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The Interventional Capacity of Community Health Volunteers for Screening and Linkages of Non-Communicable Diseases in Nyeri County, Kenya

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Abstract

Non-communicable diseases (NCDs) account for 63% of mortalities. Approximately 80% of these NCD-related deaths occur in LMICs. A quasi-experimental study utilizing a non-equivalent pre-and post-test was conducted from May 2022 to March 2023 with 370 study participants. Multistage cluster and random sampling were used to select ten community units, and therefore, 150 CHVs were chosen for the control unit, and 150 were used to form the interventional group. Data was collected from the KOBO app. Six (6) homogenous FGDs comprised ten members, and 10 KII were conducted across study sites. Quantitative data was analyzed using SPSS version 28.0, and qualitative data was audio-recorded, transcribed, and analyzed via N-Vivo 12. The study shows that 59.3% of respondents have minimal information, and 92.7% (n = 139) have no clear understanding of NCDs, with a pre-intervention capacity of 48.8%. Independent sample t-test showed a significant difference in capacity from a pre-intervention average of 48.75 (SD ± 5.7)%, which increased to 68.28 (SD ± 7.6)%, p < 0.001. A well-designed community interventional model plays a pivotal role in grassroots healthcare delivery but requires optimization for NCD management.

Keywords

1. Introduction

This article underscores the transformative role of CHVs in the screening and

linkages of NCDs in Nyeri County, Kenya. It emphasizes the interventional approaches that an interventional group initiated. Community health volunteers (CHV) are crucial and the lifeline extending care and support to the communities, particularly underserved populations. Their dedication and service in settings attributed to health workforce shortages and resource challenges [1] are commendable. In Sub-Saharan Africa and most low-income nations, the contribution of community health volunteers has resulted in several health indicator gains in children's health, maternal, reproductive Health, malaria and HIV/AIDS [2]. The efforts towards achieving universal health coverage, as well as the sustainable development goals agenda, put much emphasis on the countries investing in their community health workforce to support the delivery of primary healthcare interventions.

Integrating community health volunteers (CHVs) into formal healthcare systems has gained significant attention in global health initiatives due to its potential to extend health services to underserved and hard-to-reach populations. Several global health organizations and initiatives underscore the importance of formally integrating CHVs into the healthcare system, aiming to enhance health service delivery's reach and effectiveness. The WHO has been instrumental in promoting the integration of community health workers, including CHVs, into national health systems. It has developed guidelines and provided technical support to governments to facilitate the scaling up of CHW programs, recognizing their critical role in achieving universal health coverage (UHC).

The rationale for integrating CHV Programs into formal healthcare structures was typically anchored on the orientation of CHVs in a community; CHVs are community-owned persons or members who reside in the areas they serve, making them uniquely positioned to extend health services to remote, rural, or underserved urban areas where professional health services are scarce. Integration has ensured better coordination between primary health care and community-based activities. This has led to improved monitoring, early detection, and management of diseases, enhancing Public Health Surveillance and Response, which can significantly improve health outcomes.

By integrating CHVs into formal healthcare structures, global health initiatives aim to create resilient, responsive, and comprehensive health systems that serve all population segments better. This approach enhances the scope and quality of healthcare delivery. It contributes significantly to the call to action agenda, which has witnessed African governments commit to addressing human resources for health challenges supported by global initiatives such as the One Million Community workforce campaign.

In the past, community health volunteers have been part of primary healthcare systems, embedded within communities yet outside of, but aligned to professional health service structures. Therefore, the current global agenda is to integrate community health volunteers programs into formal structures of national health services [3]. There is a worldwide consensus on the significance of community-based health workers and on consolidating the contribution of

community-led health initiatives. However, there is general acknowledgement that the roles and categories of these health care providers are often blurred in terms of engagement, e.g. are they paid? Contracted? Permanent or casual workers? Have they undergone accredited training? In addition, what recruitment mechanisms are used, including whether or not they seek to be residents of the communities they serve [4].

According to Oleribe *et al.* [5], high healthcare costs, lack of adequate infrastructure and health worker shortages all decrease the capability of low and middle-income nations to deliver primary healthcare services to their populations. Sub-Saharan Africa has about 3% of the global health workforce, and an estimated 1.5 million more health workers are needed to provide essential health services in the region [6]. Mainly in response to these health worker shortages, the WHO launched the "treat, train, retain" initiative to strengthen and enhance the global health workforce. This involved the development of more formal cadres of community health workers defined as members who are selected by and answerable to the communities where they work, supported by the health system, and receive less training than formally trained health workers.

Generally, CHVs deliver low-cost primary healthcare services to the communities they serve. They are well situated to bridge the gap between communities and the healthcare system and facilitate engagement and overall continuity of care. Community health volunteers range from large-scale national programs to smaller community-led initiatives and have improved access and coverage of health services in rural and remote areas in lower-middle-income countries [7]. While communicable diseases such as HIV/AIDS and Tuberculosis continue to exert a heavy toll in lower-middle-income countries, NCDs are also on the rise, with an estimated 639-million hypertensive individuals living in developing countries [8]. In Kenya, NCDs increasingly account for a higher proportion of national morbidity and mortality, and numerous individuals are now living with more than one chronic condition. For instance, while individuals living with HIV represent about 7.1% of the Kenyan population, HIV/TB co-infection is also estimated to affect 48% of all new TB patients and hypertension among people living with HIV is estimated at 11.2% and 7.4% for men and women respectively [7].

