BMC Public Health

RESEARCH

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Systematic adaptation of a visual-aided adolescent nutrition intervention from peri-urban Burkina Faso for rural Uganda using intervention mapping

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Abstract

Background Adolescents and young adults (AYAs) aged 10–24 years in Sub-Saharan Africa (SSA), including rural Uganda, frequently exhibit low nutrition literacy and poor diet quality, increasing their risk of malnutrition and diet-related non-communicable diseases. Many nutrition interventions are developed in high-income or school-based settings, limiting their relevance for low-income, rural, and out-of-school populations. Context-specific, community-anchored interventions deliverable through existing community health systems remain scarce. This study systematically adapted an adolescent nutrition intervention originally developed in Burkina Faso for household-level delivery in rural Uganda.

Methods This participatory action research applied the six-step Intervention Mapping (IM) protocol, guided by the Socio-Ecological Model (SEM) and Social Cognitive Theory (SCT). Step I involved a mixed-methods needs assessment to identify behavioural and environmental determinants. A multi-stakeholder planning group comprising AYAs, parents, community health workers (CHWs), government representatives, and technical experts conducted the adaptation through six iterative design workshops using participatory approaches, including free listing, pile sorting, ranking, and consensus discussions. Steps II–III developed the logic model of change and an SCT-informed theory of change. Steps IV–V co-produced context-specific adaptations in intervention content and delivery strategies, and Step VI developed the evaluation plan.

Results The needs assessment informed a logic model describing multilevel determinants of poor diet quality and guided prioritization of behavioural and environmental outcomes. An SCT-informed theory of change linking CHW-delivered strategies to key individual and household mechanisms, including nutrition literacy, self-efficacy,

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parental support, and food availability, was established. The adapted intervention comprised nine visual-aided nutrition education flyers tailored to rural Ugandan food environments and low-literacy audiences. Delivery was structured through CHW-led household sessions incorporating demonstrations, guided discussions, storytelling, myth correction, and persuasive communication. An evaluation plan was defined to assess implementation processes and effectiveness through a randomized controlled trial.

Conclusions This study demonstrates a participatory, theory-driven approach to adapting nutrition interventions for rural AYAs. Aligning intervention content and delivery with existing community health systems offers a feasible and acceptable strategy to improve nutrition literacy and diet quality in rural Uganda and similar low-resource settings.

Keywords Nutrition literacy, Diet quality, Adolescents, Community health workers, Visual-aided education, Intervention adaptation, Sub-Saharan Africa

Background

Adolescents and young adults (AYAs) aged 10–24 years undergo a critical developmental window marked by increasing autonomy, identity formation, and the establishment of lifelong health behaviors [1]. Behaviors adopted during this phase, particularly dietary practices, have lasting implications for well-being, health equity, and disease prevention [2]. Across low-middle income countries (LMICs) including Sub-Saharan Africa (SSA), many AYAs consume unhealthy diets [3], driven in part by low nutrition literacy [4–6]. Nutrition literacy refers to the ability to obtain and understand nutrition information (cognitive), apply it in daily food choices (functional), and act on healthier eating intentions (behavioural) [7, 8]. In a 2020 study conducted in Eastern Uganda, 45% of adolescents consumed low-diversity diets [9]. Such unhealthy diets are associated with a triple-burden of malnutrition: micronutrient deficiency, undernutrition, and overweight; and increase the risk of diet-related non-communicable diseases (NCDs) later in life [10, 11]. Undernutrition impairs immunity, cognitive skills, academic performance, and productivity [10, 12], increasing healthcare costs [13]. Strengthening nutrition literacy during adolescence may therefore improve current health while shaping healthier adult dietary behaviors [14, 15].

Uganda's national policies on nutrition and health prioritize healthy and adequate diets across the life course [16–18]. Yet implementation efforts and delivery approaches remain largely school-based, leaving many AYAs in rural settings, particularly those out of school, insufficiently reached. While school-based interventions target in-school adolescents, community-based delivery platforms have the potential to reach both in-school and out-of-school AYAs through household engagement. Although nutrition education interventions can improve dietary behaviors [19], many have been designed and evaluated in urban high-income countries (HICs) [19, 20] and are not well adapted to rural SSA contexts. Consequently, vulnerable out-of-school AYAs continue to be underserved [21], underscoring the need for community-grounded nutrition education strategies that are feasible for rural settings.

One potential approach is to systematically adapt existing interventions that have demonstrated feasibility in related contexts rather than developing entirely new programs [22–25]. An adolescent nutrition intervention previously co-designed in Burkina Faso through the ARISE-NUTRINT initiative [26] provides one such example. The intervention was developed in collaboration with community stakeholders and delivered through illustrated flyers and household-level education sessions to improve adolescent nutrition literacy and dietary practices. It comprised nine thematic modules covering topics such as adolescent nutrition needs, healthy eating, budgeting and meal planning, and the relationship between diet and well-being. Key messages were presented through visual aids to support comprehension among AYAs with varying literacy levels (Supplementary material 1).

Although originally implemented in a peri-urban setting in Burkina Faso, the intervention's household-centred design and use of simple visual communication tools suggested potential relevance for rural contexts. In rural Uganda, community health workers (CHWs) already function as trusted providers of health information and play a central role in community health service delivery [27–30]. Evidence from LMICs, including SSA, shows that CHW-led community education can effectively improve health knowledge and promote preventive behaviours [31–34]. In rural Uganda, CHW-delivered programs have improved adolescent girls' knowledge, attitudes, and antenatal care attendance [35]. These characteristics suggested that the intervention could be adapted for delivery through existing CHW structures in rural Uganda.

Systematic adaptation of existing health promotion interventions offers a cost-effective and efficient alternative to developing new programs while preserving evidence-based components [25, 36]. The present study aimed to systematically adapt an adolescent nutrition intervention originally developed in Burkina Faso for

implementation in rural Uganda to improve nutrition literacy and diet quality among both in- and out-of-school AYAs.

Methods

Study design and setting

This participatory action research [37] was conducted in Mayuge district, within the Iganga–Mayuge Health and Demographic Surveillance Site (HDSS) [38] in rural Eastern Uganda. In this context, livelihoods are predominantly based on subsistence agriculture and small-scale trading activities, and recent evidence from 2025 has highlighted suboptimal dietary practices among AYAs in the area [6].

Study conceptual framework

The adaptation process was guided by the six-step Intervention Mapping (IM) protocol [39], informed by the Socio-Ecological Model (SEM) [40] and Social Cognitive Theory (SCT) [41, 42]. The IM protocol provided the overarching structure for the systematic adaptation of the original intervention through six iterative steps: needs assessment, specification of behavioural and environmental objectives, selection of theory-based behaviour change methods, intervention production, implementation planning, and evaluation planning (Fig. 1). The SEM informed identification of behavioural and environmental determinants across individual, interpersonal, community, and societal levels. SCT guided the selection of theory-based behaviour change methods and their translation into practical delivery strategies suitable for rural household-level implementation.

Intervention adaptation process participants (planning group)

A multi-stakeholder planning group ($n = 20$) was purposively selected to participate in the adaptation process. Participants were identified through consultation with Makerere University School of Public Health (MakSPH), district health and education officials, and community gatekeepers. The group comprised AYAs, parents, CHWs, teachers, district officials, civil society representatives, and public health and nutrition experts (Table 1).

