

# NOURISHING HEROÍNAS IN MOZAMBIQUE: UNDERSTANDING, DESIGNING WITH, AND TAILORING NUTRITIONAL INTERVENTIONS TO ADOLESCENT GIRLS



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Emily LaRose, Nadia Osman, Katia Santos Dias, Alia Poonawala, Wendy Gonzalez, Zineb Felix, Abby Falla

## ABOUT GAIN

The Global Alliance for Improved Nutrition (GAIN) is a Swiss-based foundation launched at the UN in 2002 to tackle the human suffering caused by malnutrition. Working with governments, businesses and civil society, we aim to transform food systems so that they deliver more nutritious food for all people, especially the most vulnerable.

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The Global Alliance for Improved Nutrition (GAIN)  
Rue de Varembé 7  
1202 Geneva  
Switzerland  
T: +41 22 749 18 50  
E: [info@gainhealth.org](mailto:info@gainhealth.org)

[www.gainhealth.org](http://www.gainhealth.org)

## SUMMARY

Adolescence is a time of rapid physical, cognitive, social, and emotional development that sets the foundation for health and provides an opportunity to improve life chances. Mozambique has a large and growing population of young people, but their health and social indicators are poor, especially for girls. Food insecurity is widespread, there is limited dietary variety, low intakes of fruits, vegetables and protein-rich foods, and a heavy reliance on starchy foods. This contributes to a perpetual cycle of malnutrition and poverty.

Creating meaningful and contextually relevant nutrition-focused behaviour change interventions is challenging. Good practice acknowledges the need to include adolescents in designing programmes that affect them and their peers. However, little time, effort, and money have been invested in designing effective and relevant nutritional interventions for very poor adolescent girls. Human-centred design (HCD) is an innovative approach that brings users into the design process to co-create solutions for complex problems, ensuring that new initiatives are relevant and appropriate and accurately reflect participants' realities. HCD supports contextual learning through exploration, ideation, and iteration.

This paper describes how, together with partner agencies, community members, and adolescents, the Global Alliance for Improved Nutrition sought to apply the principles of HCD to develop a ready-to-pilot test package of culturally and contextually appropriate interventions to improve dietary habits of very low-income adolescent girls in Mozambique. There were numerous challenges to improving nutrition in this context, including family resource limitations, limited supply and access to nutritious and safe foods, low literacy levels, adolescent girls' domestic responsibilities, and engaging girls with little agency. The two final interventions, the Heroínas Game and the Cooking Academy, were developed with sensitivity to these factors. The results of the pilot are forthcoming. With significant contributions by the girls and their influencers in the HCD process, these interventions offer a promising opportunity to improve dietary habits of adolescent girls.

### KEY MESSAGES

- Human-centred design (HCD) is a technique that brings the user into the design process. Though HCD has not been widely applied to nutrition challenges, its application can help identify context-specific priorities, especially in very low-income settings.
- An HCD approach to creating behaviour change interventions can help to identify users' motivations, abilities, and opportunities—all of which drive behaviour change success.
- Continuous learning through ideation, prototyping, and iteration provides valuable insights into users' realities, though the process is time consuming and resource intensive.
- Engaging adolescents in work that impacts them and their peers is critical. Still, there are challenges to consider in working with adolescent girls in very low-income communities. A lack of agency, limited resources, low literacy, and significant domestic responsibilities all impact how and whether the girls can participate in HCD activities.

## BACKGROUND AND OBJECTIVE OF THIS WORKING PAPER

Nutrition-focused behaviour change interventions have traditionally focused on informing, counselling, and educating target groups about the health benefits of consuming particular foods or nutrients. Using an information-based approach often assumes that participants are likely to make eating decisions based on reasoning and rational benefits. Additional underlying assumptions include that people do not know which types of foods are healthy, are concerned about improving their health, and are equipped and motivated to make sustained dietary changes (1,2). Didactic approaches, like informing and educating, also assume that the information and delivery are both contextually relevant and applicable for participants.

There is a growing body of literature that suggests that encouraging behaviour change by solely imparting knowledge, in the absence of sufficient motivation, opportunity, and ability, rarely results in significant or sustained alterations in habits or behaviour (3–5). Human behaviour is inherently complex and is significantly influenced by social norms, self-efficacy, contextual environments, and habits (6). While much remains unknown about how behaviour patterns change, studies have found that successful interventions are tailored to target populations and actively engage their participants. Successful participant engagement is vital to trigger the underlying motivation and ultimately shift routines and make a sustained change (6,7).

Bringing participants into the programme design process provides a pathway for public health professionals, project managers, designers, researchers, and educators to better understand how individual socio-cultural circumstances, environments (e.g., home, school, work), and personal priorities shape behaviours. Human-centred design (HCD) is an innovative approach to project design wherein the population of interest is actively involved in developing and testing potential solutions to complex problems (8). While HCD is founded in traditional socio-behavioural research methods and the principles of social innovation,<sup>1</sup> HCD methods offer flexibility through exploration, rapid testing and learning, and iterative idea generation processes (8). HCD has been used across public health in both high- and low-income settings with projects to improve health care delivery, support Ebola outbreak control, improve infant mortality, encourage handwashing and sanitation, and teach dietary self-monitoring for improved nutrition habits (10). For adolescents, HCD has been employed to support adolescent health and contraceptive use in Tanzania, Ethiopia, and Nigeria and to encourage lifestyle change for participants with obesity in the United States (8,10). Well performed HCD processes can be used to support behaviour change activities by fostering facilitator learning via the core principles of empathy, context, ideation, and iteration (10). The principles of empathy and context ensure that the problem is viewed and explored through the eyes of the people most directly affected by it. Ideation is a collaborative, unrestrained, and solution-focused process that moves beyond the constraints of the contextual environment into realms of unlimited possibility. Iteration relies on and grounds solutions in the people for whom the solutions are focused; it is a process of continuously

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<sup>1</sup> Social innovation has been defined by the Stanford Social Innovation Review as 'a novel solution to a social problem that is more effective, efficient, sustainable, or just than existing solutions and for which the value created accrues primarily to society as a whole rather than private individuals' (9).

gathering and adapting to insights on how the people at the heart of the process interact with the ideas. The findings from these learning processes can then be explored in the context of behaviour models to develop meaningful and appropriate interventions.

While there are multiple behaviour change frameworks proposed in the literature, the key factors for behaviour change commonly include the elements of motivation, ability (or capability), and opportunity. Motivating factors reflect desires, impulses, and inhibitions and include pleasure versus pain, hope versus fear, and social acceptance versus rejection. Ability or capability is framed by time, money, physical strength, cognitive effort, social norms, and routine. Opportunity refers to factors including time, location, cultural norms, and social cues that allow a behaviour to occur (4,5,11). HCD can be used to integrate these factors into contextually appropriate behaviour change interventions by identifying, exploring, and validating drivers, facilitators, barriers, habits, and opportunities relevant to the target group.

Adolescence<sup>2</sup> is a time of rapid physical, cognitive, social, and emotional development that sets the foundation for health in later life. About 15-20% of total stature and half of adult body weight and bone mass are achieved during adolescence. Blood volume expands, and the heart, brain, lungs, liver, and kidney all increase in size. The high rate of growth during puberty is second to that in infancy, but is greater in duration, and therefore total nutritional requirements during puberty may be greater than during any other period in life. Additional nutritional needs to support this growth and development include an overall increase in energy intake (also due to increased appetite), protein and amino acids for growth of muscle, and calcium and Vitamin D for bone growth. The onset of menstruation, hormonal changes, and sexual and reproductive development places additional iron, folic acid, and zinc demands on adolescent bodies (13).

In early adolescence, dietary decisions are largely prescribed by parents or educational institutes, but as young people become older adolescents (15 years and over), they become more autonomous in their decision making, influenced by a broader range of perspectives including peers (14). There are significant gaps in our understanding of the determinants of adolescent health and well-being, as well as how to reach adolescents and what can stimulate their interest in improving their health and well-being. Experts have acknowledged the vital need to include adolescents in designing and implementing programmes that affect them and their peers (15), but adolescents, especially girls in low- and middle-income countries (LMICs), often have limited agency, which can make engagement in programme design difficult (16). Little time, effort, and money have been invested in designing persuasive nutritional interventions that resonate with and are relevant to very poor adolescent girls in LMICs (16–19).