Community health volunteers (CHVs) in Kenya have the potential to improve access to primary healthcare and enhance outcomes, mostly where services are not readily available. This is evidenced by the use of CHVs in HIV programming, which has provided a full continuum of care at three levels: household, community, and facility levels. Thus, by adopting the F3C AMREF model, CHVs were adopted to deliver non-communicable disease services in Nyeri County, which focused on household or community and linkage processes.

At the household and community level, community health volunteers (CHVs) were trained to carry out education, awareness on risk factors, lifestyle modification, and screening for chronic diseases and those who tested positive like raised blood pressure and blood glucose, were referred to the nearest health care facility

for further care and treatment and later back to the community treated and well equipped with knowledge on NCDs hospital and self-care and for further follow-up by CHVs. To ensure that CHVs are effective in screening and linkages of NCDs in the county, there is a need to enhance the existing model by improving and introducing simple, tailor-made NCDs (Hypertension and Diabetes Mellitus) training modules for CHVs. The proposed model focused on skills training and capacity enhancement in terms of a didactic and practical approach that covered NCD causes, Risk factors, signs and symptoms, Investigations or diagnosis, prevention and control, and emergency care for NCD complications leading to the acronym "CRISPS model" [9].

2. Study Justification

Community health volunteers (CHVs) are critical in extending health services to underserved populations. However, the existing frameworks for their deployment often face several challenges and gaps that can hinder their effectiveness. Addressing these gaps through thoughtful interventions not only boosts the performance of CHVs but also enriches the literature on their impact on public health systems. There are gaps or challenges within existing CHV Frameworks that affect their effectiveness; these include inadequate training and support where CHVs often receive minimal training that is not comprehensive enough to cover all aspects of their responsibilities, especially in complex health interventions or in handling non-communicable diseases. There is also a lack of formal recognition and integration in health care systems and structures, significantly affecting their motivation and limiting their professional growth and access to resources.

In low and middle-class countries, *i.e.*, Kenya, there are insufficient incentives and remuneration to support voluntary or low-paid positions like CHVs [10]. This has led to high turnover rates among CHVs, undermining the continuity of care and establishing trust within communities. This, coupled with limited resources and tools, limits CHVs' ability to perform their duties effectively. Therefore, considering the many gaps and challenges experienced by CHVs, there should be enhanced training programs that include developing and implementing comprehensive training modules that are periodically updated to reflect changing health priorities and new health information. These programs should also be designed to enhance the skills of CHVs in areas such as data collection, patient counselling and management of a broader range of health conditions.

There is also a need for formal recognition and career development that formally accredited the system for CHV training and recognition that clears the career pathways, potentially leading to better job satisfaction and lower turnover [11]. This system will also facilitate better integration into the national health workforce. In addition, a structured incentive and remuneration that offers clear guidelines for remuneration and other incentives aligned with local economic

conditions and workload can help maintain motivation and commitment among CHVs. To achieve great strides in CHV screening and linkages, essential tools and resources are needed to ensure that CHVs have access to necessary medical and data recording tools to improve their efficiency and effectiveness. Mobile health technologies could be particularly impactful in this area [12].

This study has, therefore, contributed to a base of concrete literature implementing and evaluating these interventions, which will substantially contribute to the literature on CHV effectiveness by providing evidence-based insights into how specific changes in their framework can lead to improved health outcomes. Furthermore, publishing results from these interventions will guide policymakers in refining CHV programs globally, ensuring that these community-based health workers can perform optimally and are recognised as a vital part of the healthcare system.

3. Study Design

This quasi-experimental study design utilised a non-equivalent pretest post-test method to evaluate the Interventional capacity of community health volunteers in screening and linkages of NCDs in Nyeri County. A quasi-experimental design was used because a randomised controlled trial was not feasible due to practical and logistical constraints. This study was carried out between May 2022 to March 2023. 150 community health volunteers were selected randomly to join the interventional group, and another 150 community health volunteers were randomly selected to join the control group based on specific inclusion criteria relating to the intervention objection, ease of access and willingness to participate.

A Multi-stage cluster sampling method was used to select community units as the primary sampling unit, and later, the CHVs were chosen as secondary sampling units from the primary sampling unit. Data was collected through pretest and post-test evaluations among the CHVs aged 18 years and older. The initial pretest was carried out before the Intervention was rolled out and after the training. Apost-test evaluation was done after a month of the field follow-up for skills acquisition and return demonstration to the interventional group; data was further collected using self-administered questionnaires and the majority through the help of a research assistant in the research app KOBO tool. Both pretest, post-test and data collection modalities employed similar methodologies to ensure consistency in data collection procedures.

4. Study Setting

The study was conducted in community units within Nyeri County. The county in the central region of Kenya presents a unique healthcare landscape characterized by a mix of urban and rural populations, typical of many counties transitioning through rapid urbanization and demographic changes. Like other regions in Kenya, Nyeri faces numerous health challenges, particularly concerning

the rise in non-communicable diseases (NCDs), the availability of healthcare infrastructure, and the implementation community health volunteer (CHV) initiatives.

Non-communicable disease (NCD) prevalence. Non-communicable diseases, such as cardiovascular diseases, diabetes, cancer, and chronic respiratory diseases, have been on the rise in Nyeri County, mirroring global and national trends. Recent statistics indicate that cardiovascular diseases remain a leading cause of morbidity and mortality, exacerbated by lifestyle factors such as dietary habits, physical inactivity, and tobacco use [13]. Hypertension and diabetes mellitus are notably prevalent, affecting a significant portion of the adult population.

