



Happy Village Plus: Community-empowered health promotion interventions in Sri Lanka

Ajith Alagiyawanna^{a,1}, Zoey Verdun^{b,c,1} , Bernardo Andretti^d , Lathika Athauda^e ,
Ranjith Batuwanthudawa^a, Madawa Chandratilake^e, Laksara De Silva^f, Palitha Karunapema^g,
Indeewara Muthiarachchi^a, Chathura Palangasinghe^f, Ashan Pathirana^a, Kusal Weerasinghe^a,
Nalinda Wellappuli^h, Dilukshi Wickramasinghe^a , Millawage Supun Dilara Wijesinghe^a,
Prasad Katulandaⁱ, Anuradhani Kasturiratne^e, Gary Frost^j, Franco Sassi^{b,c} ,
Marisa Miraldo^{b,c,*} 

^a Health Promotion Bureau, No.2, Kynsey Road, Colombo, 08, Sri Lanka

^b Centre for Health Economics & Policy Innovation, Imperial Business School, Imperial College London, South Kensington Campus, Exhibition Rd, London, SW7 2AZ, UK

^c Department of Economics and Public Policy, Imperial Business School, Imperial College London, South Kensington Campus, Exhibition Rd, London, SW7 2AZ, UK

^d NEOMA Business School, 1 Rue du Maréchal Juin, Mont-Saint-Aignan, 76130, France

^e Faculty of Medicine, University of Kelaniya, Thalagolla Road, Ragama, Sri Lanka

^f Centre for Diabetes, Endocrine and Cardio-metabolic Research, Department of Clinical Medicine, Faculty of Medicine, University of Colombo, Sri Lanka

^g Director Health Information, Ministry of Health, Colombo, 10, Sri Lanka

^h School of Medicine, University of Keele, ST5 5BG, UK

ⁱ Faculty of Medicine, University of Colombo, 25 Kynsey Rd, Colombo, 00800, Sri Lanka

^j Department of Metabolism, Digestion and Reproduction, Faculty of Medicine, Imperial College London, Faculty Building South Kensington Campus, London, SW7 2AZ, UK

ARTICLE INFO

Keywords:

Health promotion
Community-based interventions
Health determinants
Non-communicable diseases
Sri Lanka
Precede-proceed model
Nutbeam model

ABSTRACT

Background: Non-communicable diseases (NCDs) account for over 80% of deaths in Sri Lanka. Addressing these diseases is challenging due to their complex social, behavioural, and environmental causes. Community-based health promotion programmes focused solely on single risk factors and education provision show limited effectiveness. This study describes Happy Village Plus (HVP), a grassroots, community-based intervention designed to select and implement health promotion interventions aligned with communities' health-related needs in Western Province, Sri Lanka.

Methods: HVP was conducted in six communities from November 2022 to June 2024. We recorded Capacity Building and Engagement Activities by type of activity and stakeholders engaged, and Community Interventions by approach and health determinant. Communities' health-related risk factor needs were obtained from individual-level data from 1712 individuals. Regression analyses were conducted to assess whether the community interventions chosen matched communities' health-related needs.

Findings: A total of 1217 Capacity Building and Engagement activities were recorded. Community interventions (n = 975) most often addressed diet-related determinants, followed by physical activity and BMI, and to a lesser extent, tobacco and alcohol. For most communities, insufficient fruit and vegetable consumption was the most prevalent health-related need, followed by insufficient physical activity, alcohol use, and smoking. Our results show the selected interventions align with identified needs.

Interpretation: This paper demonstrates the feasibility of implementing grassroots, holistic, multi-faceted, community interventions covering a wide range of health determinants and NCD risk factors in a developing country

Note: the middle authors starting from Lathika Athauda up to and including Millawage Supun Dilara Wijesinghe have been ordered alphabetically.

* Corresponding author. Department of Economics and Public Policy & Centre for Health Economics & Policy Innovation, Imperial Business School, South Kensington Campus, Exhibition Rd, London, SW7 2AZ, UK.

E-mail address: m.miraldo@imperial.ac.uk (M. Miraldo).

¹ Co-First authors: Ajith Alagiyawanna, Zoey Verdun.

