct of the training, and evaluation of the patients' progress.

Before the start of the implementation of the intervention, baseline data was collected, synthesized and interpreted [15], to aid development of the community health education intervention. The developed training tool was revised rigorously under the guidance of the supervisors and pre-tested to ensure its suitability. The training tools were continuously revised during the project. The education training tool was based on the following national manuals [4, 31, 32], and international standards [3, 6, 18, 33–37]. The malaria education manual consisted of four modules; (1) Uganda national malaria policy (policy goal, objectives and elements), (2) parasitology and entomology (causes, transmission, distribution, life cycle, vector habitation, and malaria prevention and control), (3) clinical features (clinical features of malaria, common signs and symptoms of uncomplicated and complicated malaria, and (4) malaria management [treatment using ACT - important instructions to follow when taking ACT, what to do if you take more medicines than you should and what to do if you forget to take the medicine, things you need to know before use of ACT, possible side effects of ACT, medicine storage, myths about malaria, advantages of completing treatment and disadvantages of non-completion, things to do and never to do at home and role of healthcare workers (HCW)]. The tool was revised rigorously under the guidance of supervisors and practicing professionals before its final adoption. The community education intervention was conducted for one month (May 2023). There was a time lag of nine months before post-test data was collected to ensure that what was taught in the intervention was not forgotten by the community members, community members are practicing what they had learnt, and diffusion of the innovation had taken place [19, 38]. This enabled in the assessment of the impact of the education intervention in this study.

The trainings were conducted through the following channels; (1) at the outpatient departments of the 42 public health facilities within Kamuli district for two days targeting patients seeking services at these facilities on pre-announced days – lasting 30 minutes (15–20 minutes for presentation and 10–15 minutes for question and answer sessions, (2) 27 parish community trainings each training lasting 1 hour (40 presentation and 20 minutes question and answer session) on pre-communicated days using the village health teams (VHT) model [18, 19, 39], and (3) facility-based training/mentorship of HCW at the 42 public health facilities lasting one hour (45 training and 15 minutes question and answer) (Additional file 1). The customized guide was shared with the participants during such engagements for continual referral after training. The community education trainings were done in the month of May 2023. The training method was both didactic and participatory. The training targeted the community members specifically, with HCW trained to aid sustainability of trainings at health facilities and within the community during facility outreach campaigns. A brief assessment before and after each training of the participants was performed to assess change in their knowledge. Furthermore, use of visuals on the blister packs and displayed posters was done. This helped in assessing the knowledge level of the participants and immediate contribution of the training to the participants.

There was a mid-term assessment after six months (December 2023) of patients' adherence to ACT before the final evaluation in February and March 2024. This aimed at keeping a watch on the community but also ensure that information diffusion is taking place as planned.

Stage III: Post-test phase

At the post-test phase (February and March, 2024) following the educational intervention, an evaluation of the intervention was done to measure the change in the knowledge and adherence behavior of the patients to ACT in the management of malaria. The participants were not matched to those in the baseline phase thus unpaired. The resultant change in knowledge and practice was attributed impact of the education intervention in the study.

Ethical considerations

The study was approved by the Maseno University Scientific and Ethics Review Committee (MUSERC/01122/22), the Mengo Hospital Research Ethics Committee (MH/REC/144/10-2022) and the Uganda National Council for Science and Technology (HS2576ES). The study objectives,

benefits, potential risks, and procedures were explained to the participants and parents/guardians of the potential study children at each time. Children were only included in the study if their parents or guardians provided written informed consent. If the participant, parent, or guardian could not read or write, a witness chosen by the participant/parent/ guardian co-signed the consent/ assent form.

Data management and analysis

Data capture screens were designed in Epi-data version 3.1 with inbuilt checks and double entry command to minimize data entry errors. Data were entered and secured on a protected computer. Data were transferred from Epi-data to IBM SPSS version 20 software for statistical analyses. Exploratory analyses were done to check for cleanliness and any outliers or erroneous looking data were cross-checked and cleaned where errors were identified. Further analysis was done on tablet count response as a measure of patients' adherence to ACT prescriptions. Mann-Whitney test was run to compare pre- and post- intervention adherence levels to measure the impact of the education intervention, and effect size of the intervention computed. Statistical significance was established at $p < 0.05$.