Therefore, Ten (10) community units were selected randomly and allocated to intervention and control sites. These included Gatitu, Kamoko, Kinunga, Nyeri town, and Unjiru health centresformed Interventional groups and Gichira, Kiganjo, Mweiga, Ihururu, and Wamagana for control groups. Homogenous CHVs in these community units were alphabetically selected to produce a sample representing the whole population.

5. Study Participants

Community health volunteers in the intervention group were recruited from the selected community units. Participants underwent random assignment to the intervention group, and their informed consent was meticulously obtained, prioritizing ethical considerations throughout the study. The control group comprised community health volunteers with attributes similar to those of the CHVs in the interventional group and were randomly selected from community units. These participants enrolled on a pretest; later, the interventional group was extensively trained on NCDs, and later, a post-test was carried out among the intervention group.

6. Selection Criteria

The study participants were selected from a pool of CHVs aged 18 years and above who reside and are volunteers under the Community health strategy in Nyeri County who could consent to the study. However, CHVs who did not consent to the study were excluded.

6.1. Current CHV Model

This CHV model was adopted from the AMREF facility-community chronic care (F3C), which is an HIV programming model but has been adapted for use in delivering non-communicable diseases (NCDs) screening and linkage services [14]. The model's continuum of care comprises three levels: household and community, facility level, and linkages. At the household and community level, CHVs are trained to carry out education, awareness on risk factors, lifestyle modification, and screening for chronic diseases, and those who test positive for raised blood pressure and blood glucose are referred to the nearest health care

facility for further care and treatment.

At the linkage level, clients for chronic disease care identified at the community level were promptly paired with health centres that manage NCDs and act as referral units for CHVs. Once the clients receive care, they are empowered with knowledge of the disease and self-management and later linked back to the community through support groups and treatment. This model was introduced in Nyeri County and was purely adopted to prevent and promote healthy living, especially in children under five years and TB patients. Subsequently, during the outbreak of COVID-19, CHVs were deployed to carry out public health education and follow-up to ensure adherence to WHO protocols in the community units.

6.2. The Interventional Model

In Nyeri County, the use and reliability of CHV were remarkably noted in the control of COVID-19. The success of COVID-19 control and prevention was attributable to the use of CHVs, especially in how they carry out health education and promote healthy living. Later, due to the rising number of NCDs in the county, CHVs' scope of work was drastically shifted to screening and linkages of NCDs in their respective community units. Despite the use of CHVs, the number of NCDs and their related complications continued to rise in the county. This led to several questions regarding CHV capacity towards NCDs (Hypertension, diabetes, and cancers) screening and linkages and especially the use and results in interpretation with a high level of precision of screening tools, knowledge, and preparedness in addressing NCD emergencies like elevated blood pressure, deranged blood sugars? In addition, what is the community members' perception of the capacity of CHVs in screening NCDs? Thus, these discussions and questions led to the coining of a simple, clear, and easy-to-understand model anchored on a locally available community item/food called potato.

Potatoes are locally available foods that are familiar and acceptable in every household [15]. Mainly, this food can be used to create potato crisps that, if salted, are very crunchy and sweet, and they are a fast food snack for every reveller and local. Therefore, this name was adopted and used to describe a model focusing on NCDs causes risk Investigations, signs, symptoms, predisposing and control factors and, thus, an acronym Crisps that results in the CRISPS Model.

This Crisps model was adopted because it resonates well with the locals whose most everyday staple food is potatoes in almost every meal, and it will be easier for the CHVs to recall and attach their health education, screening, and linkages to this Intervention. This model introduced an intervention that focused on CHV skills and capacity building through didactic and practical training components that cover NCD causes, risk factors, signs and symptoms, investigations or diagnosis, prevention and control, and emergency care for NCD complications as described by the acronym "CRISPS". As shown in Figure 1 below.
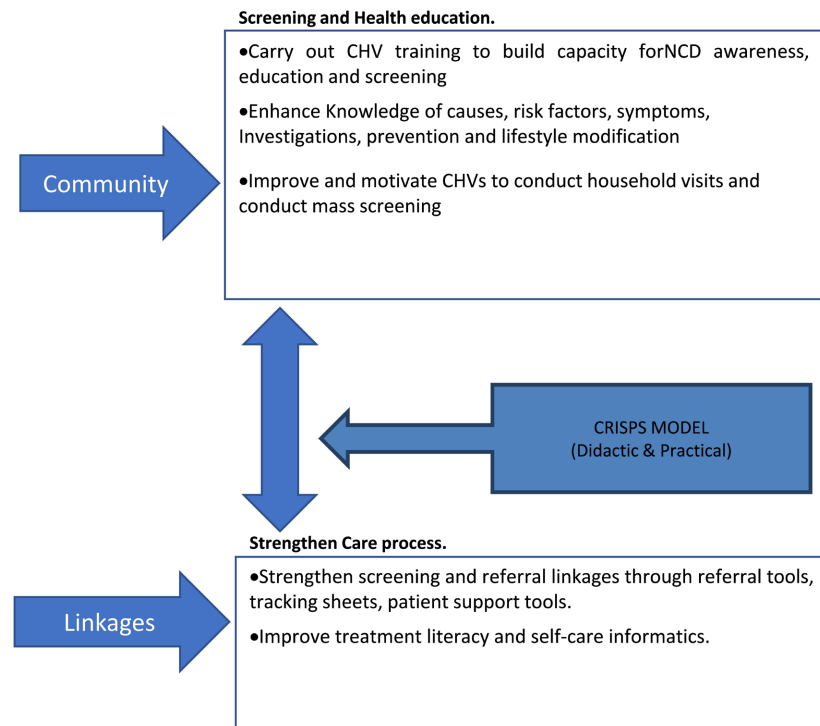
Screening and Health education.