<https://doi.org/10.1016/j.socscimed.2026.119455>

Received 1 July 2025; Received in revised form 20 April 2026; Accepted 26 May 2026

Available online 8 June 2026

0277-9536/© 2026 The Author(s). Published by Elsevier Ltd. This is an open access article under the CC BY license (<http://creativecommons.org/licenses/by/4.0/>).

context. We highlight that, when empowered, communities can select interventions that align with their health needs, with higher disease prevalence increasing the likelihood of choosing relevant interventions.

1. Background

Non-communicable diseases (NCDs) are leading causes of death globally (World Health Organization, 2024a). The burden of NCDs is particularly high in Sri Lanka (Ministry of Health and Department of Census and Statistics, 2021; World Health Organization, 2024b), accounting for over 80% of total deaths in the country compared to 62% in the South-East Asia region (World Health Organization, 2024c). NCDs are influenced by broader socioeconomic, environmental, and individual health determinants (Atanasova et al., 2022a; Atanasova et al., 2022b; World Health Organization, 2017; Kusuma et al., 2022). They have modifiable behavioural risk factors (e.g., alcohol use, unhealthy diet, physical inactivity), metabolic risk factors (e.g., obesity, high blood glucose levels), and environmental risk factors (e.g., air pollution) (World Health Organization, 2023). NCDs can also occur simultaneously (i.e., multimorbidity). For instance, one study found that cardiometabolic multimorbidity affects 36.3% of Sri Lankan adults (Prathapan et al., 2020). Given their multiple causes and risk factors, NCDs are therefore complex diseases to address and mitigate. However, NCD-targeting health promotion interventions often fail because they: 1) target a single NCD determinant (e.g. only encouraging healthy eating) (Marmot and Bell, 2019), 2) rely solely on education campaigns (e.g., fail to incorporate behavioural insights) (Mertens et al., 2022), and 3) are designed and implemented without community engagement (e.g., being ineffective or having unintended consequences) (Moore et al., 2021). It is therefore unclear whether communities will select interventions based on their observable needs, or if there may be additional factors that guide their choices.

Previous research suggests that health promotion efforts using a community-driven, whole-systems, behaviourally oriented approach can be more effective in addressing multiple NCDs (Marmot and Bell, 2019). Interventions in developing countries are effective in addressing NCD risk factors (Sarrafzadegan et al., 2009; Tran et al., 2017), relying on community engagement with grass-roots level selection of interventions suited to the local needs (Murray et al., 2013; Payán et al., 2017). In developed countries, a notable example is the Finnish North Karelia Project, which implemented lifestyle changes through environmental modifications and large-scale education campaigns – including community involvement, engagement of informal leaders, and targeting multiple NCD risk factors and thereby reducing cardiovascular disease risk factors and mortality (Jauho, 2021).

This paper describes Happy Village Plus (HVP), a novel, holistic, behaviourally oriented, community-based, health promotion programme by the Health Promotion Bureau (HPB). Built upon the original Happy Village programme launched in 2019 (Alagiyawanna et al., 2025), HVP was piloted in six communities in Western Province, Sri Lanka. HVP offers a complex package of community-based interventions grounded in several conceptual frameworks (behavioural (Mertens et al., 2022), Precede-Proceed (PP) (Green and Kreuter, 2005), Nutbeam (1996)) that integrates behavioural insights. It aims to target multiple NCD risk factors and other health determinants (e.g., air pollution) and their associated behaviours. Importantly, for each determinant (e.g., salt), multiple interventions are available to be selected and implemented by the community, allowing them to comprehensively target various behaviours or behavioural drivers according to their perceived needs.

Previous evidence shows that interventions targeting multiple behaviours simultaneously can also have limited effectiveness, with reviews showing that multi-behaviour programmes across key NCD risk factors, such as diet, physical activity and cardiovascular health, frequently produce modest or mixed results (Prochaska and Prochaska, 2011). HVP addresses these challenges by adopting a community-driven

prioritisation approach in which communities themselves select the determinants most relevant to their own identified needs, rather than adopting a top-down approach in which interventions address all (or many) determinants at once without prioritisation. Evidence from LMICs suggests that this kind of community engagement in the design and selection of health interventions improves adherence and health outcomes, in part because community ownership over programme content reduces resistance and increases sustained participation (Khatri et al., 2024; Pilkington et al., 2017). This bottom-up selection process therefore reduces the risk of overloading participants while still enabling a multi-faceted response to NCD risk factors.