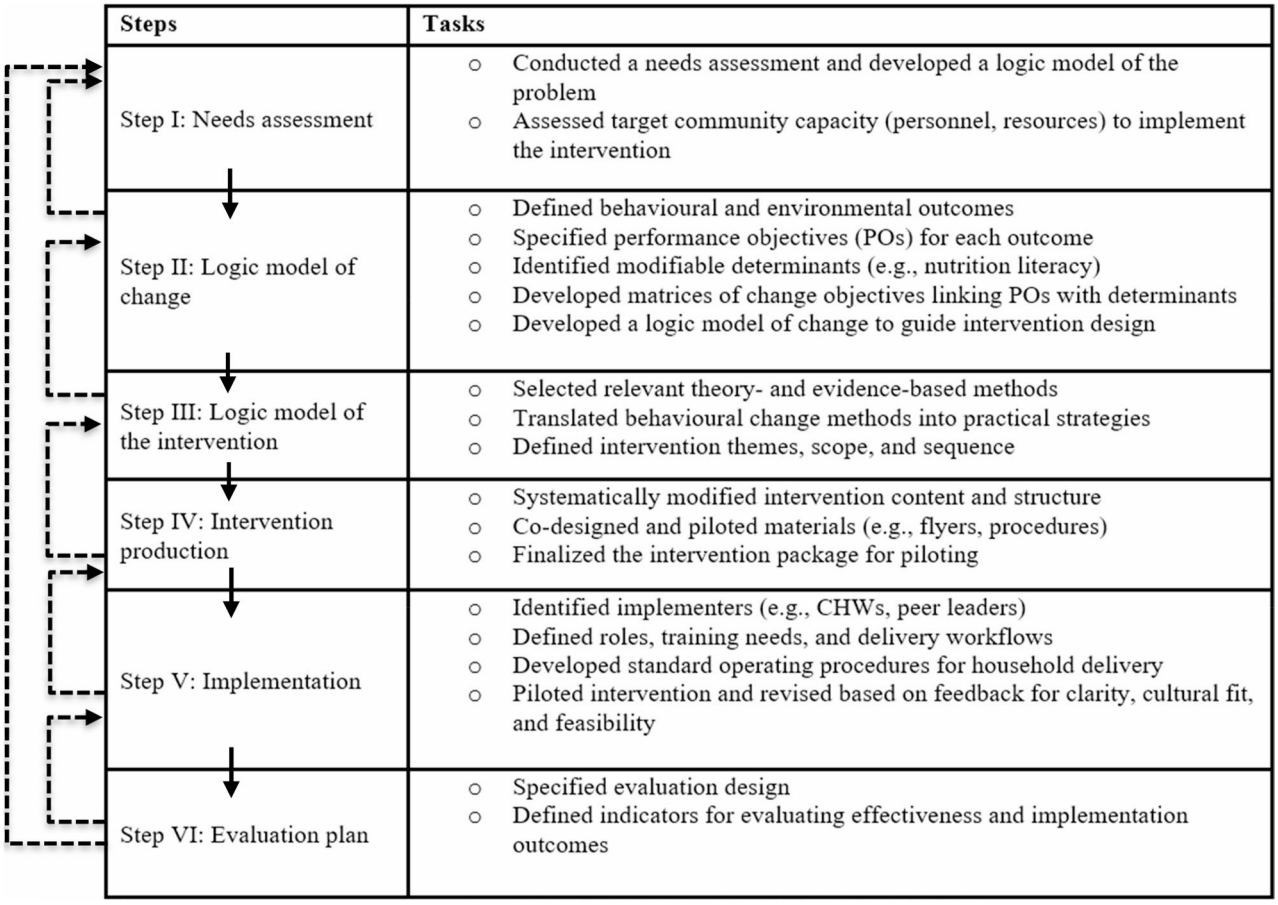

Fig. 1 Framework for intervention adaptation using the six-step IM protocol. Legend: Dotted arrows indicate iterative processes, while solid arrows represent the sequential steps of the IM protocol

Table 1 Inclusion criteria and key contribution of participants of the adaptation process

Planning groups	Affiliation / Category	Roles / Expertise	Gender / Age category	Key contributions
Group I (6 members)	MakSPH	Nutrition epidemiologist, behavioural scientist, 2 public health specialists (research associates), public health nutritionist, communication expert (graphic designer)	Adult professionals; three male and three females	Technical and methodological leadership; integration of theory and evidence
Group II (6 members)	Mayuge District local government and CSOs	Nutrition and health educator, education officer, primary and secondary school teachers, a CSO representative	Adult professionals; three male and three females	Contextual adaptation, alignment with district community health and education structures
Group III (8 members)	Community stakeholders	2 AYAs (18–24 years), 2 youth peer leaders, 2 parents, 2 CHWs	AYAs and adults; four males and four females	Community perspective, lived experience, ensuring acceptability and feasibility

CSOs Civil Society Organizations, *AYAs* Adolescents and Young Adults

Planning group I (technical experts) facilitated interpretation of evidence and theoretical alignment. Planning group II (district-level stakeholders) provided contextual insights on implementation feasibility within existing systems. Planning group III (AYAs, parents, and CHWs) contributed lived experiences and practical perspectives on household-level delivery.

Intervention adaptation procedures

The intervention adaptation was implemented through six IM-aligned co-design workshops. The first design workshop (Step I) was held on 2 April 2024, while the remaining workshops (Steps II–VI) were conducted the following year, between January and April 2025. Each session lasted one day and was facilitated by two trained members (one male and one female) of the research team, both Master of Public Health graduates with prior experience in participatory research methods. Semi-structured discussion guides developed a priori based on the IM framework (Supplementary material 2) were used to structure the co-design sessions.

Across all steps, participatory techniques, including free listing, pile sorting, ranking, and facilitated consensus discussions, were applied to support collaborative review of the original intervention, identify context-specific adaptation needs, generate ideas, group related concepts, prioritize options, and agree on final decisions.

Where differing perspectives emerged (e.g., between adolescents, parents, CHWs, and technical experts), these were discussed within the planning group and resolved through facilitated consensus discussions. Consensus was guided by three criteria: (i) alignment with theoretical behaviour change principles (SCT), (ii) feasibility within rural household delivery contexts, and (iii) clarity and acceptability for low-literacy AYAs and parents. This iterative deliberation process ensured that differing priorities across stakeholder groups (planning groups I, II, and III) were systematically reconciled, with priority given to adaptations that improved comprehension and feasibility without compromising core behavioural messages. Outputs from each step informed subsequent steps, making the process cumulative. All co-design proceedings were documented through detailed field notes, audio recordings, and compilation of group outputs (e.g., matrices and draft materials), which were used to guide subsequent adaptation activities.

The procedures for each of the six IM steps are described below, while the outputs generated from each step are presented in the Results section.

Step I: Needs assessment

The needs assessment was informed by two preliminary studies conducted in the same setting: (i) a quantitative survey assessing nutrition literacy and diet quality among AYAs, and (ii) a qualitative study exploring socio-ecological determinants of dietary practices. Detailed methods for these studies are reported elsewhere [6, 43].

Findings from these studies were discussed within the planning group during design workshop I and synthesized into a logic model of the problem through guided discussion and consensus building. In addition, free listing was used to identify locally available human resources and community actors that could support intervention delivery.

Step II: Logic model of change

In Step II, the planning group developed the logic model of change for the adapted intervention, building on determinants identified in Step I. Free listing was used to generate potential behavioural outcomes (adolescent dietary practices) and environmental outcomes (household influences), followed by pile sorting to categorize related outcomes and associated determinants. Outputs were documented on flip charts and subsequently digitized.