●Carry out CHV training to build capacity forNCD awareness, education and screening

●Enhance Knowledge of causes, risk factors, symptoms, Investigations, prevention and lifestyle modification

●Improve and motivate CHVs to conduct household visits and conduct mass screening

Community

CRISPS MODEL
(Didactic & Practical)

Strengthen Care process.

●Strengthen screening and referral linkages through referral tools, tracking sheets, patient support tools.

●Improve treatment literacy and self-care informatics.

Linkages

Figure 1. Linkage and referral process, (CHV handbook, MoH 2013).

6.3. Model Rollout

Community health volunteers were informed of the study and recruited as per study protocol. CHVs were either in two groups: an interventional unit group that was exposed to a pre and post-test exam and afterwards an intervention model (CRISPS model) and a control unit group that was only enrolled to a pretest and no capacity building in terms of skills training but continued with routine NCDs screening and linkages in the respective community units.

The intervention group underwent one week of training, including practical and didactic components. Training teams comprised health professionals (Nurses, clinical officers, medical officers, and public health officers) who were fluent in the official English Kiswahili languages and predominantly spoke local languages at each community unit.

Didactic training covered NCDs definitions, causes, signs and symptoms, risk and predisposing factors, investigation and screening methods to use. Didactic programming is designed to meet developing demands in psychological practice, professional growth, and current concerns in the field, in addition to supporting the development of necessary competencies [16]. Didactic elements were assessed using a pre-training knowledge test before the introduction of the intervention, and later, the aspect was evaluated with a post-training knowledge test before deploying CHVs to the field for screening and linkages. Practical training covered knowledge on various components of blood pressure machines, establishing correct cuff size, and how to take and interpret blood pressure at different sites, which includes the arm and leg, and taken 5 minutes apart with an au-

tomated Omron blood pressure machine.

Further practical topics covered measuring height with a tape measure mounted on a stand and taking weight using a digital scale, calculating BMI with a target population, completing risk factor and linkages forms, and maintaining confidentiality during the screening and linkage process. Practical assessments were completed by obtaining anthropometric measurements on an individual basis by the trainers as part of the post-training assessment. Only CHVs who passed both the knowledge test with a minimum score of 60% on content knowledge for NCD pretests and the usage of tools, interpretation, and recording of screening results were deployed to their respective community units, and those not meeting the scores joined the next group of CHVs for remedial training.

The CHVs deployed to the field carried out return demonstrations under the observation of research assistants during a 1 - 2-week run-in period. The research coordinator randomly selected a community unit, and the corresponding CHVs accompanied the researcher for the day's screening and linkage activity. They observed the process and ensured adherence to the study guidelines and protocols. All CHVs were observed in this manner before the end of the run-in period to help identify any performance issues before they participated in the study, and those CHVS who did not do so well in this run-in period were paired with other CHVs who performed so well in the run-in period for support and mentorship. After the run-in period, the CHVs were officially deployed to their respective community units, and the research team started the follow-up process with study tools like questionnaires, group discussions, and interview guides.

7. Data Management and Analysis

This study relied on a mobile app data collection app whereby a smartphone running on android version 9 software and a Kobo toolbox were used to collect and store data collected from the study participants. This method was ideal, considering that the country was recovering from the COVID-19 menace. The technique enabled real-time data transmission, and analysis was very prompt and efficient. In this study, data management comprises two stages, namely data entry by clerks and data analysis by the researcher with the help of a statistician.

The physical questionnaires were verified and uploaded to the Kobo App. Once all the data was uploaded to the Kobo toolbox, it was then exported to a Statistical Package Software for Social Sciences (SPSS) version 24 for data analysis with inferential statistics like Chi-square test, T-test, Analysis of Variance on gain scores, residual scores, repeated measure and analysis of covariance to establish whether Interventional CHV model was effective in screening and linkages of NCDs in Nyeri County. Descriptive data was presented in the form of figures and tables. Data collected through focused group discussions and key informant interviews was audio-recorded, transcribed, translated into English, and coded for content analysis through N-Vivo software version 12 according to themes. The findings augment quantitative results and later conclude whether

the Intervention employed in the CHVs model effectively screened and linkages of NCDs in Nyeri County.

8. Results

Three hundred (300) CHVs (150 per arm), ten key informants, and six focused group discussions comprising ten discussants per group, consisting of community health workers and community health volunteers, were included in the study. The response rate was 100%.

8.1. Demographic Characteristics of Community Health Volunteers

The majority, 61.3% (n =184) of the community health volunteers were female and 72.7% (n =218) were aged 40 years and above. In investigating the level of education, 71.7 % (n =215) had secondary level as their highest level of education, as shown in Table 1.

8.2. Pre-Intervention Assessment of the Capacity of CHVs

A descriptive analysis was done to investigate the pre-interventional capacity of CHVs in NCDS screening and linkage. The assessment used a five-point likert scale where 1 = Strongly Disagree, 2 = Disagree, 3, Neutral, 4 = Agree, and 5 = Strongly Agree. Most respondents, 59.3% (n = 89), disagreed with the statement that they have the right to information concerning the screening methods used in detecting NCDs.