The aim of this paper is two-fold. First, to describe the engagement activities and assess the interventions selected by the six communities with the objective to characterize what risk factors have been prioritized and what type of interventions were selected. Second, to measure baseline health-related needs in relation to risk factors and descriptively evaluate whether the selected interventions align with their health needs.

2. Healthy Village plus: Conceptual framework

The full HVP protocol is described in Alagiyawanna et al. (2025). HVP bridges several conceptual models by integrating traditional health promotion with behavioural science and community engagement. It builds on foundational public health efforts, as outlined in the Ottawa Charter for Health Promotion, which defines advocacy, enabling, and mediation as core health promotion functions (World Health Organization, 1986). The Nutbeam model of health literacy (Nutbeam, 1996) further applies these principles, providing a framework for using information provision to prevent health risks and NCDs. To provide a framework for our analysis and conceptually describe HVP, we combine the Nutbeam model with other behavioural change conceptual models (behavioural (Mertens et al., 2022), PP (Green and Kreuter, 2005), Nutbeam (1996)). The conceptual framework developed by HVP uses multiple theoretical frameworks and models including but not limited to: diffusion of innovation, social cognitive theory, health belief model, theory of recent action and theory of planned behaviour. A key innovation in HVP is the integration of more effective behavioural insights into the set of interventions offered (Mertens et al., 2022). This is achieved by encouraging behavioural change via “if-then” statements to encourage healthier habits (Galizzi, 2014; Gollwitzer, 1999; Gollwitzer and Sheeran, 2006), referred to as a *nudge* in the literature. Figure A1 presents these elements through an adaptation of the PP model (Green and Kreuter, 2005). Additionally, HVP adopts a holistic approach, targeting multiple risk factors and associated behaviours through a comprehensive set of interventions to avoid negative spillovers that can occur when only one behaviour is addressed (Shreedhar and Galizzi, 2021).

Beyond individual behaviour change, HVP also works to create supportive environments by mobilising community stakeholders, improving local health information infrastructure, and engaging institutional actors across public health, local government, and the private sector. This is further reflected in the programme's situational analysis phase, conducted by Health Promotion Field Agents (HPFAs) prior to the intervention. Drawing on social, behavioural, environmental, educational, and administrative needs diagnoses of each community, HPFAs map local health needs and present findings to Health Promotion Boards and Medical Officers of Health. Within the first month, HPFAs convene local conferences bringing together formal and informal community leaders to advocate for HVP implementation and collaboratively develop contextually appropriate action plans. This process is explicitly

designed to build the social and institutional infrastructure necessary for sustained healthy choice environments, rather than relying solely on individual behaviour change. Finally, HVP is grounded on the principle that sustained and effective behaviour change requires community buy-in, empowerment and engagement (Kim et al., 2022). Therefore, HVP interventions are designed and implemented based on a dynamic local needs assessment and through continuous grassroots engagement in the design, selection and implementation of the interventions.

In sum, HPB, via the HPFAs, conducted a situation analysis to assess the needs within the communities. Subsequently, HPB extensively engaged with stakeholders (e.g., community members, medical officers of health, and informal leaders) and further incorporated the feedback into the assessments to design and facilitate sustained and effective behaviour change through community buy-in and empowerment (Alagiawanna et al., 2025; Kim et al., 2022). The details of the conclusion of such assessments of HPB, which include for each identified health determinant the i) main health messages, ii) actions for at home, and iii) actions at the community level, can be found at <https://tinyurl.com/intervention-table>.

3. Methods

We combine at the community level the HVP data on Community Interventions and Capacity Building and Engagement Activities with the individual-level surveillance data on health-related needs.

3.1. HVP data

HVP was implemented between November 2022 and June 2024 in the six communities (Dahampura, Gangaboda-Peliyagoda (henceforth Gangaboda), Thalgasmote, Narampola, Rukmale and, Jamburaliya; Fig. 1). The data from the six communities form an unbalanced panel because the number of recorded interventions and engagement activities varies across communities. Interventions differ by approach and determinant, and engagement activities differ by type. Due to the bottom-up nature of implementation, not all interventions or engagement activities were consistently implemented each day or even each week.