Participants then undertook a ranking exercise to prioritize outcomes based on perceived behavioural impact, feasibility of change, and alignment with the planned rural community delivery. Ranking was conducted through individual scoring followed by group discussion to reach consensus on priority outcomes. Determinants

emerging from the needs assessment were reviewed and ranked according to importance, feasibility of modification, and potential impact within the intervention timeframe. Performance objectives were subsequently defined for each prioritized outcome.

Using matrix development worksheets adapted from the IM protocol, prioritized determinants were systematically mapped to corresponding performance objectives to generate matrices of change objectives. For each outcome, the planning group specified the required changes in determinants linked to each performance objective, forming the logic model of change for the planned intervention.

Step III: Logic model of the intervention (theory of change)

In Step III, prioritized determinants and change objectives from Step II were translated into SCT-based behaviour change methods and corresponding delivery strategies. Potential methods were generated through free listing, drawing on determinants identified in the needs assessment (Step I) and the logic model of change, and were complemented by a pre-defined list of SCT-informed methods. These methods were organized using pile sorting into broader categories aligned with SCT constructs.

Participants then undertook a ranking exercise to prioritize behaviour change methods based on expected behavioural impact, feasibility within rural household settings, suitability for low-literacy contexts, and sustainability. Ranking was conducted through individual scoring followed by group discussion to reach consensus on priority methods. The highest-ranked methods were operationalized into practical delivery strategies through facilitated small-group review sessions, during which participants specified how each method could be applied in household-level delivery, followed by plenary consensus discussions to agree on final strategies. These strategies were subsequently synthesized into the intervention's theory of change through a structured process led by a Behavioural Scientist in group I, incorporating inputs from all three planning groups.

Step IV: Intervention production

Building on outputs from Steps I–III, Step IV involved participatory modification of the original Burkina Faso intervention to improve contextual fit for rural Uganda. During Workshop IV, participants reviewed the nine thematic modules and their associated messages through guided group discussions, assessing relevance to the local rural context.

Free listing was used to identify required adaptations in message content, language, visual illustrations, and delivery approaches to better reflect local foods, cultural practices, and household realities. Proposed adaptations were organized using pile sorting, grouping similar suggestions into categories related to message content, visual presentation, and delivery strategies. These were refined through consensus discussions to ensure revisions maintained theoretical integrity (SCT-based) while improving cultural relevance and comprehension for low-literacy audiences.

Behaviour change methods prioritized in Step III were translated into practical delivery strategies suitable for CHW-led household visits, including demonstrations, guided discussions, storytelling, and visual-aided counselling. Draft intervention materials were developed in English and translated into *Lusoga* (the commonly spoken local language) by bilingual team members familiar with the study setting. The translated materials were reviewed by the three planning groups to ensure clarity, conceptual equivalence, and appropriateness for low-literacy audiences, and were then prepared for piloting. The draft materials were subsequently pretested with selected households to assess usability and delivery feasibility, and feedback informed refinement of both content and delivery approaches.

Step V: Implementation plan

Step V focused on operationalizing the adapted intervention for implementation within rural household settings. Findings from the community capacity assessment in Step I were reviewed to identify feasible delivery platforms and locally available resources, while behaviour change methods prioritized in Step III were systematically translated into practical strategies for household-level delivery through structured group review and consensus discussions. Proposed delivery approaches were organized through pile sorting into broader implementation components and subsequently prioritized based on feasibility, acceptability, and alignment with existing CHW structures. Ranking was conducted through individual scoring followed by group discussion to reach consensus on priority delivery approaches.

The selected delivery approaches were synthesized into a structured delivery matrix specifying monthly thematic sequencing, session content, delivery strategies, and the roles of CHWs, adolescents, and household members during intervention sessions. These strategies were further operationalized through co-developed standard operating procedures (SOPs) to support consistent household delivery. The SOPs provided step-by-step guidance on session flow, use of visual materials, delivery of behaviour change techniques, and participant engagement during household visits. CHWs received structured training delivered by the research team, including practical demonstrations, role-play, and orientation to SOP-guided session delivery.

Specifically, modelling was implemented through demonstrations of locally available foods and balanced meals, while guided practice was delivered through interactive discussions and role-play on meal planning and food choices. Reinforcement and self-efficacy enhancement were incorporated through praise and encouragement during follow-up visits, and persuasive communication was delivered through simple, culturally adapted messages supported by visual-aided flyers. Mobilization of social support involved engaging parents or guardians during household sessions, while self-monitoring was promoted by encouraging adolescents and families to reflect on their dietary practices during subsequent visits.

Piloting of intervention content and delivery strategies

To assess the feasibility and usability of the adapted intervention, the nutrition education materials and delivery procedures were piloted in rural Iganga District, which shares similar socio-demographic, livelihood, and health system characteristics with Mayuge District, where the intervention adaptation was conducted [9, 35, 38]. Although the IM protocol commonly positions content pretesting in Step IV, piloting was incorporated into Step V to simultaneously evaluate both intervention materials and delivery procedures.

Nine visual-aided thematic flyers and the accompanying delivery strategies were pretested with purposively selected households. Each trained CHW delivered a structured household session using the draft intervention materials. The pilot assessed (i) content usability, including message clarity, cultural relevance, visual interpretation, and comprehension of educational messages, and (ii) delivery feasibility, including session flow, duration, CHW confidence, and household engagement.

Following the pilot sessions, feedback was collected through structured debrief discussions guided by semi-structured checklists developed a priori. Field notes were systematically documented, and observations from pilot sessions were recorded to ensure consistency in capturing feedback across households. All feedback sources were compiled and reviewed to identify areas requiring refinement of the intervention materials and delivery procedures.

Step VI: Evaluation plan

In Step VI, an evaluation plan was developed to assess the effectiveness of the adapted intervention and to examine implementation fidelity and contextual influences during delivery.

Results

Step I: Needs assessment and logic model of the problem

Detailed needs assessment findings have been reported elsewhere [6, 43]. In summary, the studies highlighted important gaps in nutrition literacy and identified multiple determinants influencing adolescents' dietary behaviours across individual, interpersonal, and community levels. These included knowledge and preferences at the individual level, parental and peer influences at the interpersonal level, and broader contextual factors such as cultural norms, media exposure, and food availability.

Insights from the needs assessment were synthesized into a logic model of the problem (Fig. 2), illustrating the interactions between these determinants and guiding identification of priority behavioural and environmental factors to be addressed through the adapted intervention.

During brainstorming on community capacity, CHWs, youth peer leaders, and selected parent or AYA representatives were identified as potential implementers and delivery agents, laying the groundwork for a community-anchored, locally appropriate implementation model for the planned intervention.

Step II: Logic model of change

Four behavioural outcomes and two environmental outcomes were prioritized to guide subsequent adaptation procedures, based on a total of 20 votes. These outcomes formed the basis for the logic model of change presented in Table 2. The behavioural outcomes included improving nutrition knowledge (19), increasing fruit and vegetable intake (18), adopting healthier dietary practices through reduced consumption of refined grains, sugar-sweetened beverages (SSBs), and fried foods (17), and strengthening comprehension and use of nutrition information (16). The environmental outcomes focused on strengthening parental support for healthy meals (17) and reducing the availability of unhealthy foods within households (15).