Results

Baseline characteristics of study participants and health facilities

A total of 2532 study participants were enrolled with equal numbers at pre-test and post-test times. At each time, 422 participants in no follow-up arm were not followed up and the remaining 844 participants followed up (equal numbers of 422 followed up on days 2 and 4). A total of 400 participants were followed up at Kamuli Hospital, 328 participants at Namwendwa HC IV, and 160 participants at each of six remaining HC IIIs. At each of the facilities, half of the participants were followed up on either day 2 or day 4. At pre-test phase, majority 543 (64.3%) of participants were females. The median age of all patients was 20 (IQR 9.25, 32) years, with an overall enrollment of 481 (57%) aged above 18 years. At post-test phase, majority of 528 (62.6%) of participants were females. The median age of all patients was 21 (IQR 10, 31) years, with an overall enrollment of 481 (58.1%) aged above 18 years. At both times, majority of the participants were not married [pre-test = 517 (61.3%); post-test = 503 (59.6%)], and this was consistent across all facilities except at Nabirumba HC III and Bupadhengo HC III where only 40 (50%) and 39 (48.8%) respectively were not in a relationship. The overall mean size of the households was at pre-test 6.09 (minimum = 1, maximum = 16) members and post-test 6.01 (minimum = 1, maximum = 17) members, with highest mean size (mean = 8.04, minimum = 2, maximum = 13) at Balawoli HC III at pre-test phase and highest mean size (mean = 7.85, minimum = 2, maximum = 13) at Bugulumbya HC III during post-test phase. Overall, at pre-test phase the majority, 666 (79%) of households were led by fathers, and least 19 (2.3%) by siblings, and similarly, at post-test phase the majority 686 (81.4%) of households were led by fathers and least 17 (2%) by siblings. Further, at pre-test phase, the majority of 261 (30.9%) participants were daughters followed by 218 (25.8%) partners, and least 4 (0.5%) grandparents by relationship to household head. Similarly, at post-test phase, the majority 252 (29.9%) participants were daughters followed by 201 (23.8%) partners, and least 11 (1.3%) grandparents by relationship to household head. By homestead with telephone contact, the majority at pre-test phase 683 (80.9%) and post-test phase 702 (83.2%) of households had a mobile telephone set (Table 1).