Table 1. The demographic characteristics of CHVs in Nyeri County.

Demographic factors	Frequency	Percent
Female	184	61.3
Male	116	38.7
Age (Mean, SD)	42 ± 3.21	
18 - 25 years	5	1.6
26 - 33 years	17	5.6
34 - 40 years	60	20.1
Above 40 years	218	72.7
Highest level of education		
Secondary level	215	71.7
Certificate/diploma	73	24.3
Master's level	12	4
Occupation		
Casual	115	38.3
Self-employed	145	48.3
Salaried employee	40	13.4

More than half of the respondents, 52.0% (n = 78), agreed with the statement that non-communicable diseases are caused by inadequate intake of fruit and vegetables. Almost half of the respondents, 48% (n = 72), were undecided on the statement that dyslipidemia and obesity cause non-communicable diseases. Most of the respondents, 79.3% (n = 119), strongly disagreed with the statement that community members with NCDs seek healthcare services promptly. Further, almost all of the respondents, 92.7% (n = 139), strongly disagreed with the statement that community members have an increased understanding of NCD screening and linkages.

In addition, CHVs gave views on refresher training that involved all of them and being put under a payroll. They also had other prayers to the existing system that included the provision of first aid kits, uniforms, badges, raincoats, umbrellas, and drugs like painkillers; due to the lack of these materials and inadequate training, CHVs felt that they didn't have capacity required for screening and linkages of NCDs and therefore the overall capacity of community health volunteers on non-communicable diseases screening and linkages pre-intervention was 48.8% (Inadequate capacity) as shown in Table 2.

Table 2. Pre-intervention assessment of the capacity of CHVs.

Statement	Level of agreement with the statement					Mean
	SD n (%)	D n (%)	U n (%)	A n (%)	SA n (%)	
Have the right information concerning the screening methods used in detecting NCDs	29 (19.3)	89 (59.3)	30 (20.0)	2 (1.3)	0	2.03 ± 0.7
NCDs are caused by inadequate intake of fruit and vegetables.	1 (0.7)	18 (12.0)	53 (35.3)	78 (52.0)	0	3.39 ± 0.5
Dyslipidemia and obesity cause NCDs.	0	13 (8.7)	72 (48.0)	65 (43.3)	0	3.35 ± 0.6
Physical Activity contributes significantly to NCD-related mortality.		5 (3.3)	40 (26.7)	105 (70.0)	0	3.67 ± 0.5
Behavioral risk factors among NCD patients are modifiable	0	4 (2.7)	51 (34.0)	95 (63.3)	0	3.61 ± 0.5
I am aware of my roles in screening and linkages of NCDs	10 (6.7)	81 (54.0)	29 (19.3)	30 (20.0)	0	2.53 ± 0.9
NCD is not transmissible	0	20 (13.3)	94 (62.7)	36 (24.0)	0	3.11 ± 0.6
Eating a healthy diet like fruits and vegetables helps to prevent NCDs	0	31 (20.7)	51 (34.0)	68 (45.3)	0	3.25 ± 0.8
It is easy to take and interpret NCD screening results	27 (18.0)	92 (61.3)	19 (12.7)	12 (8.0)	0	2.11 ± 0.8
The Referral link is clear and very efficient	21 (14.0)	59 (39.3)	63 (42.0)	7 (4.7)	0	2.37 ± 0.8

Continued

Community members with NCDs seek healthcare services in a timely	119 (79.3)	30 (20.0)	1 (0.7)	150	0	1.21 ± 0.4
Community members have an increased understanding of NCD screening and linkages	139 (92.7)	11 (7.3)	0	0	0	1.07 ± 03

8.3. Post-Intervention Assessment of the Capacity of CHVs on NCDs Screening and Linkages

A descriptive analysis was done to investigate the post-interventional capacity of CHVs in NCDS screening and linkage. The assessment used a five-point Likert scale where 1 = Strongly Disagree, 2 = Disagree, 3, Neutral, 4 = Agree, and five = Strongly Agree. Twelve questions were included in the analysis. The findings revealed that none of the respondents strongly disagreed with the statements

Table 3. Post-intervention assessment of the capacity of CHVs.

STATEMENT	Level of agreement with the statement					Mean
	SD n (%)	D n (%)	U n (%)	An n (%)	SA n (%)	
Have the right information on screening methods used in detecting NCDs	0	0	45 (30.0)	91 (60.7)	14 (9.3)	3.79 ± 0.6
NCDs are caused by inadequate intake of fruit and vegetables	0		50 (33.3)	87 (58.0)	13 (8.7)	3.75 ± 0.6
Dyslipidemia and obesity cause NCDs	0	2 (1.3)	54 (36.0)	78 (52.0)	16 (10.7)	3.72 ± 0.7
Physical inactivity contributes to NCD-related mortality	0	1 (0.7)	53 (35.3)	79 (52.7)	17 (11.3)	3.75 ± 0.7
Behavioral risk factors among NCD patients are modifiable	0	5 (3.3)	46 (30.7)	82 (54.7)	17 (11.3)	3.74 ± 0.7
I am aware of my roles in the screening and linkages of NCDs	0	4 (2.7)	50 (33.3)	87 (58.0)	9 (6.0)	3.67 ± 0.6
NCD is not transmissible	0	5 (3.3)	43 (28.7)	88 (58.7)	14 (9.3)	3.74 ± 0.7
Eating a healthy diet like fruits and vegetables helps to prevent NCDs	0	5 (3.3)	49 (32.7)	85 (56.7)	11 (7.3)	3.68 ± 0.7
It is easy to take and interpret NCD screening results	0	6 (4.0)	54 (36.0)	77 (51.3)	13 (8.7)	3.65 ± 0.7
The Referral link is clear and very efficient	0	4 (2.7)	56 (37.3)	77 (51.2)	13 (8.7)	3.66 ± 0.7
Community members with NCDs seek healthcare services in a timely	0	10 (6.7)	47 (31.3)	81 (54.0)	12 (8.0)	3.63 ± 0.7
Community members have an increased understanding of NCD screening and linkages	0	10 (6.7)	47 (31.3)	85 (56.7)	8 (5.3)	3.61 ± 0.7