Intervention adaptation participants emphasized the importance of prioritizing achievable behavioural and environmental changes:

> *"It's better to focus on what can realistically shift within a short time; if we build knowledge and involve parents, the rest will follow." (Behavioural Scientist, Group I, Co-design Workshop II).*

Ten contextual determinants influencing adolescents' dietary behaviours were identified, including nutrition literacy, parental decision-making and support, socio-economic status, gendered food taboos, receptiveness to health workers' advice, food access, cultural identity and food taboos, beliefs and myths related to food and sexual attractiveness, peer influence, and social media or celebrity influence. Considering perceived changeability, impact, and feasibility within the planned intervention timeframe, five determinants were prioritized, with a total of 20 votes: nutrition literacy (18), parental support (17), receptiveness to health worker advice (15),

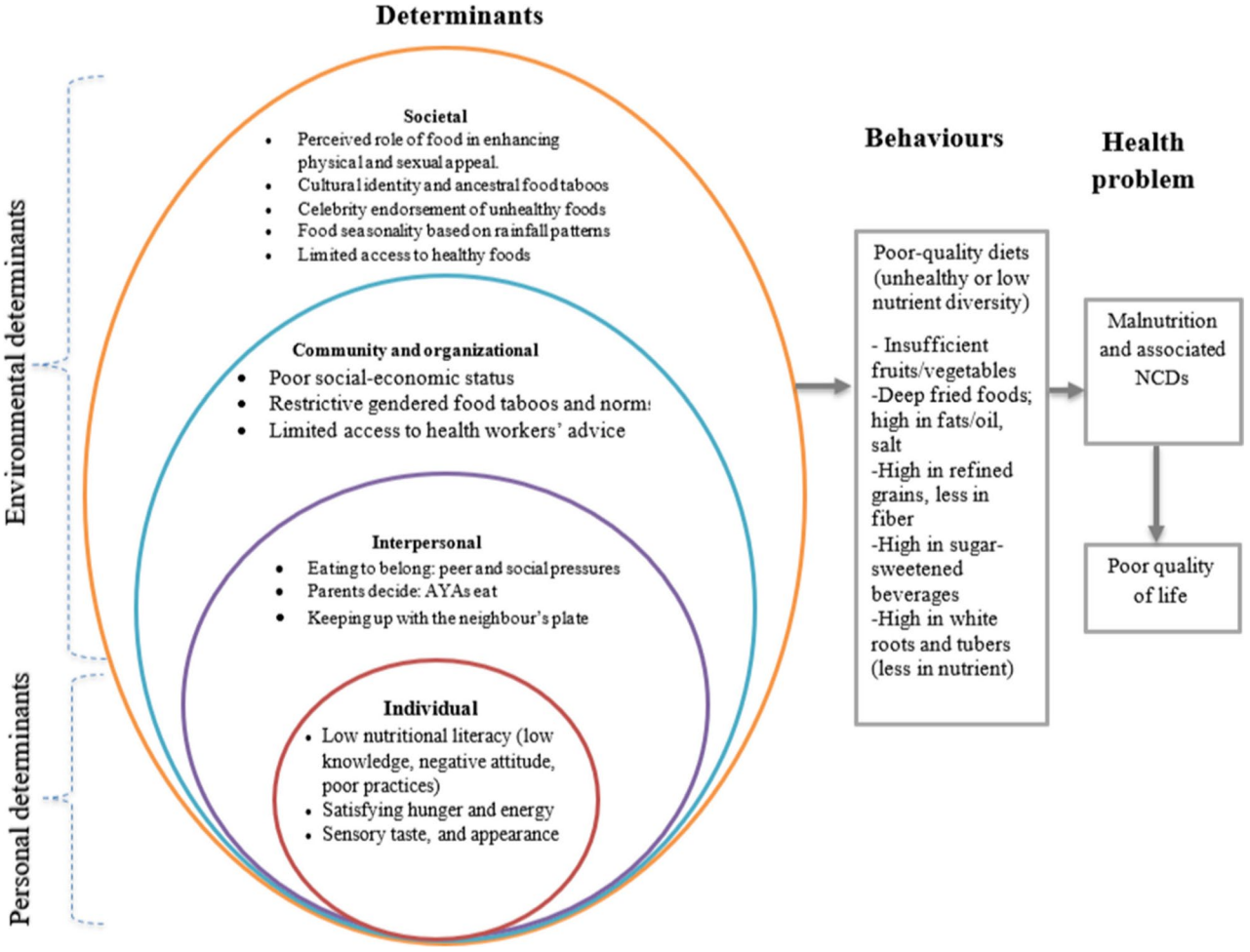

Fig. 2 Logic model of the problem developed from Step I needs assessment findings

improved access to healthy foods (14), and correction of food-related myths (13).

Determinants such as socioeconomic status and restrictive gender-based food taboos were deprioritized due to limited feasibility of modification through the planned intervention, highlighting a trade-off between intervention feasibility and comprehensiveness, as these structural determinants would require broader, multi-sectoral approaches beyond the scope of the planned intervention.

Technical expert participants highlighted the strategic importance of focusing on determinants that could realistically be influenced through education and household engagement:

> *"We can't address every determinant at once, but building nutrition literacy and involving parents gives us the highest leverage for change." (Public Health Nutritionist, Group I, Co-design Workshop II).*

Community members, especially parents, emphasized the central role of household food environments and decision-making:

> *"We are the ones who buy or grow food. If we bring healthy foods into the household, the children will eat them." (Parent, Group III, Co-design Workshop II).*

Step III: Logic model of the intervention (theory of change)

Participants identified and prioritized theory-based behaviour change methods to address the determinants and change objectives defined in Step II. Based on expected behavioural impact, feasibility within rural household settings, suitability for low-literacy contexts, and sustainability, six SCT-informed methods were prioritized, with a total of 20 votes: modelling (19), persuasive communication (18), guided practice (17), self-efficacy enhancement (16), mobilization of social support (15), and self-monitoring (13). These methods formed the basis of the intervention theory of change

Table 2 Logic model of change: Matrix of change objectives showing behavioural outcomes and environmental outcomes, performance objectives and change objectives