We do not know of any published examples of how HCD has been used to develop nutrition interventions for adolescents, especially low-income groups in LMICs. This paper describes how, together with partner agencies, community members, and adolescents, the Global Alliance for Improved Nutrition (GAIN) sought to apply the principles of HCD to develop a ready-to-pilot test package of culturally and contextually appropriate interventions to

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<sup>2</sup> Adolescence is defined by the World Health Organization as the time between childhood and adulthood, between 10 and 19 years of age (12).

improve dietary habits of very-low-income adolescent girls in Mozambique. We provide an overview of how this innovative HCD project was designed and developed, beginning with formative research using immersive learning and exploration to understand the girls' behaviours, drivers, barriers, and interests around food and nutrition. We then describe the process of co-creation, continuous learning, and iterative prototyping. Finally, we reflect on the challenges, lessons learned, and achievements in this application of HCD methods.

## METHODOLOGY

This working paper was developed via a review of internal materials in combination with a series of semi-structured, qualitative interviews with key stakeholders. Internal materials included published and unpublished reports, presentations, planning documents, and programme evaluation materials and techniques<sup>3</sup>. Scientific databases were searched to identify relevant published literature for the background and supporting information.

Interviewees included representatives from partner organisations, including the United Nations Children's Fund (UNICEF) and ThinkPlace,<sup>4</sup> GAIN staff members, and GAIN consultants. The goals of the interviews were to understand how this work was done, explore how HCD was used to interpret the formative research and develop project prototypes, identify contextual factors that influenced each phase of the project, and generate lessons learned. All interviews were conducted virtually and recorded to ensure that their content was available for later reference. All participants provided consent to be interviewed and recorded.

Background and supporting information were gathered via PubMed, employing keyword searches for publications on adolescent nutrition, human-centred design, co-creation, co-design, and the key theories of behaviour change. Literature searches were limited to the past five years unless a paper appeared to be of particular significance, as evidenced by frequent referencing by other articles. Abstracts were reviewed for relevance, and full-text papers (in English) were considered for inclusion if they explored improving adolescent dietary habits by promoting participant engagement via co-creation, co-design, or HCD methods. Additional supplementary information was obtained from reports from governmental agencies, the World Health Organization, the United States Agency for International Development and UNICEF.

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<sup>3</sup> Internal unpublished documents included the GAIN project proposal titled *Promoting Improved Diet Quality for Adolescent Girls* (November 2017), the final report from the GAIN/ThinkPlace Mozambique Co-Creation Workshop (August-September 2018), the GAIN/ThinkPlace Prototype Report (July 2019), the draft report from the rural formative research (*Understanding the nutritional behaviours of adolescent girls and their influencers in rural Nampula Province*; GAIN/ThinkPlace, August 2018), the GAIN Mozambique Design Brief: Prototyping Report (ThinkPlace, October 2018), a draft presentation that reviewed how the Fogg Behavioural Model has been used in this work (*Behaviour change model for the adolescent project Mozambique*; GAIN, no date), the GAIN Mozambique Design Brief: Refined Prototyping Report (ThinkPlace; draft 1, April 2019), and a draft overview document highlighting GAIN's work with adolescent girls in Mozambique (2019).

<sup>4</sup> ThinkPlace is a global creative agency focused on collaborative problem-solving using systems thinking and human-centred design (20).

## PROGRAMMATIC OVERVIEW

The Mozambican population is young, with 52% of the population under 18 years of age (21), mostly rural (64%), and growing rapidly (22), increasing from 31.2 million people in 2020 to a projected 45.8 million in 2035 (23). Adolescents are the fastest-growing population group in Mozambique: as of mid-2020, there were 7.4 million people (about 23% of the population) between 10 and 19 years of age, a value expected to increase to 13.2 million by mid-2050 (24). Mozambique ranks poorly for social indicators for children and adolescents, especially girls. In the UNDP Gender Development Index, it ranks 181<sup>st</sup> out of 189 of countries (25). Child marriage (53% of girls are married before the age of 18), early initiation of sexual intercourse, a high prevalence of HIV, and low literacy rates are all more common in girls than boys. More than one in four girls in rural areas and more than three in ten girls in urban areas become pregnant before the age of 18 (24).

Food insecurity is widespread, and malnutrition is a national challenge in Mozambique (26). According to 2011 national-level Demographic and Health Survey (DHS) data, the prevalence of thinness among non-pregnant adolescent girls between 15 and 19 years of age was 2%, overweight and obesity prevalence was 9.4%, stunting prevalence was 23.1%<sup>5</sup>, and anaemia prevalence was 55.6%. Lower educational attainment, rural residence, and poorer socioeconomic status were all associated with an increased prevalence of underweight, short stature, and anaemia (27,28). There were no available data at the national level for adolescent boys or younger adolescents.

Throughout the world, as in Mozambique, there are significant gaps in knowledge surrounding adolescents' nutrition behaviours, including their preferences, aspirations, motivations, needs and influences. To design effective interventions aimed at improving diet quality requires a deep understanding of the current nutrition-related behaviours of adolescents, exploration of the social context, identification of key influencers including family members and peers, and assessment of the primary determinants and motivations that modulate dietary behaviours.

One key determinant of malnutrition is low dietary diversity, but data on adolescent dietary patterns are very limited. An analysis using data from the Global School-based Student Health Surveys found that 32% of school-going 12 to 17-year-olds in Mozambique (both boys and girls) eat fruit or vegetables less than once per day, 61% eat fast food at least weekly, and 57% drink carbonated soft-drinks at least daily (29). Recent changes in dietary patterns driven by the availability of foods high in sugar, fat, and refined carbohydrates have been documented, particularly for adolescents who reside in urban areas (30). We know very little about non-school going adolescents, especially those in rural areas.

Multi-sectoral collaboration between education, social protection, and health systems is critical to tackle adolescent malnutrition challenges. Launched in 2010, the national government's multi-sectoral Plan of Action for the Prevention of Chronic Malnutrition/Stunting (PAMRDC) includes a focus on school-aged, adolescent girls. Under

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<sup>5</sup> In the cited 2011 data for adolescent girls between 15 and 19 years of age, thinness reflects the percentage with a body-mass-index-for-age (BMI-for-age) z-score of <-2SD, overweight and obesity reflect the percentage with a BMI-for-age z-score of >+1SD, and stunting reflects the percentage with a height-for-age z-score of <-2SD (27).

PAMRDC, iron and folic acid tablets are distributed to adolescent girls through schools and health centres, largely to improve pregnancy outcomes: PAMRDC aims to break the cycle of chronic malnutrition that begins before a woman becomes pregnant and continues into pregnancy, lactation, and the baby's life. Additional PAMRDC activities include school-based nutrition training for adolescents, promotion of school gardens, and nutrition-focused capacity strengthening (31).

In line with PAMRDC, the intervention described in this paper targeted adolescent girls. Adolescent girls are among the most neglected groups for targeted, effective nutrition programming and research (32). Globally, girls and young women are disproportionately affected by malnutrition, a burden that has intergenerational consequences via malnourishment carried later into pregnancy, childbirth, breastfeeding, and beyond. For these reasons, as well as to build community trust and have familial consent for the girls' participation, this was a project for and with girls, not mixed gender.

A unique aspect of conducting this work in Nampula province was the opportunity to partner with Rapariga Biz ('Action for Girls'), a platform focused specifically on building agency and addressing the unique challenges of girls and young women, as further detailed in Box 1. Embedding testing and implementation in the Rapariga Biz programme, which was made possible through a partnership with UNICEF Mozambique, the United National Population Fund (UNFPA), and the Mozambican Ministry of Health and the Ministry of Youth and Sports, allowed us to leverage the existing logistics, platforms, activities and trained mentors, as well as create valuable synergies.