Table 1
Showing pre-post-test background information of study participants

Time/ 0, 1	Variable	All	Kamuli Hospital	Namwendwa HC IV	Balawoli HC III	Nabirumba HC III	Kitayunjwa HC III	Bupadhengo HC III	Bugulumbya HC III	Busota HC III
	Patient characteristics									
0	Day 2 number	422	100	82	40	40	40	40	40	40
1		422	100	82	40	40	40	40	40	40
0	Day 4 number	422	100	82	40	40	40	40	40	40
1		422	100	82	40	40	40	40	40	40
0	Females, n (%)	543 (64.3)	128 (15.2)	91 (10.8)	55 (6.5)	60 (7.1)	47 (5.6)	45 (5.3)	63 (7.5)	54 (6.4)
1		528 (62.6)	122 (14.5)	107 (12.7)	54 (6.4)	42 (5.0)	49 (5.8)	55 (6.5)	54 (6.4)	45 (5.3)
0	Age in years, median (IQR)	20 (9.25, 32.0)	23 (19.0, 39.0)	17.5 (4, 35)	27 (18, 51)	21.5 (11, 28)	9 (4, 18.75)	15.5 (5.25, 23)	14 (6, 21)	23.5 (15, 42)
1		21 (10, 31)	18 (7, 27)	22 (18, 33.75)	20.5 (15.5, 30)	19 (3, 30)	19 (5, 30.75)	26 (17.25, 40)	27.5 (18, 48.75)	16.5 (6, 26)
Age category in years										
0	0–18, n (%)	363 (43)	42 (21)	84 (51.2)	23 (28.7)	31 (38.8)	60 (75)	49 (61.3)	51 (63.7	23 (28.7)
	19 and above, n (%)	481 (57)	158 (79)	80 (48.8)	57 (71.3)	49 (61.2)	20 (25)	31 (38.7)	29 (36.2)	57 (71.3)
1	0–18, n (%)	354 (41.9)	101 (50.5)	51 (31.1)	31 (40)	40 (50)	40 (50)	22 (27.5)	22 (27.5)	46 (57.5)
	19 and above, n (%)	490 (58.1)	99 (49.5)	113 (68.9)	48 (60)	40 (50)	40 (50)	58 (72.5)	58 (72.5)	34 (42.5)
Marital status										
0	Married, n (%)	327 (38.7)	78 (39)	74 (45.1)	38 (47.5)	40 (50)	20 (25)	15 (18.8)	23 (28.7)	39 (48.8)
	Not married, n (%)	517 (61.3)	122 (61)	90 (54.9)	42 (52.5)	40 (50)	60 (75)	65 (81.2)	57 (71.2)	41 (51.2)
1	Married, n (%)	341 (40.4)	71 (35.5)	70 (42.7)	28 (35)	36 (45)	36 (45)	41 (51.2)	38 (47.5)	21 (26.2)
	Not married, n (%)	503 (59.6)	129 (64.5)	94 (57.3)	52 (65)	44 (55)	44 (55)	39 (48.8)	42 (52.5)	59 (73.8)
Household size										
0	Mean (min, max)	6.09 (1, 16)	4.69 (1, 10)	7.29 (3, 15)	8.04 (2, 13)	6.01 (1, 13)	6.74 (2, 16)	5.49 (1, 8)	5.64 (2, 16)	5.69 (1, 15)
1		6.01 (1, 17)	5.55 (1, 16)	5.21 (1, 16)	4.96 (1, 9)	7.3 (3, 15)	7.15 (2, 17)	6.03 (1, 15)	7.85 (2, 13)	5.54 (1, 9)
Household head										
0	Father, n (%)	666 (79)	139 (69.5)	161 (98.2)	58 (72.5)	68 (85)	68 (85)	52 (77.5)	57 (72.2)	53 (66.2)
	Mother, n (%)	100 (11.9	39 (19.5)	0 (0)	8 (10)	3 (3.8)	4 (5)	16 (20)	14 (17.7)	16 (20)
	Sibling, n (%)	19 (2.3)	10 (5)	3 (1.8)	0 (0)	1 (1.2)	0 (0)	2 (2.5)	2 (2.5)	1 (1.2)

Time: 0 – Pre-test phase, 1 – Post-test phase, n – Frequency, % - Percentage, IQR – Interquartile range, HC – Health Centre