Outcomes	Performance Objectives (POs)	Determinants	Change Objectives (COs)
BO1. AYAs increase knowledge of dietary recommendations	PO1. Correctly identify components of a balanced diet	Individual: Nutrition literacy	Understand that a balanced diet includes proteins, vitamins, fibre, and carbohydrates
	PO2. Recognize recommended daily intake of fruits and vegetables	Individual: Nutrition literacy	Become aware of portioning meals into half vegetables/fruits, a quarter protein, and a quarter carbohydrate
	PO3. Recall benefits of consuming a balanced diet	Individual: Nutrition literacy	Internalize the importance of consuming a variety of food sources for proper nutrition
BO2. AYAs improve comprehension and use of nutrition information	PO1. Understand nutrition-related messages in different formats	Individual: Nutrition literacy	Recognize key nutrients and their functions in food
	PO2. Differentiate between healthy and unhealthy food choices	Individual: Nutrition literacy	Assess food labels and ingredient lists to make informed dietary choices
		Environmental: Misinformation/myths (sexual appeal & physical attractiveness claims)	Reject common myths that certain foods enhance sexual appeal/attractiveness; base choices on health guidance from CHWs and evidence-based messages
BO3. AYAs adopt healthier dietary practices (reduce refined grains, SSBs, fried foods, sweets)	PO1. Reduce intake of unhealthy foods	Individual: Nutrition literacy	Understand the negative health effects of excessive sugar and fat consumption
	PO2. Choose more nutritious foods when purchasing meals outside the household	Individual: Nutrition literacy	Select fresh and minimally processed foods when purchasing meals
	PO3. Plan and prepare healthier meals at household	Individual: Nutrition literacy	Cook healthy meals at household rather than buying on fast food
	PO2. Choose more nutritious foods when purchasing meals outside the household	Environmental: Physical access to healthy foods	Identify and use nearby low-cost sources of fruits, vegetables, and whole grains; substitute refined staples with available wholegrain options
BO4. AYAs increase fruit and vegetable intake	PO1. Increase frequency of vegetable consumption to ≥ 4 times per week	Individual: Nutrition literacy	Recognize the role of vegetables in improving health and preventing deficiencies
	PO2. Incorporate a variety of dark green leafy vegetables into the diet	Individual: Nutrition literacy	Value household-grown vegetables as fresh, healthy, and cost-effective
	PO3. Promote vegetable consumption among peers and family	Individual: Nutrition literacy	Encourage peers and family to make vegetables central in meals
	PO1. Increase frequency of vegetable consumption to ≥ 4 times per week	Environmental: Physical access to healthy foods	Use household gardens and local markets; plan purchases around seasonal availability and household budgets
	PO2. Incorporate a variety of dark green leafy vegetables into the diet	Environmental: Physical access to healthy foods	Grow or procure locally available dark green leafy vegetables; integrate them into weekly meal plans
EO1. Parents support AYAs to eat and adopt healthy meals	PO1. Ensure availability and accessibility of nutritious foods at household	Environmental: Parental support; physical access to healthy foods	Increase cultivation and purchase of vegetables and fruits for daily consumption
	PO2. Reduce availability of unhealthy foods at household	Environmental: Parental support	Reduce purchase of processed snacks, SSBs, and fried foods at household
	PO3. Ensure adolescents consume adequate food at household	Environmental: Parental support	Recognize that adolescence is a period of rapid growth and requires sufficient nutritious food
EO2. Parents reduce access to unhealthy foods within the household environment	PO1. Limit purchase of SSBs, refined grains, and deep-fried snacks	Environmental: Parental support; physical access to healthy foods	Substitute unhealthy foods with more affordable, healthier options
	PO2. Encourage receptiveness to health workers' advice	Environmental: Health worker advice; misinformation/myths	Apply guidance from CHWs; correct common myths within the household and community information environment

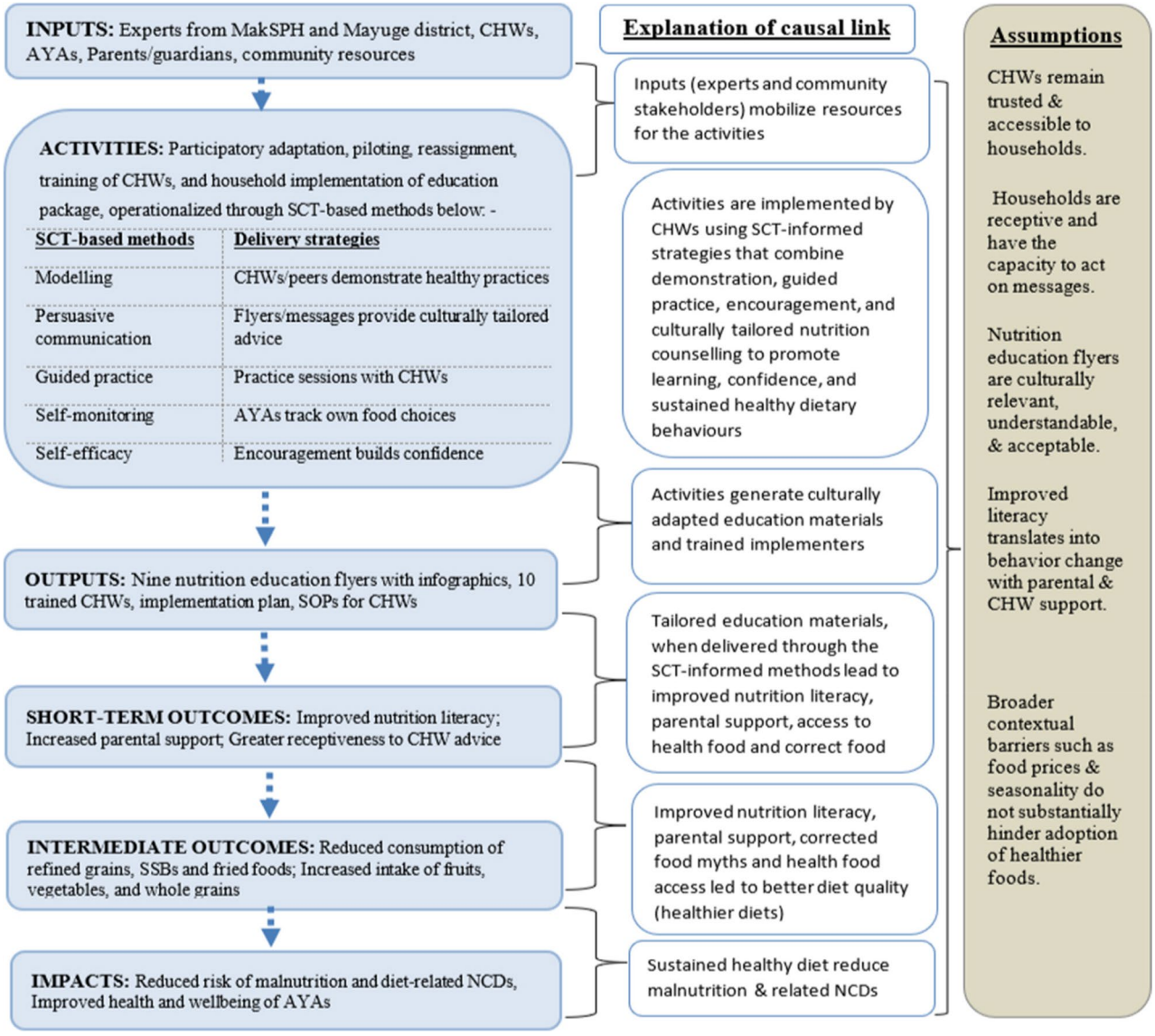

Fig. 3 Logic model of the intervention (theory of change) showing SCT-based methods and delivery strategies

presented in Fig. 3. Other methods, such as peer-group competitions and digital prompts, were considered less feasible in rural low-resource settings and deprioritized. This selection was consistent with recommended steps in the IM protocol [39] and theoretical evidence from SCT [41, 42].

This participatory process reflected both technical reasoning and community perspectives. A behavioural scientist emphasized the theoretical backbone of the intervention:

> *"If nutrition literacy is our entry point, we must design strategies that build both knowledge and confidence – this is how we move from information to action." (Behavioural Scientist, Group I, Co-design Workshop III).*

Group II (district officials and teachers) strongly supported using existing CHW structures as the delivery platform:

> *"We already have CHWs visiting households. If they're trained to model and guide, this can fit easily into what already exists." (District health team member, Group II, Co-design Workshop III).*

Adolescents, young adults, and parents underscored trust and credibility as essential to behaviour change:

> *"When CHWs come to our homes and involve our parents, it becomes easier to follow what is being taught because decisions about food are made*

together." (Adolescent, 18 years, Group III, Co-design Workshop III).
"If we see CHWs and our parents practicing what they teach, we'll believe it and follow it." (Adolescent, 19 years, Group III, Co-design Workshop III).