#### **BOX 1. RAPARIGA BIZ**

Launched in 2016, Rapariga Biz is the largest adolescent programme for girls between 10 and 24 years of age in Mozambique. Led by the Government of Mozambique, coordinated by UNFPA and implemented with UNICEF, UN Women and the United Nations Educational, Scientific and Cultural Organization (UNESCO), the programme mostly focuses on Sexual and Reproductive Health and Rights and aims to prevent child marriage and teenage pregnancy by empowering girls and women to make informed and healthy decisions. With the support of *Coalizão* (a non-governmental organisation and implementing partner), Rapariga Biz uses an integrated human-rights approach to promote sexual and reproductive health, leadership, personal development and citizenship for vulnerable girls and young women and aims to reach one-million girls via community involvement activities in Nampula and Zambezia provinces. Programme activities include mentorship, psycho-social support, economic empowerment opportunities, behaviour change campaigns, adolescent and youth engagement activities, and improving access to education, health and justice services (33–35).

## **APPLYING HUMAN-CENTRED DESIGN**

Human-Centred Design (HCD) is flexible, process focussed and committed to 'real-world' testing and adaptation. With HCD, solutions are not imposed upon users; instead, users are



placed at the centre of the design process and equipped and enabled to actively participate in project development. To explore how HCD could be used to develop an innovative intervention for adolescent girls in Mozambique, we collaborated with ThinkPlace Kenya on creative design and intervention development. While HCD methods vary, the process we used in this work followed the following five phases: 1) Discover; 2) Define; 3) Co-Design and Ideate; 4) Prototype and Test; 5) Plan and Implement (10).

## PHASES 1 AND 2: DISCOVER AND DEFINE

To better understand habits of and influences on low-income adolescent girls, GAIN and ThinkPlace conducted two immersive, formative studies in Nampula Province. The first was conducted in May-June 2017 in the urban areas of Nampula City (inland) and Nacala Porto City (on the coast) in the northern part of the country, where there is high population density and a large proportion of the population are adolescents (36). In July 2018, a second formative research study was conducted, this time in the rural communities of Nametil (Mugovolas District) and Itoculo (Monapo District) (37). The geographic areas are shown in Figure 1.

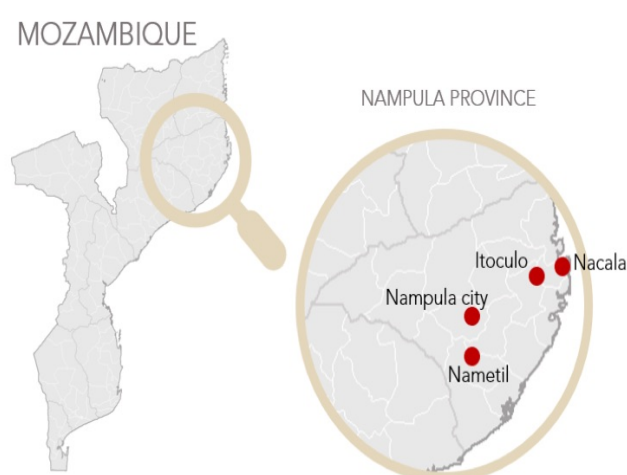


Figure 1: A map of Mozambique showing the relevant cities in Nampula Province.

We conducted focus group discussions; one-on-one, semi-structured interviews; and observations of adolescent girls and their influencers (e.g., parents, aunts, uncles, grandparents) in their homes and in contextual environments such as schools, during their social activities and in the market. While the girls were in school, the researchers met with the girls' parents and influencers as well as market vendors, teachers, and community leaders (36,37). A total of 223 participants (urban: n= 151 total, n= 78 adolescent girls, n= 73 influencers; rural: n= 72 total, n= 24 adolescent girls, n=48 influencers)

were recruited with the support of Save the Children<sup>6</sup> and Coalizão (see Box 1) (36,37).

## KEY FINDINGS

<sup>6</sup> Save the Children was involved solely in recruiting participants to participate in formative research activities, not as a formal partner organisation.

Overall, the research revealed that girls' eating habits were largely dictated by availability, economic access, and social and cultural norms and expectations. Given the limited economic circumstances of the girls and families, food choice and dietary variety were limited. Food choices were largely made on the basis of how filling something was considered to be. Parents were the primary influence for the girls in the home and commonly controlled what and how much food was eaten in the home. Adolescent girls had very little if any control over household meal decisions. Knowledge of what constitutes a healthy diet was limited (36,37). Girls had little self-efficacy and agency within family and social structures and limited exposure to novel recipes or cooking techniques. Friends and matriarchal figures somewhat influenced the girls outside of the home especially on what food is valued (Figure 2). This influenced whether to bring food to school or buy (unhealthy) snacks near or on site for instance.

There were many commonalities between the rural and urban findings related to food consumption. Adolescent girls in both rural and urban communities subsisted on a



Figure 2: An overview of the people who influence adolescent girls' eating habits in Nampula.

monotonous diet dominated by starchy staples and driven by accessibility and affordability limitations. Cooking was seen as a "woman's job" in family life. Women and girls spent a significant part of each day procuring foods in their small farms or home-gardens or in the markets, making selections based on availability and cost rather than planning meals in advance. Cooking choices were based on the foods procured and commonly took up to two hours, with foods often being left to cook for extended periods (which could lead to nutrient degradation, especially vitamins A to E and K and key minerals including potassium, magnesium and calcium) (36,37).

While girls and their families desired varied diets, the quantities and types of foods purchased, especially by families in urban areas, were heavily reliant on how much money was available on a daily basis. Grains and starches made up the bulk of their diets, and vegetable portions were small. Beans and fish were the most common protein sources, although portion size and frequency were larger in rural areas. Chicken and other meats were eaten rarely, mostly on special occasions. Dairy consumption was not common in urban or rural settings. Girls did not commonly eat breakfast and, if it was consumed, it was in small

quantities. In some cases, there was not enough food to prepare meals for the whole family, and there was often little food available for breakfast (36,37).

There were, however, notable differences between the urban and rural environments that impacted both food selection and eating behaviours. In urban areas, men were commonly labourers and the sole wage earners, but in rural communities, both paid and unpaid labour were divided between men and women. This difference in labour impacted food preparation: in urban areas, men provided money for food and women made purchasing decisions; in rural areas, men were more likely to be involved in food-related decision-making. Fathers' influence on household diets was weaker, however, when the father's time was divided between households (in the case of men with multiple wives). There was also greater equity in portion sizes and meal-time seating dynamics in rural communities: families sat together at a table and shared food with no gender preference in rural areas, whereas in urban areas, fathers tended to receive the largest portions and sit at a table while other family members were seated on mats on the floor (36,37).



*Figure 3: Oil is synonymous with taste and used in large quantities: in this photo, the whole bottle pictured was used to make a family meal.*

Rural families were heavily reliant on home production of maize, cassava, and beans and had greater access to and consumption of fruits (primarily oranges, tangerines, bananas, starfruit, lemons, and grapefruits) than urban families, which relied on markets and daily wage income to purchase food. Girls in urban areas, unlike girls in rural areas, were sometimes given small amounts of pocket money to buy snacks at schools. Options were dictated by vendors near the school grounds and included processed foods high in sugar and fat, including cookies, fried snacks, and sweets. In rural areas, vegetable oil was used in large quantities and was seen as synonymous with adding flavour to meals (Figure 3).

## IDENTIFYING PRIORITY BEHAVIOURAL AIMS

Using formative research findings alongside data on the nutritional status of adolescent girls from the DHS 2011 (26, 27), four primary and two secondary nutritional behaviours were identified as priorities to guide the co-creation, ideation, and prototype process. The primary behaviours relate to dietary diversity and quality and meal frequency. They are increased consumption of breakfast (i.e., less skipping), of fruits (in frequency, variety, and portion size), of dark green leafy vegetables (in quantity and frequency), and of beans (in quantity and frequency). The two secondary behaviours were more focused on dietary quality: reducing the quantity of oil added to meals and reducing the consumption of highly processed, fried, and sweet foods and soft drinks, particularly for girls in urban areas.

Formative research findings were also used to inform the development of three behavioural goals to frame and guide the co-creation and ideation process. These three behavioural goals related to abilities, motivators and opportunities and were considered as critical to successful change in eating behaviour:

**Behavioural Goal 1: Increase agency and decision-making power:** Agency and decision-making at the individual or household level is limited by economic and environmental constraints, but empowering girls has been shown to have a positive impact on their food consumption patterns, health, and social outcomes and on life chances more generally (38). Formative research findings show that adolescent girls have little agency or autonomy in household food decision-making. Increasing this is critical to realising change.