Time/ 0, 1	Variable	All	Kamuli Hospital	Namwendwa HC IV	Balawoli HC III	Nabirumba HC III	Kitayunjwa HC III	Bupadhengo HC III	Bugulumbya HC III	Busota HC III
	Patient characteristics									
	Grandparent, n (%)	58 (6.9)	12 (6)	0 (0)	14 (17.5)	8 (10)	8 (10)	0 (0)	6 (7.6)	10 (12.5)
1	Father, n (%)	686 (81.4)	175 (87.5)	119 (73)	60 (75)	79 (98.8)	70 (87.5)	59 (73.8)	61 (76.2)	63 (78.8)
	Mother, n (%)	100 (11.9)	12 (6)	32 (19.6)	14 (17.5)	0 (0)	5 (6.2)	14 (17.5)	8 (10)	15 (18.8)
	Sibling, n (%)	17 (2)	5 (2.5)	5 (3.1)	3 (3.8)	1 (1.2)	0 (0)	2 (2.5)	0 (0)	1 (1.2)
	Grandparent, n (%)	40 (4.7)	8 (4)	7 (4.3)	3 (3.8)	0 (0)	5 (6.2)	5 (6.2)	11 (13.8)	1 (1.2)
Relationship to household head										
0	Son, n (%)	166 (19.7)	32 (16)	47 (28.7)	10 (12.5)	12 (15)	21 (26.2)	26 (32.5)	11 (13.8)	7 (8.8)
	Daughter, n (%)	261 (30.9)	62 (31)	49 (29.9)	15 (18.8)	25 (31.2)	33 (41.2)	32 (40)	34 (42.5)	11 (13.8)
	Sibling, n (%)	17 (2)	8 (4)	1 (0.6)	0 (0)	1 (1.2)	0 (0)	2 (2.5)	2 (2.5)	3 (3.8)
	Grandchild, n (%)	39 (4.6)	8 (4)	0 (0)	4 (5.0)	4 (5)	8 (10)	0 (0)	6 (7.5)	9 (11.2)
	Grandparent, n (%)	4 (0.5)	4 (2)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
	Self, n (%)	139 (16.5)	38 (19)	22 (13.4)	25 (31.2)	10 (12.5)	5 (6.2)	11 (13.8)	4 (5)	24 (30)
	Partner, n (%)	218 (25.8)	48 (24)	45 (27.4)	26 (32.5)	28 (35)	13 (16.2)	9 (11.2)	23 (28.7)	26 (32.5)
1	Son, n (%)	163 (19.3)	41 (20.5)	25 (15.2)	16 (20)	23 (28.7)	18 (22.5)	6 (7.5)	10 (12.5)	24 (30)
	Daughter, n (%)	252 (29.9)	87 (43.5)	41 (25)	29 (36.2)	19 (23.8)	15 (18.8)	16 (20)	16 (20)	29 (36.2)
	Sibling, n (%)	26 (3.1)	5 (2.5)	4 (2.4)	2 (2.5)	3 (3.8)	8 (10)	2 (2.5)	0 (0)	2 (2.5)
	Grandchild, n (%)	40 (4.7)	9 (4.5)	8 (4.9)	5 (6.2)	2 (2.5)	4 (5)	7 (8.8)	4 (5)	1 (1.2)
	Grandparent, n (%)	11 (1.3)	3 (1.5)	5 (3)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	3 (3.8)
	Self, n (%)	151 (17.9)	12 (6)	35 (21.3)	12 (15)	13 (16.2)	16 (20)	23 (28.7)	29 (36.2)	11 (13.8)
	Partner, n (%)	201 (23.8)	43 (21.5)	46 (28)	16 (20)	20 (25)	19 (23.8)	26 (32.5)	21 (26.2)	10 (12.5)
	Homestead with telephone contact									
0	Yes, n (%)	683 (80.9)	184 (92)	164 (100)	75 (93.8)	42 (52.5)	33 (41.2)	51 (63.7)	59 (73.8)	75 (93.8)
1		702 (83.2)	183 (91.5)	161 (98.2)	76 (95)	51 (63.7)	53 (66.2)	48 (60)	56 (70)	74 (92.5)

Time: 0 – Pre-test phase, 1 – Post-test phase, n – Frequency, % - Percentage, IQR – Interquartile range, HC – Health Centre

Level of patients' adherence to ACT

At pre-test phase, the overall patients' adherence to ACT treatment by recall of tablets remaining in the blister pack was 587/ 843 (69.6%) and 588/844 (69.7%) by tablet counting. Majority 663/ 758 (87.5%) of respondents by recall had adhered to ACT treatment in their previous malaria episode. Whereas, at post-test phase, the overall patients' adherence to ACT treatment by recall of tablets remaining in the blister packs was 703/ 844 (83.3%) and 700/ 844 (82.9%) by tablet counting. Most 684/ 759 (90.1%) of respondents by recall had adhered to ACT treatment in the previous episode. Further data analysis in this study was based on tablet counting particularly with dosing and timing (Table 2).