The resulting delivery strategies for rural households included demonstrations of locally available foods and balanced meals, storytelling with illustrated flyers, role-play and household discussions, and praise and feedback during CHW household visits. The intervention theory of change links CHW training, revised educational messages, and visual-aided materials to key individual and household mechanisms, including nutrition literacy, self-efficacy, parental support, and food availability. These pathways indicate potential improvements in healthier dietary practices, including reduced consumption of refined grains, fried foods, and sugar-sweetened beverages, and increased intake of fruits, vegetables, and whole grains, thereby reducing risks of malnutrition and diet-related NCDs [10, 44, 45].

Step IV: Intervention production

The adapted intervention comprised nine visual-aided thematic flyers integrating SCT-informed delivery strategies. The specific content modifications and their rationale are summarized in Table 3. Revisions focused on improving cultural relevance and simplifying key messages using locally familiar foods, language, and visuals. While all nine thematic modules from the original intervention were retained to preserve its core structure, participants considered restructuring selected themes (e.g., combining 'budgeting and meal planning' with 'choosing the right food from the market or garden' content) to reduce repetition and enhance coherence during delivery. These deliberations reflected efforts to streamline content while maintaining feasibility for household-level implementation.

District stakeholders highlighted opportunities to consolidate related themes during adaptation discussions:

"Some of these topics seem related, for example, diet and disease and lifestyle – so we discussed whether they could be combined to reduce repetition during delivery." **(***District education team member, Group II, Co-design Workshop IV).*

However, decisions on restructuring were carefully weighed against the need to retain theoretical and behavioural completeness of the intervention. A technical expert emphasized that each module addressed distinct determinants identified in the needs assessment:

"Even though some themes overlap, each one addresses a different issue we identified – if we remove or merge them, we risk missing important messages that influence behaviour at home." (Public Health Nutritionist, Group I, Co-design Workshop IV).

Community stakeholders further reinforced the importance of retaining all modules to reflect lived household realities and ensure comprehensive message coverage. A parent participant (group III) noted:

"Each topic speaks to something we see in our homes; if you remove one, people may not understand the full picture." (Parent, Group III, Co-design Workshop IV).

Technical expert participants emphasized that contextual adaptation should maintain theoretical integrity while improving accessibility for rural audiences:

"We must keep the behavioural logic strong, but say it in a language and show it in a way people understand. Besides, there is need to put a lot of message in visuals because our target community generally have a poor reading culture." (Nutrition Epidemiologist, Group I, Co-design Workshop IV).

Visual communication was widely supported as an effective strategy for improving comprehension and engagement among adolescents and households. District stakeholders highlighted the importance of using locally recognizable images:

"If the pictures show our real food, gardens, and households, people will not see it as foreign – they'll take it seriously." (District health team member, Group II, Co-design Workshop IV).

Adolescents similarly noted that familiar imagery would make the messages easier to remember and discuss within households:

"When we see what we actually eat on the flyer, it's easier to remember and talk about it at household and school." (Adolescent, 17 years, Group III, Co-design Workshop IV).

Several contextual adaptations were introduced to improve local relevance. Foods unfamiliar to the rural Eastern Ugandan context, such as baobab and sardines, were replaced with locally available equivalents such as *dodo*, *nakati*, cassava, and silverfish. Messages addressing common food-related myths identified during needs

Table 3 Adaptation of the Burkina Faso nutrition education messages to the rural Ugandan context

Theme	Burkina Faso version	Adaptation to rural Uganda context	Rationale for modification
1. Rich and Balanced Diet	Promoted dietary diversity and meal frequency using examples such as baobab, sardines, and millet porridge, with food illustrations depicting a balanced diet.	The theme was retained, but the concept of a balanced diet was simplified using locally available staples (dodo, nakati, cassava, beans, and silverfish), and visuals were added to show food groups and nutrient functions. Vector food illustrations were replaced with real food images, and micronutrient supplement capsules were removed.	Improve comprehension, maintain focus on diversity, and enhance relevance through locally recognized foods and utensils.
2. Eating Habits and Hygiene	Focused on consistent meal times, eating slowly, and hygienic food preparation in schools and households, with cartoon-style drawings illustrating handwashing.	The theme was retained and expanded to incorporate rural water, sanitation, and hygiene practices (e.g., handwashing with soap). Cartoon-style drawings were replaced with real images illustrating handwashing.	Reinforce household-based practices and align with national community hygiene messaging.
3. Consequences of Poor Diet	Linked overconsumption of sugary, salty, and fried foods to overweight, diabetes, and heart disease, using illustrations of healthy and unhealthy food choices and lifestyles.	Text was simplified and visuals were restructured for clarity. The original images were replaced with vector illustrations depicting unhealthy lifestyles and their effects.	Improve relatability and illustrate locally available risk foods.
4. Functions and Sources of Vitamins and Minerals	Provided examples such as baobab leaves, spinach, sardines, and sweet potato leaves as sources of micronutrients, supported by cartoon-style drawings and illustrations.	Examples were substituted with locally available food equivalents (dodo, nakati, bbuga, silverfish, beans, and millet) while maintaining nutrient emphasis. Cartoon-style drawings were replaced with real images of locally available vitamin- and mineral-rich foods.	Reflect local availability and nutrient equivalence; increase recognition among AYAs.
5. Physical Activity and Lifestyle	Emphasized daily exercise routines (e.g., jogging and games) and reduced screen time, using silhouettes of running and dancing and icons illustrating the benefits of physical activity.	The content was retained, but examples were replaced with rural Ugandan activities such as fetching water, walking long distances, and playing football, and motivational slogans were added. Additional vector illustrations and real images were incorporated to depict a wider variety of physical activities.	Increase contextual relevance by aligning with the lifestyles of rural Ugandan adolescents.
6. Budgeting and Meal Planning	Encouraged economical meal planning and vegetable patch gardening, using terms such as 'corn-based meals' and 'vegetable patch,' with vector illustrations of a farmer preparing to grow vegetables at home.	More specific guidance on budgeting and planning healthy meals was added. Real images were introduced, and the focus was expanded to include budget-friendly meal planning strategies and foods.	Improve linguistic and contextual accuracy; emphasize affordability and self-reliance.
7. Link Between Diet and Mood	Discussed how certain foods influence mood, using examples such as canned foods and processed snacks, with icons and cartoons illustrating the relationship between diet and mood.	Replaced canned foods with local fried snacks (chips, *gonja*, *mandazi*); added examples of mood-enhancing foods (tilapia, silverfish, groundnuts, fruits); included a water reminder (≥ 4 cups/day). Vector illustrations of local foods were added to reinforce the relationship between diet and mood.	Enhance relevance to local diets and promote hydration and nutrient–mood awareness.
8. Choosing the Right Food on the Market or from your garden	Focused on avoiding high-fat packaged foods and reading labels, with text boxes illustrating how to choose appropriate food products.	Added local examples (mandazi, cooking oils, spice mixes, sweetened juices); expanded to include myths linking food to physical attractiveness; emphasized checking expiry dates. Text boxes were replaced with images of packaged foods, food labels, and vector illustrations of healthy foods from the market or the home garden.	Address misinformation identified in Step I and broaden scope to reflect actual market products.
9. Understanding Anaemia	Highlighted iron and vitamin C sources such as spinach, sardines, and baobab, and included guidance on avoiding tea after meals. Cartoons illustrated different iron sources, and icons depicted signs of iron-deficiency anaemia.	Replaced examples with millet, beans, *nakati*, and silverfish (iron); added passion fruit, mango, and pineapple (vitamin C); simplified technical terms for low-literacy audiences. Cartoons were replaced with real images of different locally available iron-rich foods.	Reflect local diets and enhance comprehension of nutrient sources and absorption.

assessment (Step I), particularly beliefs linking certain foods to physical beauty or sexual attractiveness, were explicitly incorporated into theme eight of the adapted intervention to enhance relevance and support behaviour change within the local context.