**Behavioural Goal 2: Improve knowledge about good nutrition practices:** Food and nutrition literacy has been shown to shape and improve familial dietary practices. Practical, basic nutrition knowledge has been identified as a contributor to differences in dietary intake between socioeconomic groups (39,40), and maternal nutrition knowledge has been shown to improve child nutrition indicators (40). Similarly, adolescents with greater food knowledge (or food literacy) have been shown to have improved dietary habits when compared to their peers (41). Both the adolescent girls and their influencers had limited knowledge about nutrition; inaccurate, community-based beliefs about “bad” foods were commonly held. The spread of nutrition misinformation via schools, health centres, and word-of-mouth presented a concern. The field team thus identified a need for priority interventions to address basic nutrition concepts, healthy diet composition, and the importance of a nutritious diet.

**Behavioural Goal 3: Increase exposure to new foods and ways of cooking:** Cooking interventions to improve self-efficacy (42) and participation in cooking activities (e.g., the purchase, preparation, and growing of food) have been shown to improve dietary habits for children (43,44) and families (45). Limited cooking skills can be a barrier to healthy eating, especially in resource-limited settings (46,47). With limited financial resources, the adolescent girls and their influencers were hesitant to explore new foods and cooking methods because of the potential for waste. Researchers did, however, observe a desire among participants to try new foods in a risk-free manner (e.g., tasting a new food or dish prepared by someone else). Through the formative research, it became clear that the girls would require support from their parents, particularly their mothers, to make dietary changes. Similarly, their mothers also required opportunities to develop cooking and food preparation skills to improve dietary quality for their daughters and families.

### PHASE 3: CO-DESIGN AND IDEATE

Ideation is a rapid brainstorming process that encourages participants to think quickly and generate wild, innovative ideas. The process sought to challenge what *is* and to explore what *could be*. It did so by supporting participants to think out loud, without imposing restrictions or limiting criteria on what can or cannot be proposed, to communicate visually, to build on one another's ideas, and to defer judgement.

In August 2018, two ideation and co-creation workshops were held in Nampula Province (one rural-focused workshop in Itoculo, one urban-focused workshop in Nacala), with the goal of generating ideas to address nutrition-related behaviours. In each of the workshops, participants were divided into four groups: adolescent girls 15-19 years of age (Itoculo: n=9; Nacala: n= 9), female influences (e.g., mothers, grandmothers, aunts) (Itoculo: n=4; Nacala: n= 4), and male influencers (e.g., fathers, grandfathers, uncles) (Itoculo: n=5; Nacala: n= 4).

Five questions, based on formative research insights, guided Activity 1:

1. What would motivate families to change what they are eating every day?
2. What is preventing adolescent girls in Itoculo/Nacala from changing what they are eating?
3. What is preventing families in Itoculo/Nacala from changing what they are eating every day?
4. Apart from the hospital, who do you trust/listen to when it comes to health and nutrition?
5. What is healthy eating for you?

These were discussed within groups, with the answers later shared back with the other groups and facilitators. As an example of the type of content merging, a summary of answers to the second question is provided in Box 2.

The goals were to understand if opinions aligned with the insights into the girls' needs, behaviours, values, beliefs, family dynamics, and social structures gained from the formative research. Since participants were from similar demographic, social, and cultural backgrounds and communities as those who participated in the previous studies, we expected that new knowledge generation would be limited in this early stage. Indeed, the insights gathered during the introductory activities largely overlapped with those from the formative research. We also sought to validate that the nutritional aims and goals described above were contextually appropriate and relevant. The introductory activities also enabled participants to learn to work creatively and collaboratively in advance of other workshop ideation activities. We sought to support and encourage participants to identify feasible ways of improving their diets in their context and to build common understanding, preparing participants to identify solutions as part the next workshop activity.



Figure 4: A group of adolescent girls who participated in the co-creation workshop

### BOX 2. ACTIVITY 1: RESULTS FROM QUESTION 2

What is preventing adolescent girls in Itoculo from changing what they are eating?

**Lack of decision-making power:** Meals are chosen by parents and are heavily influenced by men, who provide income for their families. Adolescent girls have little agency and are not often part of food/meal decision-making.

**Economic status of the area:** Itoculo is a rural area, which makes access to jobs difficult. This has a negative impact on parents being able to provide food for their families.

**Limited access to a variety of foods:** The foods grown in these areas are limited, and therefore families have access to a variety of food items.

**Limited knowledge of new ways of preparing food:** Families have limited knowledge of the different ways to prepare meals and repeatedly eat the same foods, prepared in the same way.

**Limited knowledge:** Families have limited knowledge about the importance of eating a varied diet.

**Limited production of diverse food crops:** Families in Itoculo are farmers, and they primarily eat what comes from their farms.

In *Activity 2: Design Challenges* participants generated ideas that could improve eating habits. The groups focused on identifying opportunities to improve girls' diets and then generating as many ideas and solutions as possible to solve the design challenge. Ideas were clustered into patterns and themes, putting similar ideas together. The top three ideas from each workgroup were 'pitched' to the other groups. On day 2, the groups took part in a Concept Development Workshop to further developed these top three ideas to include a description, possible participants, participant recruitment strategies, and potential success metrics.

#### PHASE 4: ITERATIVE PROTOTYPING AND TESTING

In September 2018, GAIN and ThinkPlace began developing and testing prototypes based on the concepts generated during the ideation and co-creation workshops and the ideas generated by GAIN and ThinkPlace using insights into the eating behaviours, motivations, barriers and opportunities. In total, 13 prototypes were created and clustered into five themes: Cooking, Rapariga-Biz based, Interactive Media, Market Interventions and Community Group Interventions (as summarised in Box 3). Initial prototypes varied in their

complexity; some prototypes were simple elements that could be part of a larger intervention, while others were more complex, suited to independent interventions.

Trials of each prototype event, activity, or concept were planned in Itoculo and Nacala to explore how the adolescent girls, their influencers, and their local community responded to it.

### BOX 3: THE 13 PROTOTYPES CO-CREATED

#### Cooking Interventions

- **Cooking Lab:** A women's group that meets to learn new recipes
- **Cooking Competition:** A competition where couples prepare a dish to be judged by other couples and community leaders
- **Cooking Club & Academy:** A group of women and adolescent girls meets to learn about cooking methods

#### Rapariga Biz-based Interventions

- **Games for Rapariga Biz:** Word games, puzzles, trivia, and food group games to educate the girls in Rapariga Biz about the importance of eating fruits
- **Pledge (Olapha):** A competition where adolescent girls participated in a daily challenge around healthy eating (such as eating breakfast).

#### Interactive Media Interventions

- **Cinema Club:** Promotional videos highlighting the importance of fruits, vegetables, and proteins in meals via existing cinema clubs
- **Eteatro:** Community-based comedies, plays and songs about healthy eating
- **DVDs:** pre-recorded videos of theatre plays and recipe demonstrations

#### Market Interventions

- **Oscola Box:** A communication strategy using a box (and posters/leaflets) with colourful pictures of fruits to attract adolescents to buy fruits
- **Food Tags:** A communication strategy using tags to communicate the nutritional benefits of consuming certain foods such as dark green leaves, proteins, and fruits at the market

#### Community Group Interventions

- **Saving Group's Song:** Promotion of three meals per day via speeches, plays, theatrical performances, and songs via existing savings groups
- **Soccer Game:** Sharing leaflets and booklets during a football match to encourage spectators to eat fruits and vegetables; includes a theme song for half-time
- **Mesquita Speech:** Uses the influence of religious leaders to persuade male influencers to change their families' diets

Using the dynamic learning and testing inherent to the HCD process, we observed and assessed how adolescents and their families interacted with the initial prototypes, learned what elements worked or did not work, and sought to understand how awareness and sensitisation might translate into action. Each prototype was tested and evaluated using qualitative and quantitative methods, including observation of the prototyping events, participant counts during prototyping activities, focus group discussions, exit interviews, and follow-up interviews a few weeks after the event. Following rapid testing, promising aspects of the prototypes were further strengthened, and weaker elements were dropped as part of a second iteration. This process continued through several iterations, depending on the level of potential determined during field testing.