investigated. Most of the respondents, 60.7% (n =91), agreed they had the correct information concerning the screening methods used to detect non-communicable diseases (NCD). The findings established that post-intervention, the capacity of CHVs on NCDs screening and linkages increased to 68.3% (Adequate capacity), as shown in Table 3.

8.4. Differences in the Pre and Post-Interventional Capacity of CHVs in Screening and Linkage of NCDs in Nyeri County

A paired samples t-test was conducted to investigate whether there were significant differences between the post and pre-intervention capacity of CHVs in screening and linkage of NCDs in Nyeri County. The findings showed that significant differences on many levels were investigated. However, knowledge of the statement that Physical In-activity contributes significantly to non-communicable disease-related mortality (p = 0.609) and behavioural risk factors among NCD patients are modifiable (p = 0.102), showed no significant differences pre and post-intervention, as shown in Table 4.

8.5. General Comparison of Pre and Post-Intervention Findings in Screening and Linkage of NCDs in Nyeri County

The paired sample t-test conducted showed that in investigating the community health volunteers' skills and knowledge of non-communicable diseases screening and linkages, there was a significant difference in capacity pre-intervention with an average of 48.75 (SD ± 5.7)%, which increased to 68.28 (SD ± 7.6)%, (p < 0.001) as shown in Table 5.

Table 4. Differences in the pre-and post-interventional capacity of CHVs in Nyeri County screening and linkage of NCDs.

Capacity of CHVs	Pretest, Mean (SD)	Post-test, Mean (SD)	p-value
I have the correct information concerning the screening methods used in detecting NCDs	2.03 (0.67)	3.79 (0.60)	<0.001
NCDs are caused by inadequate intake of fruit and vegetables	3.39 (0.7)	3.75 (0.6)	<0.001
Dyslipidemia and obesity cause NCDs	3.35 (0.6)	3.72 (0.7)	<0.001
Physical Activity contributes significantly to non-communicable disease-related mortality.	3.67 (0.5)	3.75 (0.7)	0.609
Behavioural risk factors among NCD patients are modifiable	3.61 (0.5)	3.74 (0.7)	0.102
I am aware of my roles in screening and linkages of non-communicable diseases.	2.53 (0.9)	3.67 (0.6)	<0.001
NCD is not transmissible	3.11 (0.6)	3.74 (0.7)	<0.001
Eating a healthy diet like fruits and vegetables helps to prevent non-communicable diseases	3.25 (0.8)	3.68 (0.7)	<0.001

Continued

It is easy to take and interpret NCD screening results	2.11 (0.8)	3.65 (0.7)	<0.001
The Referral link is clear and very efficient	2.37 (0.8)	3.66 (0.7)	<0.001
Community members with NCDs seek healthcare services in a timely	1.21 (0.4)	3.63 (0.7)	<0.001
Community members have an increased understanding of NCD screening and linkages	1.07 (0.3)	3.61 (0.7)	<.001

Table 5. General comparison of findings of pre and post-intervention in screening and linkage of NCDs in Nyeri County.

Capacity building	Pre-intervention	Post-intervention	t-statistic	p-value
Community health volunteers' skills and knowledge of NCD screening and linkages (Mean, SD)	48.75 ± 5.7	68.28 ± 7.6	−25.31	<0.001
Knowledge assessment (Mean, SD)	79.33 ± 17.7	81.87 ± 16.1	−1.3	0.196

9. Discussion

Community health volunteers (CHVs) are individuals chosen from within the community who voluntarily provide essential health-related services and information to their communities [17]. They play a crucial role in public health by bridging the gap between formal healthcare systems and underserved or marginalized populations. Their roles and responsibilities vary widely depending on the community's specific needs and the healthcare system they serve. Still, generally, they fulfil the following functions: Health Education, Monitoring and Reporting, Disease Surveillance, Maternal and Child Health, Advocacy and Mobilization.

Nyeri County has an unusual population distribution, with more women than men [18]. The study revealed that out of 184 respondents, 61.35% were females. Additionally, a significant portion of these respondents, 72.7% (218 individuals), were aged 40 years and above. Moreover, 71.7% (215 individuals) of the respondents had completed their education up to the secondary level, indicating the educational attainment within the surveyed population. This is not different from studies on CHV in India and Uganda [19], where the majority of the study population waswomen.The study revealed initial gaps in knowledge among respondents regarding the screening methods and causes of non-communicable diseases (NCDs).