Intervention materials were redesigned to emphasize visual illustrations, minimal text, and simple layouts to improve accessibility for low-literacy audiences. These adaptations transformed the original peri-urban, West African-oriented materials into household-visit flyers suitable for CHW-led delivery in rural Uganda. Two copies of each flyer were produced in English and Lusoga and printed on glossy paper for piloting.

Step V: Implementation plan

Community Health Workers were selected as the primary delivery agents of the adapted intervention. This was informed by findings from the community capacity

brainstorming in Step I and reinforced by stakeholder discussions highlighting the trust, accessibility, and established role of CHWs in household-level health promotion within rural communities.

Participants emphasized the importance of leveraging existing community health systems to translate theory-informed strategies into practical delivery approaches:

> *"The strength of this program lies in making theory work through existing CHW systems, not creating something entirely new." (Public Health Specialist, Group I, Co-design Workshop V).*

District stakeholders in planning group II (district health and education staff, teachers, and civil society representatives) also emphasized the practical advantages of engaging CHWs as frontline implementers of the adapted intervention:

> *"Since CHWs were part of the original program in Burkina Faso, and they are part of our community health system here too, keeping them makes both technical and practical sense and will ease implementation of the intervention." (CSO representative, Group II, Co-design Workshop V).*

Parents, AYAs, and CHWs in group III confirmed that CHWs' familiarity with households made them well suited to deliver the intervention:

> *"CHWs already visit households and know our families, so if anyone is to teach us about food and health, it should be them." (Young adult, 22 years, Group III, Co-design Workshop V).*
> *"We have seen CHWs helping with house-to-house immunization and health talks during child health days. They are known in the village and will be listened to more than new people." (Parent, Group III, Co-design Workshop V).*

The original Burkina Faso intervention included weekly short text messages delivered via mobile phones to reinforce CHW-delivered messages. However, this component was not retained in the Ugandan adaptation due to feasibility constraints, including limited phone access and use among AYAs, as identified in Step I [6], and its lower appropriateness for low-literacy rural households compared with face-to-face CHW-led delivery. It was replaced with quarterly CHW home visits to reinforce key intervention messages.

The final delivery model comprised monthly CHW-led household visits supported by visual-aided flyers. Household sessions incorporated demonstrations of locally available foods and balanced meals, interactive discussions and role-play, and reinforcement through praise and feedback. Parents or guardians were actively engaged during sessions to strengthen household-level support for behaviour change. The implementation plan was further structured through a delivery matrix outlining thematic sequencing, delivery strategies, and the roles of CHWs, AYAs, and parents or guardians (Supplementary material 3), alongside co-developed SOPs to support consistent implementation (Supplementary material 4).

Piloting of intervention content and delivery strategies

The pilot sessions demonstrated that the visual-aided flyers and accompanying delivery strategies were generally well understood and feasible for CHW-led household delivery. CHWs reported that the SOPs provided clear guidance for structuring sessions and maintaining message consistency.

> *"Following the SOPs makes it easy to know what to say and when; I don't fear forgetting anything." (CHW, Group III, Co-design Workshop V).*

Household sessions typically lasted 40–50 min and were characterized by interactive discussions between CHWs, adolescents, and household members. Adolescents described the participatory delivery approach as engaging and easier to understand than conventional lectures:

> *"It was not like a lecture. We could talk and ask questions, and the pictures helped us understand." (Adolescent, male, 17 years, Group III, Co-design Workshop V).*

Participants highlighted the usefulness of the visual illustrations in explaining nutrition concepts and supporting household discussions about food choices.

> *"The pictures make it easy to know what you should cook to eat and why. You don't have to read long explanations." (Adolescent, male, 17 years, Group III, Co-design Workshop V).*

Parents appreciated the clarity and practicality of the flyers but recommended minor adjustments to improve visibility for older household members.

> *"I like that the messages are short and clear, but some pictures need to be bigger for older people like us." (Parent, female, 50 years, Group III, Co-design Workshop V).*

CHWs also emphasized that the visual-aided materials simplified delivery of the nutrition education sessions.

Fig. 4 Sample illustration of adaptations made in contents for theme 1

> *"We [CHWs] can use these flyers easily to deliver the education messages because they are simple and straight to the point, and the pictures make them even simpler to use for training." (CHW, Group III, Co-design Workshop V).*

Pilot feedback informed several refinements to the adapted materials and SOPs (Supplementary material 5), including simplification of technical terminology, stronger reinforcement prompts, improved visual sequencing, and larger font size to enhance readability for older household members.

Final nutrition education flyers adapted to the rural Uganda context

A sample of the final adapted nutrition education flyer (theme 1) is presented in Fig. 4 to illustrate how the original Burkina Faso materials were culturally adapted for the Ugandan context. The adapted flyers for the remaining eight themes are provided in Supplementary material 6.

Step VI: Evaluation plan

A two-arm randomized controlled trial comparing AYAs receiving the CHW-led intervention with those receiving routine facility-based nutrition and health education is planned; primary outcomes include nutrition literacy and diet quality. The trial is prospectively registered with the Pan African Clinical Trials Registry (PACTR202501305580883). In addition, a complementary mixed-methods assessment examines implementation fidelity and delivery experiences. Evaluation indicators, data sources, and analytical approaches are summarized in Supplementary material 7.

Discussion

This study systematically adapted a visual-aided adolescent nutrition intervention from Burkina Faso for rural Eastern Uganda through a participatory co-design process. Guided by the six-step IM protocol and informed by the SEM and SCT, the adaptation produced a context-specific intervention package comprising revised nutrition messages, culturally familiar visual-aided flyers, CHW-led household delivery strategies, and co-developed SOPs tailored to low-literacy rural households. By retaining the core thematic structure of the original intervention while revising content, visuals, and delivery arrangements, the adaptation improved cultural relevance, feasibility, and acceptability for rural Uganda without requiring the development of an entirely new intervention. This study provides an applied example of a systematic, theory-driven approach to adapting nutrition interventions by explicitly linking contextual evidence, behavioural theory, and implementation design. It demonstrates how existing programs can be translated into operationally feasible household-level delivery models in low-resource settings.

Systematic adaptation was necessary because the original intervention was developed for a different social, linguistic, and service-delivery context. In rural Eastern Uganda, adolescents' dietary behaviours are shaped not only by individual knowledge gaps but also by parental influence, community norms, food-related beliefs, and access to health information [6, 43]. The adapted intervention therefore moved beyond simple information provision to align nutrition literacy content with household decision-making, trust in CHWs, and the realities of food access in rural communities. This aligns with evidence that behaviour change interventions are more effective when adapted to the social and implementation contexts in which they are delivered [22, 46]. The use of simplified language, local idioms, and culturally familiar food images strengthened functional nutrition literacy, as observed during pilot household sessions. These adaptations enabled adolescents and household members to interpret, discuss, and apply nutrition information within their everyday food environments, with participants

actively engaging with visual materials and relating them to locally available foods.