## COOKING PROTOTYPES

One challenge identified in the formative research was that often a small number of traditional recipes were passed from one generation to the next with little innovation, leading to a monotonous diet and limited cooking skill development. There is also a strong fear of wasting food and money, which limits motivation to innovate and try new techniques or recipes. The three cooking prototypes, described in Figure 5, were designed to create a 'cooking revolution' and test whether that could increase cooking skills, knowledge, and confidence. This could, in turn, increase dietary quality (e.g., by preserving more nutrients during cooking), diversity, and meal frequency, especially that of breakfast, as people would have a range of easy-to-prepare or made-in-advance options for the first meal of the day.



Figure 5: The three different cooking prototypes tested with the adolescent girls and influencers

During the prototyping of the Cooking Lab, participants proved to be familiar with the ingredients and had some simple recipes, but they found it challenging to develop new recipes independently, and guidance from the nutritional expert facilitating the Lab was needed. Since most girls are told (generally by other female family members like mothers or aunties) what and how to cook when they prepare food at home, splitting the generations into groups (mothers/aunties as one group and girls as another) helped to give the girls the autonomy and permission needed to generate ideas. The two groups were also very



interested in each other's recipes and eager to learn from them. Both groups expressed an interest in continuing to learn new recipes and skills—but only with the support of someone who could teach and guide them. The prototyping of the Cooking Club and Academy reinforced this observation: having been shown a new technique or recipe using familiar ingredients, participants were able to easily replicate the steps and enthusiastic to try at home. Building the skills of girls alongside their mothers/female influencers increased their agency by giving the older generation confidence that the girls could replicate the new, approved recipes at home. Community interest and participation in the Cooking Competition were high. The novelty of seeing couples cooking and judging the dishes together was especially appreciated. Certification was valued, as were the nutritional coaching and the demonstration and tasting of recipe innovations for familiar ingredients. Challenges included footfall, promotion, location, and timing of the competitions.

Across all three cooking prototypes, it was clear that learning new recipes and skills via cooking interventions can reduce the perceived risk of trying new foods, recipes, and cooking techniques. People, including neighbours, were curious about the new dishes, and men proactively approached facilitators for information for their female family members.

### RAPARIGA BIZ (RB)-BASED PROTOTYPES

As mentioned before, we sought to leverage the RB programme, especially the mentorship sessions. As part of this, two peer-to-peer RB-based prototypes were developed to both increase nutrition knowledge and improve eating habits/change behaviour in a fun, age-appropriate and engaging manner. RB mentors were briefed on how the prototypes work and the nutritional information in them. While many of the prototypes targeted or included the girls' influencers, the RB-based prototypes described in Figure 6 were developed specifically for the girls. A key learning from both prototypes was that the mentors—and specifically their ability and commitment to develop a rapport with the participating girls—were essential to success.

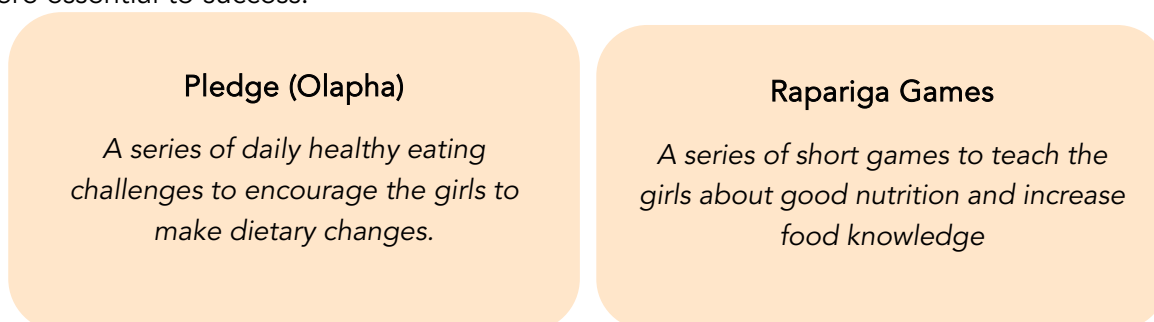


Figure 6: Two prototypes were tested with facilitation from Rapariga Biz mentors.

The Rapariga Games used colourful cards and games to generate enthusiasm and knowledge about nutrition topics. The prototyping confirmed that many girls had little baseline nutrition knowledge and low literacy levels, making it necessary to simplify information, tailor material to their abilities, and include plenty of images. It was also concluded that whilst the games were enjoyed by the girls and had potential for improving nutritional knowledge, they would

need to be implemented alongside another, more complex intervention to affect behaviour change.

The Pledge tested various tools (a calendar of challenges, hints and tips, videos (e.g., testimonials, a day in the life), peer support (mentoring and buddying), and a bracelet reward system) to stimulate conversation and engagement and to remind the girls about healthy eating. The peer support system was designed to help the girls build commitment, find solutions, and overcome challenges. We found that the agency required to both sign up for and complete challenges was directly linked to age: older girls (age 15 to 19) were more able to sign up to and complete the tasks than younger girls (age 10 to 14). Girls with very low literacy levels (around 35% of the girls in each group) had significant difficulties identifying and completing their pledge challenges. Girls who had the opportunity to choose their challenges (as opposed to being prescribed them) were more likely to complete their tasks, since some of the prescribed challenges were perceived as too difficult due to food unavailability and time constraints. The girls liked having bracelets, and girls who did not complete the challenge were disappointed that they did not have a bracelet. The connection between the bracelet and the pledge was not well understood by the girls, however, and it



Figure 7: A facilitator leading a Rapariga Game (L) and a girl showing her Pledge activity bracelet

was clear this link would have to be strengthened in further iterations.

### INTERACTIVE MEDIA PROTOTYPES

In the formative research, videos were found to be valued for entertainment and information sharing, and neighbourhood dynamics were revealed to play a significant role in community social life. The media prototypes (listed in Figure 8) aimed to test three different communication channels (DVDs, cinema projections, and comedy/drama theatre plays) as ways of delivering key messages to promote diet-related behaviour change. Participants who received the recipe DVDs had good recall of the recorded content and were willing to try new recipes. Holding theatre events at a school ensured that students were in attendance and using comedy to engage participants was deemed a successful method to promote audience engagement, participation, and messaging retention. Following theatre performances, participants suggested including summary messages and practical tips to

encourage family discussions about nutrition and health. Finally, the video projection events attracted large, attentive crowds, but in the post-video discussions using a storyline (or soap opera) format that resonates with the audience and fosters an emotional connection was recommended to optimise participation rather than opting for informational delivery.

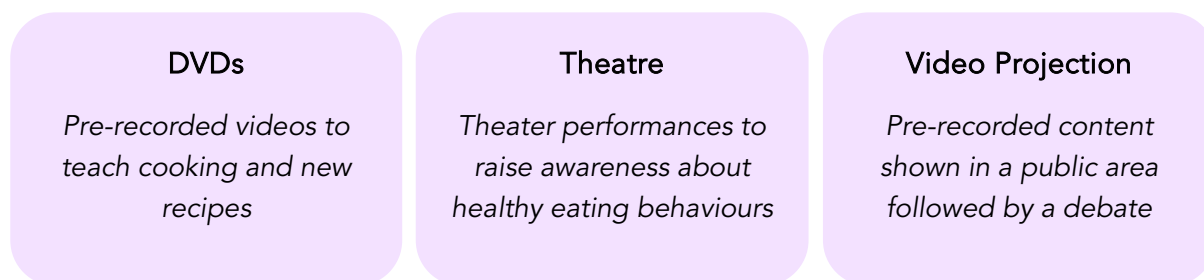


Figure 8: Three interactive media prototypes tested with the adolescent girls, influencers, and the community.

## MARKET INTERVENTIONS

Two different groups of participants (adolescent girls and male influencers) generated ideas that centred on engaging market vendors as a way to increase nutritional knowledge. We also found that whilst girls generally have little agency in what foods are available and eaten at home, girls living in urban areas do have a small amount of pocket money to buy drinks and snacks outside schools. Similarly, many household-level food purchasing decisions are not made by the girls themselves but by other members of the family/household in the market, store, or kiosk. We prototyped two market-based interventions (detailed in Figure 9) to try to shift purchasing towards healthier options.