Table 2
Level of Patients' adherence to ACT treatment

Variable	Pre- test Phase		Post-test phase	
	Adherence status		Adherence status	
	Adhered, n (%)	Did not adhere, n (%)	Adhered, n (%)	Did not adhere, n (%)
Overall				
Recall	587 (69.6)	256 (30.4)	703 (83.3)	141 (16.7)
Tablet count	588 (69.7)	256 (30.3)	700 (82.9)	144 (17.1)
Previous adherence to treatment in the last malaria episode				
Recall	663 (87.5)	95 (12.5)	684 (90.1)	75 (9.9)
Table legend: n – number, % - percentage				

Qualitatively, *availability of medicines and other supplies (ACT) in particular remains a big bottleneck affecting patients' adherence to treatment. As you may be aware, most of our clients cannot afford buying medicines from private and whenever they come here and find no drugs, they may end up buying a few drugs or resort to use of herbal medicine* (key informant – facility in-charge). *There are times when we go to facilities and we find no drugs, so in most cases, I use local herbs to manage the disease as drugs are expensive* (key informant-patient). Another patient noted that *health workers do not explain to them clearly how to use the different medicines properly. They only put drugs in the book, call your name and tell you that where there is a star – those are not available. No clear instructions are given especially at busy facilities and on busy days. The healthcare workers are rude too* (key informant – patient).

Impact of health education intervention on patients' adherence to ACT

Mann-Whitney U test revealed a statistically significant difference in the patients' adherence to prescribed ACT of pre-test and post-test after the education intervention (U = 308904.0, Z = -6.409, p < 0.0001), with higher adherence at post-test phase (mean rank = 900.50) than in the pre-test phase (mean rank = 788.5), and a small effect size (r) = 0.156 (Table 3).

Table 3
showing impact of health education intervention on patients' adherence to ACT prescription

Variable	Ranks				Test statistics				
	Time – Pre- post-test	N	Mean Rank	Sum of Ranks	Mann-Whitney U	Wilcoxon W	Z	Sig	r
Adherence level	Pre-test	844	788.50	665494.00	308904.0	665494.0	-6.409	0.000	0.156
	Post-test	844	900.50	760022.00					
Legend: N = sample size, sig – P-value, r = effect size, scale of effect size: 0.1 = small effect, 0.3 = medium effect, 0.5 = large effect.									

Qualitatively, most facility in charges seem to agree that *public health talks can improve the adherence of patients to medicines including ACT. However, health workers seem not to want to give talks as they say they are busy with routine works* (key informants). *The district has employed education assistants to educate the community about several diseases, proper use of medicines among other things in the district* (key informant). To enhance the patients' adherence to ACT, several informants recommend that: *(1) Government to make ACTs and other medicines readily available at public facilities, (2) health workers to rationally use the drugs, (3) health workers to continually educate their clients and explain how to use the medicines appropriately, (4) health workers to improve customer care, and (5) health workers to be present at facilities all the time to attend to patients* (key informants).

Discussion

The study determined the impact of the health education intervention on patients' adherence to malaria ACT. At pre-test phase, patients' adherence to ACT was 69.7% similar to a Kenyan study [40]. At post-test phase, adherence was 82.9% in line with other studies scoring high patients' adherence levels to prescribed antimalarials [21, 41–43]. The current findings are contrary to studies reporting patients' adherence less than 50% [9, 44–46]. The difference in adherence levels in the current study has been assigned to variations in methodologies, and other studies being done at a time before the introduction of the efficacious ACT [46, 47], as noted in our earlier longitudinal study [15]. According to the key informants, non-adherence to ACT was attributed to factors like failure for patients to buy drugs whenever there is stock out at public facilities, use of herbal drugs in times of scarcity of ACTs at facilities, healthcare workers not explaining the proper use of drugs to clients, and lack of customer care among service providers. The above factors have been noted in other studies [15, 48, 49]. The availability of medicines, continuous community education and ensuring that service providers are professional may greatly improve patients' adherence to ACT. The study showed a statistically significant difference in the patients' adherence to ACT, with higher adherence at post-test (mean rank = 900.5) than in the pre-test phase (mean rank = 788.5),

with small effect size (r = 0.156). As shown, the intervention improved the patients' adherence to malaria ACT [19, 21, 22, 50, 51]. The study demonstrates that irrespective of the era and drug formulation, public health education remains a powerful tool in improving the knowledge and adherence of patients to health advise and medication. The small effect size could be a result of enrolling different participants at pre-test and post-test phases. The current study also demonstrates the diffusion of health information within the community [52]. To avert and reduce the gravity of the current situation and to reap the full benefits of proper adherence, patients' education on proper usage of ACT in-terms of dosage and timing, its health benefits and related adverse events should aggressively be conducted by professionals at all levels [23, 24, 53], and this could improve their overall adherence to prescription and health guidelines.