A significant portion lacked accurate information on detection methods, attributing NCDs to inadequate fruit and vegetable intake while showing uncertainty about dyslipidemia, obesity, and the causes of NCDs. In Uganda and DR Congo, the use of CHVs in HIV programs was not successful due to disparities in cultural and knowledge gaps in terms of nutrient values attributable to some

fruits and other vegetables in one community to the other [2]. This study has highlighted that community members with NCDs often do not seek timely healthcare services, and there is a lack of increased understanding regarding NCDs, particularly related to screening and linkages among community members. This has also been alluded to in several global studies showing a similar pattern of poor health-seeking services among NCD patients.

The pre-intervention assessment of community health volunteers (CHVs) demonstrated an overall capacity of 48.8% in terms of knowledge about NCDs, screening modalities and interpretation of the results and process of referrals and linkages, which significantly increased to 68.3% after the introduction and implementation of Crisps intervention model [9]. The post-intervention analysis indicated that a structured learning approach and mentorship significantly improved the CHVs' understanding of NCDs, particularly in screening and linkages.

The McNemar test for knowledge assessment demonstrated significant differences between pre and post-intervention across all variables assessed. The McNemar test is a non-parametric test used to analyze paired nominal data [20]. Overall, the comparison showed a substantial increase in capacity from 48.75% to 68.28% post-intervention, indicating the effectiveness of the Intervention in enhancing CHVs' model in screening and linkages for NCDs. Comparing the results of this study and others across the globe, especially educational Intervention, it is noted that educational Intervention improves the mitigation modalities for diseases like diabetes and hypertension by increasing and raising awareness of the disease process and self-care approaches, therefore reducing the disease burden [21].

Therefore, this study's findings align with the general trend observed in interventions aimed at enhancing the knowledge of CHVs regarding NCDs. These interventions involved a structured learning trend that significantly improved the understanding of NCDs among volunteers. In summary, this study shows that an enhanced volunteer model encompassing well-structured learning and mentorship positively impacted the capacity of CHVs regarding NCD screening and linkages.

10. Conclusions

The in-depth analysis of Community Health Volunteers (CHVs) and their capacity in screening and linking Non-Communicable Diseases (NCDs) in Nyeri County revealed multifaceted findings. The study unveiled a significant disparity in capacity regarding low knowledge and understanding of NCDs among CHVs, pointing to the crucial need for a simple community-based intervention model and training.

The Intervention involving structured learning methods and mentorship demonstrated a notable increase in CHVs' capacity and understanding of NCDs, specifically in screening and linkages. However, challenges such as inadequate resources, traditional beliefs, and communication breakdowns were identified as

barriers hampering their efficiency in NCD-related tasks.

Recommendations

1) **Continued and Improved Training:** To bridge the knowledge gap regarding NCDs, CHVs must receive ongoing, comprehensive, and culturally sensitive training. Such training should encompass modern healthcare practices, handling workload challenges, and better communication strategies tailored to diverse needs.

2) **Community Engagement and Sensitization:** Implementing more structured, community-centric approaches involving effective communication, mobilization, and sensitization can enhance the capacity and acceptance of CHVs' roles in combating NCDs. Addressing traditional beliefs and engaging with local structures and committees is vital to aligning the community with modern healthcare practices.

3) **Research Continuation and Policy Implementation:** Continuous research and evaluation should drive policy implementations, ensuring that insights gathered are translated into practical changes. This might include reforms in CHV training modules, healthcare resource distribution, and community engagement programs

Strength of the Study

This study overly focused on the CHVs who are community-owned resource persons, are privy to the community units they serve and are part of the NCD cycle. The involvement of an intervention and the subsequent follow-up and return demonstration in the community enabled a process of engagement among the CHVs, which brought about a sense of ownership and belonging. However, the study had a few limitations that included recall biases among the elderly CHVs, and some of the CHVs in the NCD program experienced some forms of discomfort due to the NCD disease process they are undergoing.

Ethical Considerations

Confidentiality was maintained across all sections and processes for this study. Study permission was obtained from the School of Postgraduate at Jomo-Kenyatta University of Agriculture and Technology (JKUAT) Ref Number JKU/2/11/HSH411-0183/2018, clearance and research ethical approval was obtained from the Ethical Review Board of Kenya Medical Research Institute-Scientific Ref Number KEMRI-SERU/CPHR/025-07-2021/4400.

A research permit was obtained from the National Commission for Science Technology and Innovation Ref number NACOSTI/P/22/20516). Subsequently, study permission from Nyeri County Ministry of Health Ref CGN/HEALTH/HRM/5/VOL11, Nyeri County Commissioner Ref NYC/ADM/1/57/VOL VIII/94, Ministry of Education Nyeri County Ref Number CDE/NYI/GEN/23/VOL IV/86 and later permission from community units' in-charges. Before consent-

ing to the study, participants were explained in a language that they could understand: the purpose, benefits, and risks associated with participating in the research and absolute voluntarism.

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Conflicts of Interest

The authors declare no conflicts of interest.