Figure 9: Two market intervention prototypes were tested in local markets.

While the food tags (see Figure 10 for an example) were intended to be a call to action and buyers were curious about the new information, only some vendors reported an increase in sales. Since many customers intend to purchase specific items at the market and vendors were not trained to provide additional information about nutrition, informational signs alone were not enough to change purchasing decisions. Similarly, though the School Boxes attracted attention, celebrity endorsement and marketing messages did not appear to drive fruit purchases from the box.

## COMMUNITY GROUP PROTOTYPES

Using community and group events as an opportunity to engage groups as collective organisations was an idea generated by adolescent girls and male influencers during the co-design workshops. These events were seen as ways to share information and discuss healthy dietary practices in a way that could positively affect the eating habits of the whole family. In Nampula, semi-formal civic and social societies are common, and formative research findings showed that membership of them, especially of savings groups, is aspirational; religion is also a centrepiece of many social networks.

Three different group- or event-based approaches were prototyped (Figure 11). For testing practicalities, we found that plugging into existing groups is easier than forming new groups. Weekly Savings Group meetings provided an ideal opportunity to reinforce key messaging with music and song, information, and discussion. Maintaining space and time for questions and having a moderator trained in nutrition were identified as important for ensuring that participant questions could be answered. A mixed-gender group was also a success, as men were vocal and seen as potential connectors, spreading information to their families. Without the support of a trained moderator to guide discussion and answer questions about nutrition topics, the group did not continue with the songs or messaging.



Figure 10: An example of the Food Tags

**Savings Group Song**  
*Introduction of positive nutrition behaviours through songs and written materials*

**Soccer Game**  
*Introduces men to healthy nutrition practices during soccer matches*

**Mesquita Speech**  
*Uses the influence of religious leaders to persuade male influencers to change family diets*

Figure 11: The three community-based prototypes tested in Round 1



Figure 12: A group of influencers learns about nutrition with leaflets and a song during a Savings Group meeting

Though well attended, soccer games were found to be chaotic, which made messaging difficult. To use them as a means to reach men and change behaviour would need significant iterative refinement. The Mesquita Speeches were well received, and the influence of religious leaders was significant. One month following the Mesquita Speech intervention, however, out of 11 followers who participated, none reported implementing new cooking practices or applying nutrition knowledge in their homes. Moreover, men did not seem to perceive it to be their role to share or

discuss the nutritional information with their family, unlike the proactive encouragement and interest for their families shown by men during the cooking prototyping.

## SUMMARY OF PROTOTYPING AND TESTING: ROUND ONE

The first round of rapid prototyping thus led to mixed success—which was as intended, as the HCD prototyping approach assumes and allows for a certain amount of ‘failure’ in the ideas tested. The lessons learned were presented to the various project stakeholders, including the participants of the co-design process, to discuss which ideas to take forwards into further phases of iterative prototyping and testing. Resource availability, logistics, practicality, and potential for impact and scale were considered when evaluating which prototypes had potential. The Cooking Competition, Cooking Club And Academy, Cooking Lab, DVDs, The Pledge, Theatre, and Video Projection were deemed to have high potential. The school box and Rapariga games would require further iterating and testing. The Food Tags, Savings Song, Soccer Game, and Mesquita speeches had low potential to become viable and effective interventions to improve girls’ nutrition.

In April 2019, GAIN and ThinkPlace reviewed the prototyping results, brainstormed about how each prototype could be further developed and refined, and created a strategy for the subsequent prototyping phase. Early in the refinement process, the team determined that, while the DVD prototype provided an opportunity to engage participants in the home environment, and that DVDs were a popular and valued form of entertainment (with many of the same ones watched repeatedly), DVD production would be resource intensive to pursue. It was thus not developed further. In total, three prototype ideas were selected for further prototyping exploration and development in Phase Two: the School Box, the Pledge and the Cooking Club and Academy. From this point, we focus on the ideas that became interventions to pilot test: the Pledge and the Cooking Club and Academy.

**The Pledge:** The Pledge was originally designed to encourage girls to fulfil daily healthy eating challenges using principles of gamification<sup>7</sup> to motivate the girls to participate. Some of the challenges were too difficult, and there was not a clear link between the bracelet reward system and the challenges. In the refinement stage, to further embrace the principles of gamification, the pledge was redesigned and renamed as the Heroínas Game ('As Heroínas') following a co-creation workshop with adolescent girls and Rapariga Biz mentors in June 2019. The Heroínas Game is a new game with attainable and attractive rewards to motivate participation, repeated behaviours designed to increase the participants' ability to attain rewards and develop long-term habits, and triggers that promote and encourage action (through specific missions and tasks).

**Cooking Club and Academy:** Participants enjoyed the Cooking Club and Academy activities in the first prototyping phase, but the value proposition for participants was found to be nebulous. The goal for further prototyping was to better support and encourage behaviour change through a sense of achievement, increased time and convenience, familial praise for the food prepared at home, new skill acquisition, and/or potential revenue generation. In advance of the second prototyping phase, it was renamed as the Cooking Academy and redesigned as a 10-week course, led by a trained facilitator and co-facilitator, that provided an opportunity for mothers and daughters to participate in cooking activities together and learn recipes and cooking skills to use at home.

## PROTOTYPING AND TESTING: ROUND TWO

The second round of prototype testing was conducted in Nacala Porto in June 2019. The goal was to test the revised prototypes of the most promising interventions: the **Heroínas Game** and the **Cooking Academy**. Over three weeks, each prototype was tested, iterated, and refined using co-design methods to engage participants and mentors/facilitators to ensure that their opinions, needs, and experiences were integrated into the prototypes. After each test, the team reviewed desirability, scalability, and viability by addressing questions about required elements for intervention success, potential facilitators, and barriers to participant engagement, and how participants might engage across the package of interventions.

### THE HEROÍNAS GAME

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<sup>7</sup> *Gamification* applies a game or elements of a game in a non-game context to make learning, skill-building, or routine tasks into something fun. Game rankings, progress metrics, and rewards are given to participants when they have completed challenges or met certain milestones (7,48).

The formative research identified that there were few opportunities for the girls to play between their school and domestic responsibilities. The Heroínas Game endeavoured to support the child-like nature of the girls' social context and provide an opportunity for the girls to interact with their peers, build skills, knowledge, confidence, and motivation, and have fun. The game was designed to encourage the girls to change behaviour by completing weekly game 'missions' that, if completed successfully, were rewarded. Completion of missions allowed progression through levels and ultimately lead to them becoming a *Heroína*, represented by a character they chose at the start of the game (see Figure 13).



Figure 13: The three Heroínas created for the game

These three *Heroínas* were developed in an ideation session with Rapariga Biz girls and mentors.

At its core, the aim of the Heroínas Game was to stimulate habit-forming healthy eating behaviours through incentivising and rewarding the completion of missions related to healthier eating choices. Missions and rewards were designed to encourage the girls to invest time in the game, prevent boredom and create excitement. When missions were successfully completed, the girls were rewarded with beads (shown in Figure 14) that could be added to a bracelet.

To test the Heroínas Game, Rapariga Biz mentors were trained as facilitators, and two groups of adolescent girls (n= 41; ages 10 to 14 and 15 to 19) were selected by Coalizão to participate in the first prototype session. In the session, the mentors introduced the game, generated excitement and explained the materials, including the choice of *Heroína* characters. Girls who lived close to each other were divided into teams of five, each with a team captain who also lived close. This peer support system (the team and the captains) allowed girls to help each other and work as a team, sharing resources and overcoming challenges. After the session, feedback was elicited from the girls and the mentors about clarity, accessibility, variety of rewards and level of difficulty of the missions. For sessions two and three, the game materials were redesigned to be easier to understand and more visual, better aligned to the girls' low literacy levels. The game was tested again, and post-test interviews were conducted with girls, mentors, and mothers. Though there was some confusion about meeting times that impacted participation, the girls enjoyed and understood the game dynamics. All girls who participated in multiple sessions had a won at least two beads (rewards), such as those pictured in Fig. 14, each.