Limitations

The study findings could be limited due to lack of a control group. However, the use of pre-post intervention study design and Mann-Whitney U test statistic in the analysis controlled for any bias. The other limitations at longitudinal phases have been discussed elsewhere[15].

Conclusion

The study established above average (69.7%) and very good (82.9%) patients adherence levels to ACT at pre-test and post-test phases respectively. The education intervention impacted positively the patients' adherence to ACT with a small effect in this community. Despite a number of other factors influencing patients' adherence to ACT such as stock out of drugs as noted in our earlier study, there is need to continuously educate the community about adherence to medicines as prescribed and tighten government medicine supply.

Declarations

Acknowledgements

The authors would like to acknowledge the School of Public Health and Community Development of Maseno University, Kenya, staffs of Kamuli General Hospital Laboratory, study participants, and research assistants. Special thanks to Lydia Mukisa, Dr. Judith P. Alexander-Squires, Stephen Odeke Abunyanga, Dr. Louis Elizabeth, Dr. Sylvia T. Callender-Carter, and Agnes Melisa Bawate.

Authors' contributions

CB conceived the study, took lead in data collection, analysis and drafted the initial draft of this manuscript. BG, STCC, and CO provided guidance on the overall design of the study. BG and CO revised the manuscript. All authors read and approved the final manuscript.

Funding

Not applicable.

Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author on a reasonable request.

Ethics approval and consent to participate

The study was approved by the Maseno University Scientific and Ethics Review Committee (MUSERC/01122/22), the Mengo Hospital Research Ethics Committee (MH/REC/144/10-2022) and the Uganda National Council for Science and Technology (HS2576ES). Written informed consent was obtained from study participants and in case of minors, informed assent was obtained from the parent/guardian before any study-specific procedures were done. written informed consent was also sought from all key informants who participated in the study.

Consent for publication

"Not applicable" in this section.

Competing interests

The authors declare that they have no competing interests.

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Figures

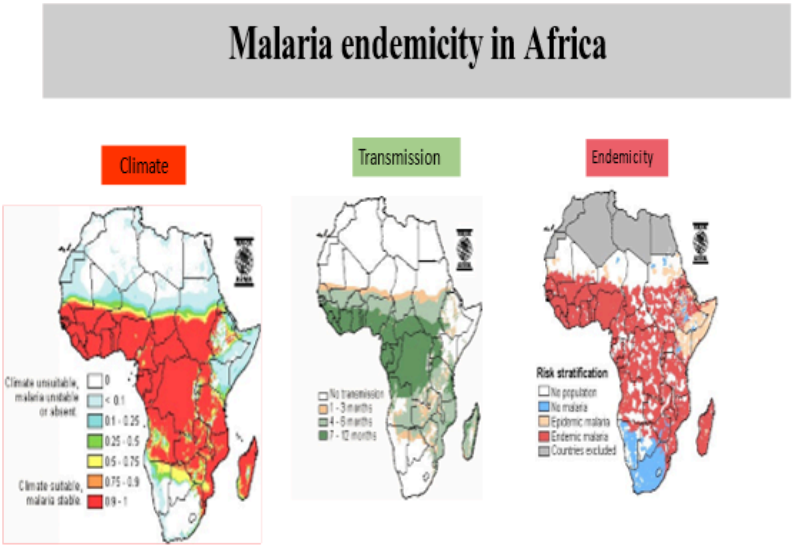

Figure 1

Legend not included with this version

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