References

[1] Nyanja, N., *et al.* (2021) Application of the Ultra-Poverty Graduation Model in Understanding Community Health Volunteers' Preferences for Socio-Economic Empowerment Strategies to Enhance Retention: A Qualitative Study in Kilifi, Kenya. *Human Resources for Health*, **19**, Article No. 104. https://doi.org/10.1186/s12960-021-00645-5

[2] Ndu, M., Andoniou, E., McNally, S., *et al.* (2022) The Experiences and Challenges of Community Health Volunteers as Agents for Behaviour Change Programming in Africa: A Scoping Review. *Global Health Action*, **15**, Article ID: 2138117. https://doi.org/10.1080/16549716.2022.2138117

[3] Angwenyi, V., *et al.* (2018) Moving to a Strong(er) Community Health System: Analysing the Role of Community Health Volunteers in the New National Community Health Strategy in Malawi. *BMJ Global Health*, **3**, e000996. https://doi.org/10.1136/bmjgh-2018-000996

[4] Banerjee, S. and Wilks, L. (2022) Work in Pandemic Times: Exploring Precarious Continuities in Paid Domestic Work in India. *Gender*, *Work & Organization*, gwao.12858. https://doi.org/10.1111/gwao.12858

[5] Oleribe, O.E., *et al.* (2019) Identifying Key Challenges Facing Healthcare Systems in Africa and Potential Solutions. *International Journal of General Medicine*, **12**, 395-403. https://doi.org/10.2147/IJGM.S223882

[6] WHO (2021) The State of the Health Workforce in the WHO AFRICAN Region. https://www.afro.who.int/publications/state-health-workforce-who-african-region-2021

[7] Karageorgos, G., *et al.* (2019) The Promise of Mobile Technologies for the Health Care System in the Developing World: A Systematic Review. *IEEE Reviews in Biomedical Engineering*, **12**, 100-122. https://doi.org/10.1109/RBME.2018.2868896

[8] Egwim, J., *et al.* (2024) Prevalence, Awareness and Risk Factors for Hypertension in Adults Attending a Tertiary Hospital in South-East Nigeria. *Open Journal of Clinical Diagnostics*, **14**, 7-24. https://doi.org/10.4236/ojcd.2024.142002

[9] Mugambi, K.L. (2024) Crisps Model: Effectiveness of an Enhanced Community Health Volunteers Model in Improving Screening and Linkages of Non-Communicable Diseases in Nyeri County, Kenya.

[10] Riang'a R.M., Nyanja, N., Lusambili, A., *et al.* (2024) Implementation Framework for Income Generating Activities Identified by Community Health Volunteers

(CHVs): A Strategy to Reduce Attrition Rate in Kilifi County, Kenya. *BMC Health Services Research*, **24**, Article No. 132. https://doi.org/10.1186/s12913-023-10514-7

[11] Colvin, C.J., Hodgins, S. and Perry, H.B. (2021) Community Health Workers at the Dawn of a New Era: 8. Incentives and Remuneration. *Health Research Policy and Systems*, **19**, Article No. 106. https://doi.org/10.1186/s12961-021-00750-w

[12] Stocks, J., Choi, Y., Ibrahim, S. and Huchko, M. (2022) Iterative Development of a Mobile Phone App to Support Community Health Volunteers during Cervical Cancer Screening in Western Kenya: Qualitative Study. *JMIR Formative Research*, **6**, e27501. https://doi.org/10.2196/27501

[13] Wekesah, F.M. *et al.* (2020) Determinants of Mortality from Cardiovascular Disease in the Slums of Nairobi, Kenya. *Global Heart*, **15**, Article 33. https://doi.org/10.5334/gh.787

[14] Non-Communicable Diseases. Amref Health Africa in Kenya. https://amref.org/kenya/our-work/pillar-2-innovative-health-services-solutions/non-communicable-diseases/#:~:text=Using%20the%20Facility%2DCommunity%20Chronic,communicable%20Disease%20(NCD)%20services

[15] Racaud, S. (2021) Low-Cost Business in Kenya from the City to the Countryside. In: Fouéré, M.-A., Pommerolle, M.-É. and Thibon, C., Eds., *Kenya in Motion 2000-2020*, Africae, Nairobi, 175-197. https://doi.org/10.4000/books.africae.2495

[16] Tejedor, G., *et al.* (2019) Didactic Strategies to Promote Competencies in Sustainability. *Sustainability*, **11**, Article 2086. https://doi.org/10.3390/su11072086

[17] Lusambili, A.M., *et al.* (2021) Community Health Volunteers Challenges and Preferred Income Generating Activities for Sustainability: A Qualitative Case Study of Rural Kilifi, Kenya. *BMC Health Services Research*, **21**, Article No. 642. https://doi.org/10.1186/s12913-021-06693-w

[18] Kimathi, G., Kiarie, J., Njarambah, L., Onditi, J. and Ojakaa, D. (2022) A Cross-Sectional Study of Antimicrobial Use among Self-Medicating COVID-19 Cases in Nyeri County, Kenya. *Antimicrobial Resistance & Infection Control*, **11**, Article No. 111. https://doi.org/10.1186/s13756-022-01150-7

[19] Kuule, Y., *et al.* (2017) Community Health Volunteers in Primary Healthcare in Rural Uganda: Factors Influencing Performance. *Frontiers in Public Health*, **5**, Article 62. https://doi.org/10.3389/fpubh.2017.00062

[20] Abdi, S.J. (2023) A Comprehensive Guide for Selecting Appropriate Statistical Tests: Understanding When to Use Parametric and Nonparametric Tests. *Open Journal of Statistics*, **13**, 464-474. https://doi.org/10.4236/ojs.2023.134023

[21] Khani Jeihooni, A., Sobhani, A., AfzaliHarsini, P. and Amirkhani, M. (2023) Effect of Educational Intervention Based on PRECEDE Model on Lifestyle Modification, Self-Management Behaviors, and Hypertension in Diabetic Patients. *BMC Endocrine Disorders*, **23**, Article No. 6. https://doi.org/10.1186/s12902-023-01264-y