Figure 14: Sample beads given to reward mission

### COOKING ACADEMY (“ACADEMIA WAPEA”)

The cooking-focused prototypes were all well received in the first prototyping phase. Strengthening cooking skills seemed like a promising way to encourage dietary changes for adolescent girls and to involve and build trust with a key influencer of the girls: their mothers. As for the Heroínas Game, three Cooking Academy sessions were tested with mothers and



Figure 15: Cooking Academy (Academia Wapea) logo

daughters. Though the foods used in the sessions were familiar, the classes explored new techniques like soaking beans to speed up cooking times (reducing the amount of fuel required) and decrease digestive discomfort, reducing the cooking time for greens to preserve nutrients, and preparing recipes with less oil. The goal of introducing these new techniques was to allow participants to realise that different preparation methods could yield palatable results and break up the perceived monotony of meals prepared with familiar, available ingredients.

In the first session, a facilitator introduced three recipes and demonstrated how to prepare them. The ten participants then replicated the recipes. Cookbooks with recipes used in the class were provided to the participants at the end of the session. Based on feedback after the first session, the cookbooks were revised for subsequent sessions to include more images and less text, tailoring the instructions to low literacy levels. The aim of the cookbooks was to expose participants to a variety of tasty, easy, and exciting ways of cooking familiar ingredients using recipes related to the behaviour



goals set in the project – breakfast, dark green leaves, vegetables in general, beans, and cooking with less oil. Costs associated with the recipes were also estimated using local prices to ensure they were affordable for families. Everyone ate together at the end of the session, and participants were able to bring food home to share with family members. Allowing family members (especially husbands/fathers) to taste the new dishes was seen as a way to gain support for continued participation in the programme and to encourage replication of recipes at home.

In addition to observations made during the sessions, interviews were conducted with four participants after each session. Mothers were interested in participating in the Cooking Academy for social recognition as a good mother, to develop new skills, and to explore future the income-generation potential of those skills. Participants benefitted from hands-on recipe preparation: many reported preparing Cooking Academy recipes at home, and participants particularly liked preparing recipes that were familiar to them. The intergenerational aspect was also appreciated. Mothers mentioned that they enjoyed cooking the new recipes with their daughters as they were now confident the girls could cook the new recipes on their own. Following the Cooking Academy sessions, all participants reported interest in a three-month Cooking Academy programme, citing it as a valuable way to spend free time.

### **THE COOKING ACADEMY AND THE HEROÍNAS GAME AS COMPLEMENTARY INTERVENTIONS**

The Cooking Academy and Heroínas Game were designed as interventions with synergistic possibilities, and the assumed benefits of linking the two were well supported during prototyping. Together, the Cooking Academy and Heroínas Game fostered mother-daughter relationships, trust, and communication; equipped the girls with cooking skills needed to complete the Heroínas Game missions; exposed the girls and their mothers to healthier eating behaviours; and provided meaningful opportunities for the girls and their families to try new foods and recipes.

### **PROTOTYPING ROUND TWO SUMMARY**

There were several important lessons learned from the Heroínas Game prototyping. First, mentors were crucial to the successful functioning of the game and, because the girls develop a relationship with and look up to the Rapariga Biz mentors, the mentors' level of training and commitment were thus paramount. Age was a factor, too: having mentors and team captains that are closer in age to the participants would help maintain interest and dedication; older girls were seen to be busier, less available for support, and less interested in the game. Mentors also wanted to play the game, which was seen as an encouraging sign of its wide appeal. Second, 'fun' missions that involved beauty topics or play-based activities were very popular with the girls and encouraged continued participation. The reward system (the beads) confirmed design assumptions and proved to be an essential part of the game. Having different beads each week alongside more 'special' surprise beads increased the girls' engagement and motivation to achieve weekly missions. However, validation of mission completion, whilst necessary to instil a sense of achievement and a celebration of effort, was a big challenge for both the mentors and the girls. Finally, contextual factors like literacy and

purchasing power proved to be a continued challenge to the girls' completion of the missions. The use of image-based materials in the redesign proved helpful to support girls with low literacy, but many parents lacked money to support their daughters' missions (like purchasing fruit).

Participation in the Cooking Academy was seen as a way to develop skills, create social capital and recognition, and possibly build a business. Having a facilitator who communicates clearly and manages people well was found to be essential to ensure that sessions ran smoothly. While participation in and enthusiasm for the Cooking Academy were excellent, planning sessions at a time that allows for maximum participation in light of women's domestic responsibilities is an important future consideration. Finally, to gain support from husbands and family members for new food preparation recipes and techniques, it is important for women to have enough food to bring home at the end of the sessions.

## DISCUSSION

In this initiative, we endeavoured to co-design interventions that had the potential to increase adolescent girls' consumption of nutritious and safe foods in Mozambique. To do so, we applied innovative HCD techniques to understand and adapt to the girls' contextual realities, especially poverty and the associated limitations on making significant and sustainable dietary changes. Combining nutrition programming and design thinking expertise, we were able to be responsive, adaptable, and iterative as we learned through the HCD activities, including field observations, ideation workshops, and iterative prototyping activities. As far as we know, no other nutrition-focused project in low-income settings has sought to apply an immersive HCD approach to learn from and co-design with adolescent girls and their influencers. Given the paucity of literature, we highlight here some key insights for other practitioners on how to meaningfully engage adolescent girls in a co-design process.

While the approach was adapted to the specific realities of adolescent girls, however, we did not seek to affect broader cultural change in gender norms and expectations, household roles or familial expectations. Doing such work in the future will be important for three reasons. First, many adolescents, especially girls, are not fully independent and self-sufficient in their decision-making around food consumption. They rely on guidance from peers and relatives, and community and societal influences also impact their health-related decisions; addressing these broader constituencies is thus important for improving adolescent nutrition in a sustainable, long-term manner. Second, gender inequality and women's disempowerment are root causes of malnutrition. Girls and women in Mozambique are actors at all levels of the food system but often lack agency; they undertake most of the unpaid work related to food but are unable to optimise their contribution. Finally, boys also suffer a high level of malnutrition and are largely de-prioritised in nutritional programming as a specific population with specific needs, realities, and motivations. In the future, gender-transformative, culturally sensitive interventions working with both boys and girls will be needed to start to empower both genders with nutritional skills, knowledge, and behaviours and to shift harmful gender norms. Further, there is an urgent need to develop programmes that understand, adapt to, and improve the nutritional status of boys in Mozambique.

Our experience here underscores the vital importance of involving adolescents and their influencers in the co-creation process—even if this is not always easy. With limited literacy and little agency in their daily lives, encouraging the girls to participate in ideation and prototyping events proved challenging. The girls' limited access to communication technology (especially phone ownership) and to a variety of nutritious, safe foods were also barriers to adapt to. Moreover, a significant amount of domestic responsibility leaves the girls (indeed women in general) with little time or freedom for other activities. Practicalities—like scheduling participation to ensure sufficient time for travel, meal planning, school attendance and household duties—should not be underestimated.

A similar challenge was our reliance on feedback from various stakeholders in the iterative prototyping process – mentors, vendors, parents, community leaders and the girls themselves. There were often logistical challenges in reaching and following up with these diverse groups. People were often not contactable by phone for several days, market vendors' schedules were difficult to predict, and appointments were difficult to confirm. Further, recall and recording of quantitative information (e.g., numbers of people attending, interested, or asking questions; sales; challenges completed) was inconsistent and highlighted the importance of coaching and supporting participants to assess and record measures of success.

Some of the activities were challenging for the workshop participants, and the co-design team observed that participants commonly mentioned ideas based on what they had seen or already knew, rather than generating new or inventive ideas. Similarly, many girls were shy and unfamiliar with being asked to contribute their opinions, and they had a strong desire to say the 'right' thing to please the co-design team. To overcome these challenges, we provided coaching and guided groups to build confidence and creativity. We also seeded ideas or concepts for further inspiration and idea generation. Whilst this support and encouragement were critical for capacity building and engagement in co-creation work, we recognise that it could be seen as paternalistic and not true to the 'human-centred' nature of these methods. Future HCD programming among populations with low agency living in resource-poor settings should keep in mind the need to balance the level of external support and coaching with the trust and independence that underpins human-centred design.