The adaptation process also operationalized a structured CHW-led, household-based delivery model for adolescent nutrition education, translating theory-informed methods into routine community practice. Community stakeholders emphasized the trust, familiarity, and accessibility of CHWs as critical for uptake and message credibility, while technical experts contributed to structuring SCT-informed delivery strategies for household implementation. The resulting delivery model embedded nutrition education within interactive household sessions, extending beyond school-based platforms that dominate many adolescent interventions. While many adolescent nutrition interventions have been implemented in school settings, fewer studies have documented the systematic adaptation and delivery of visual-aided nutrition education for low-literacy adolescents in rural, household contexts [19]. This approach is particularly relevant in rural Uganda, where many out-of-school adolescents remain insufficiently reached by existing nutrition education efforts [21, 47]. The adapted intervention further contributes to evidence that illustrated materials, simplified language, and household engagement can enhance comprehension and facilitate behaviour change among adolescents [48, 49].

An important context-specific adaptation was the explicit incorporation of messages addressing food-related myths, particularly beliefs linking certain foods to sexual attractiveness and body image, which were identified as salient determinants during the needs assessment. These were operationalized through targeted messaging within the visual-aided materials and reinforced during CHW-led discussions using myth-correction and persuasive communication strategies. Such beliefs have been shown to influence dietary behaviours among adolescents in diverse settings, often shaping food preferences and social norms around eating [48, 50, 51]. Integrating these culturally embedded belief systems into the behaviour change framework extends the application of intervention mapping in this context by addressing not only knowledge deficits but also socially constructed influences on adolescent dietary practices within the local context.

Strengths and limitations

This study has several notable strengths. First, we employed a systematic, theory-driven adaptation process using the IM protocol, ensuring that the intervention was not only contextually relevant but also grounded in established behaviour change theory. Second, the integration of the SEM and SCT enabled identification of multilevel determinants and their translation into practical delivery strategies. The participatory co-design approach involving multiple stakeholder groups, including adolescents, their parents, CHWs, district actors, and technical experts, enhanced contextual relevance, acceptability, and implementation feasibility. In addition, iterative refinement and piloting of both intervention content and delivery procedures strengthened usability, clarity, and alignment with rural household realities. Finally, the development of structured delivery strategies and SOPs provides a clear and replicable implementation pathway, which is rarely documented in intervention adaptation studies.

However, several limitations should be considered. The original Burkina Faso intervention was still under evaluation, limiting the availability of empirical evidence on its effectiveness; this was mitigated by piloting the adapted materials and refining them based on contextual feedback. In addition, the core active components of the original intervention were identified based on theoretical alignment and consensus among the planning group rather than empirical validation, which may affect transferability; to address this, behaviour change methods were explicitly grounded in the SCT and systematically linked to locally identified dietary determinants during construction of the theory of change for the planned intervention.

Given the participatory nature of the co-design process, there is also potential that decision-making may have been influenced by more senior or technically trained participants within the planning group. In addition, social desirability bias may have limited the expression of dissenting views during group discussions. To mitigate these risks, structured participatory techniques (including free listing, pile sorting, ranking exercises, and facilitated consensus discussions) were used to ensure that all participants contributed to idea generation and prioritization, and that decisions were not based solely on dominant voices. Furthermore, the composition of the planning group into three distinct stakeholder groups, namely technical experts (group I), district-level stakeholders (group II), and community representatives including AYAs, youth peer leaders, parents, and CHWs (group III), provided diverse perspectives and helped balance contributions, thereby reducing the likelihood of dominance by any single group.

Implications for policy and practice

Our study findings suggest that adolescent nutrition education in rural Uganda may be more effectively designed when embedded within existing community health systems and tailored to literacy levels, household food environments, and locally relevant communication strategies. Positioning the intervention within the CHW platform aligns with national health and nutrition priorities and provides a feasible pathway for integration into routine

community-based health promotion [16–18]. More broadly, these findings underscore the value of systematically adapting existing evidence-informed interventions, rather than developing new ones, to enhance contextual fit and implementation readiness in low-resource settings.

Conclusion

This study demonstrates how a structured, theory-informed, and participatory adaptation process can be used to translate an existing nutrition education intervention into a contextually appropriate and operationally feasible model for rural implementation. By systematically integrating contextual evidence, behavioural theory, and stakeholder input, the study contributes an applied example of how adaptation can be operationalized in practice. Evaluation of the adapted intervention in rural Uganda is currently underway; findings from this evaluation will be critical to assess its effectiveness and to inform scalability and adaptation in other settings.

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12889-026-27393-2.

Supplementary Material 1.

Supplementary Material 2.

Supplementary Material 3.

Supplementary Material 4.

Supplementary Material 5.

Supplementary Material 6.

Supplementary Material 7.

Acknowledgements

We are grateful to the adolescents and young adults, parents, youth peer leaders, teachers, community health workers, and Mayuge District health and education officials for their active participation and valuable contributions to the participatory adaptation of the intervention. We also acknowledge the Iganga–Mayuge Health and Demographic Surveillance Site team for supporting community mobilization and coordination of the co-design workshops.

Authors' contributions

Conceptualization: TBu, RN, JB, EB, and DG; Funding acquisition: DG, JB, AS, YB, AM, MR, MMS, WWF, and TBä; Methodology: TBu, DG, EB, and JB; Co-design of the original intervention: SS, LP, NT, MR, SCM, JM, UP, IB, JB, CN, DG, AS, YB, AM, MMS, WWF, and TBä; Intervention adaptation: TBu, EB, RN, SS, DO, DG, and JB; Writing – original and revised draft: TBu; All authors reviewed, edited, and approved the final manuscript.

Funding

This study was conducted as part of the ARISE-NUTRINT project, a collaborative project between MakSPH in Uganda, and 13 other institutions in Africa, Europe and the Harvard T.H. Chan School of Public Health in the United States of America. The project is funded by the European Union under Project Grant Number 101095616. The funders had no role in the study design, data collection and analysis, decision to publish, or preparation of the manuscript. Funding acquisition at MakSPH was led by DG and JB, co-investigators on the ARISE-NUTRINT project.

Data availability

All relevant data generated has been included within the manuscript.

Declarations

Ethical approval and consent to participate

This study was conducted in accordance with the 1964 Declaration of Helsinki. Ethical clearance for the ARISE-NUTRINT (Africa Research, Implementation Science, and Education – Reducing nutrition-related NCDs in adolescence and youth) project was obtained from the Research and Ethics Committee of the School of Public Health, Makerere University (Ref: SPH-2023-460), and the Uganda National Council for Science and Technology (Ref: HS3481ES). Written informed consent was obtained from all adult participants involved in the adaptation process, including co-design workshop participants (AYAs aged 18–24 years, parents or guardians, CHWs, teachers, civil society actors, and district officials). For adolescents aged 10–17 years, written parental or guardian informed consent was obtained, and assent was additionally secured from the adolescents. All data generated during co-design workshops contained no personally identifiable information and were stored on password-protected devices and secure servers accessible only to authorized research staff.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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Received: 7 February 2026 / Accepted: 9 April 2026
Published online: 17 April 2026

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