There are many benefits to HCD methods, and the work described in this paper resulted in many important lessons learned and two 'packaged' prototype interventions ready for pilot testing. The complete process of exploration, ideation, design, and development, however, was long and resource intensive. Alongside the significant investment required, we found maintaining momentum during the design process, measuring, and demonstrating success with prototypes, and maintaining accountability with our diverse stakeholders to be especially challenging. Others should keep in mind these time and resource impacts when deciding to embark on an HCD process.

Our experience also sheds light on the potential of certain motivators of participation and behaviour change. Interestingly, competition proved not to be a strong motivating factor for the girls' engagement; collaboration, accreditation (certificates of attendance or skills developed), and coaching were more powerful ways to build participants' interest, commitment, and confidence. During testing, knowledgeable moderators and facilitators

were valued as a trusted source of information and support and to answer questions. This experience demonstrates the value of training, mentoring, and supporting community members to develop the skills and knowledge to become trusted experts—both to equip and upskill families and communities and as a means to future income generation. We also found cooking to be a powerful tool that brings generations together, engages community interest, and builds trust and agency in families. Men seemed especially proactive and encouraging of female family members participating in cooking activities in a way that was not seen during the activities aimed at influencing men directly. Building the girls' skills and confidence, especially with cooking, created trust and increased their agency within their families.

We were able to leverage these strengths—and set aside the weaker motivators—because the rapid, iterative testing and refinement of the prototypes granted us flexibility to learn and adapt. This process does not, however, adapt well to more complex assessments, such as the extent to which a prototype holds the potential to change behaviour. It was challenging to move beyond observational or quantitative measures of attendance, engagement, and acceptance into more meaningful assessments of potential for impact on behaviour—particularly for the larger, public event-type prototypes. For that element, we sought to draw on behavioural theory to assess the prototypes' potential for behaviour change. Motivation, ability/capability, and opportunity (with the terminology differing between behavioural models) are fundamental determinants in many theories of behaviour change—all of which were aspects of the interventions examined here.

Motivation was built into the Heroínas Game in the fun focus of some of the missions and by using beads as rewards for completed missions. The game aimed to promote and instil motivation to drive sustained behaviour change via hope of earning beads. The Cooking Academy also integrated motivation by providing recipe books as part of the class and a completion certificate at the end of the session series. Ability was central to both the Cooking Academy and Heroínas Game. In the Cooking Academy, recipes were developed to showcase familiar foods in new and enjoyable (tasty and easy to digest) ways, and the Heroínas Game missions increased the girls' knowledge, skills, and confidence in preparing foods on their own. The missions were designed to be achievable and familiar and were often created to be an extension of their regular routines. By building confidence with each success, the game aimed to support confidence-building and habit-forming behaviours. Finally, opportunities were integrated into the Heroínas Game missions and included reminders and cues in the game materials, weekly meetings, and printed booklets. By responding to the missions and receiving incentives for participating in healthy behaviours, the girls could potentially develop long-lasting habitual behaviours like eating breakfast, increasing fruit or bean consumption, or incorporating other nutritious, safe foods.

A key observation throughout this process, one that cuts across these three domains of behaviour, relates to the value of intergenerational trust-building and skill development as a means to affect positive change. This holds much wider potential for impact across a range of health and social outcomes and is worth exploring to influence change in other contexts and countries.

## CONCLUSION

Using human-centred design methods, GAIN and its partners developed two promising interventions, the Heroínas Game and the Cooking Academy, with adolescent girls and their influencers in Nampula Province, Mozambique. Using an immersive, continuous learning approach, lessons from the field were continuously applied to the work, and concepts were refined through ideation, iteration, and prototyping. Respecting and working within social, cultural and gender norms, we could identify feasible and acceptable pathways through which behaviour can be influenced. By learning from and with the adolescent girls and their influencers through the HCD process, we were able to design the Cooking Academy and Heroínas Game as contextually appropriate interventions aimed at building motivation, capability, and opportunity to develop the targeted nutritional behaviours. Following the second round of prototyping, the Cooking Academy and Heroínas Game were further refined to be piloted tested in Nampula Province; this piloting started in September 2019 as part of the Rapariga Biz programme. Examples of the materials (the sign-up and calendar poster, and the poster for participants) are shown in Annexes 1 and 2. Findings and lessons learned from the development and launch of the pilot intervention, and future directions for the project, will be available in 2021. For the time being, we hope that the experiences and lessons presented here prove useful for others aiming to apply HCD principles to improve the nutrition of adolescents in low-income settings.

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**ANNEX 1: THE SIGN-UP SHEET AND GAME CALENDAR POSTER FROM THE PILOT-TESTED MODEL OF THE HEROÍNAS GAME**

**AS HEROÍNAS**

**A tua filha está convidada a participar no jogo Heroínas!!**

Dia da semana:  Local:   
 Hora:   
 Mentora:  Contacto:



**Durante 16 semanas a tua filha vai jogar este jogo que tem vários desafios que ela deverá ultrapassar para ganhar presentes lindos.**

DURANTE 16 SEMANAS A VOSSA FILHA VAI PRECISAR DO VOSSO ENVOLVIMENTO E APOIO PARA CONSEGUIR COMPLETAR OS DESAFIOS E GANHAR O JOGO. ASSINAR O VOSSO COMPROMISSO:

ASSINATURA DO PAI:

ASSINATURA DA MÃE:

**AS HEROÍNAS**

SEMANA 1	SEMANA 2	SEMANA 3	SEMANA 4
SEMANA 5	SEMANA 6	SEMANA 7	SEMANA 8
SEMANA 9	SEMANA 10	SEMANA 11	SEMANA 12
SEMANA 13	SEMANA 14	SEMANA 15	SEMANA 16

**SEMANA 16**

Ganha as 4 qualidades especiais do sonho/fantasia, da compaixão/bondade, ser batalhadora/dedicada e da inteligência/sabedoria, para te tornares na tua heroína!




**ANNEX 2: THE POSTER GIVEN TO PARTICIPANT GIRLS TO SHOW PROGRESSION THROUGH THE LEVELS AND TOWARDS BECOMING A HEROÍNA**

**AS HEROÍNAS**

Escolhe a heroína que te vai ajudar a jogar durante as próximas 16 semanas


**INÍCIO**



**PRINCESA SOFIA**

**Super-poder:**  
Fala com todos animais do mundo!


**INÍCIO**



**MULHER ARANHA**

**Super-poder:**  
Pode voar pra qualquer lugar da comunidade!

**INÍCIO**



**MULHER COBRA**

**Super-poder:**  
Se transforma em cobra para combater os bandidos!

**PRESENTES SEMANAIS**

Quanto mais desafios completares, mais amuletos ganhas para a tua pulseira ficar a cada semana mais bonita!

DESAFIOS OBRIGATORIOS	DESAFIOS EXTRAS
1 <input checked="" type="checkbox"/> → 0 AMULETO	1 <input checked="" type="checkbox"/> → 0 AMULETO
2 <input checked="" type="checkbox"/> → 1 AMULETO	2 <input checked="" type="checkbox"/> → 1 AMULETO

**Atenção:** Para ganhares amuletos dos desafios extras tens que primeiro receber pelo menos 1 amuleto dos desafios obrigatórios!

**SEMANA 04**  
SE TIVERES GANHO 3 AMULETOS OU MAIS GANHAS A QUALIDADE ESPECIAL DO SONHO/FANTASIA.

**SEMANA 08**  
SE TIVERES GANHO 6 AMULETOS OU MAIS GANHAS A QUALIDADE ESPECIAL DA COMPAIXÃO/BONDADE.

**SEMANA 12**  
SE TIVERES GANHO 9 AMULETOS OU MAIS GANHAS A QUALIDADE ESPECIAL PARA SER BATALHADORA/DEDICADA.

**SEMANA 16**  
SE TIVERES GANHO 12 AMULETOS OU MAIS GANHAS A QUALIDADE ESPECIAL DA INTELIGÊNCIA/SABEDORIA.

**SEMANA 16**  
GANHA AS 4 QUALIDADES ESPECIAIS DO SONHO/FANTASIA, DA COMPAIXÃO/BONDADE, SER BATALHADORA/DEDICADA E DA INTELIGÊNCIA/SABEDORIA, PARA TE TORNARES NUMA HEROÍNA!