Interventions and associated engagement activities were mapped by the HPFAs using Kobo Toolbox, an open-source platform used globally to collect and manage data (KoboToolbox, 2026). In the case of HVP, it was used to collect the intervention and activity data; after each

intervention or activity was conducted, details were recorded in the Kobo Toolbox platform by the HPFA assigned to that community. The data comprises Capacity Building and Engagement Activities ($n = 1217$; e.g., meetings, community mobilisation, and volunteer training), and Community Interventions ($n = 975$; e.g., health education, behaviourally informed interventions, and skills development). Each data entry was counted as a distinct event, regardless of whether the event occurred once or multiple times, and includes community, date, and whether it is a Community Intervention or Capacity Building and Engagement Activity. Fig. 2 depicts this data structure visually.

Community engagement and empowerment, through Capacity Building and Engagement Activities, took place in each community to facilitate the selection and implementation of the Community Interventions. For example, relevant information was provided, such as a 2D map showing the locations of fast-food restaurants, shops selling cigarettes, and shops selling fruits and vegetables in their community (see Appendix 2 for such a map).

For the **Capacity Building and Engagement Activities**, we mapped both (i) the activity types: attending a monthly conference, attending other meeting, meeting a government officer, meeting informal leaders; volunteer training/review; community mobilization activities; and other; and (ii) the stakeholder types: community, public officers (health), public officers (non-health), private sector, and other (see Appendices 3-5 for further details).

For the **Community Interventions**, designed to directly interact with the community members thereby addressing the selected determinants, we mapped (i) the three intervention approaches: (1) Health Education to the Community, consisting of discussions with neighbourhood groups; lectures or talk at club/society meetings; and primary medical care unit clinic discussions; (2) Behaviourally Informed Interventions, consisting of mass communication with IEC via poster, leaflet, handouts distribution, etc; mass communication with IEC via digital, social media, etc; Food Panel activity; and behavioural situational statements (exceptionally at the household level); and (3) Skills Development Interventions, consisting of workshops and training sessions for the community; demonstration/training (for cooking, exercise, stress relief, or anthropometry measurements); and demonstration in innovative tools (e.g. salt, oil, sugar measuring tools, daily water consumption), (ii) the health determinants addressed, and (iii) the number of participants reached for each intervention. We classified the health determinants into four groups: (1) Diet-Related Risk Factors (salt, sugar,

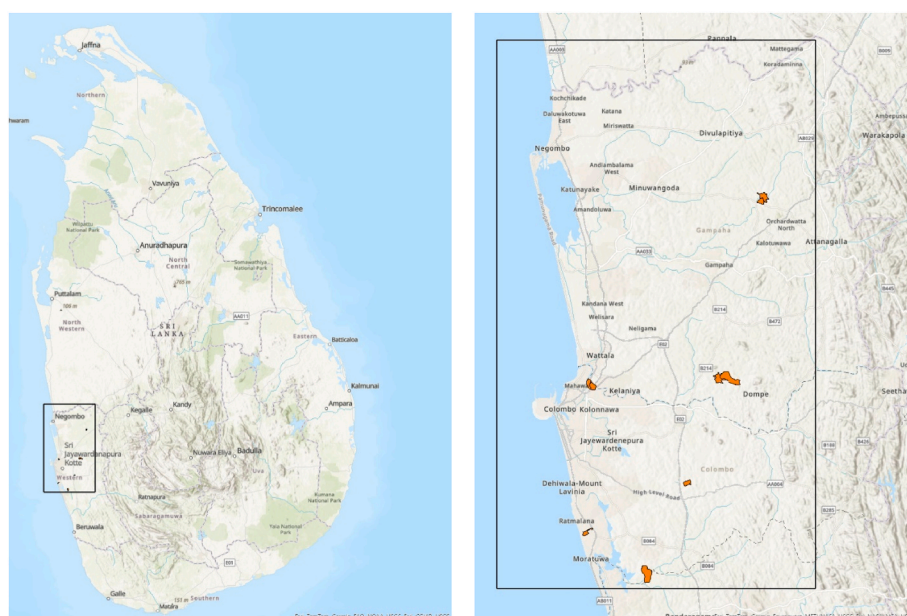


Fig. 1. HVP intervention area (left), HVP intervention communities (right).

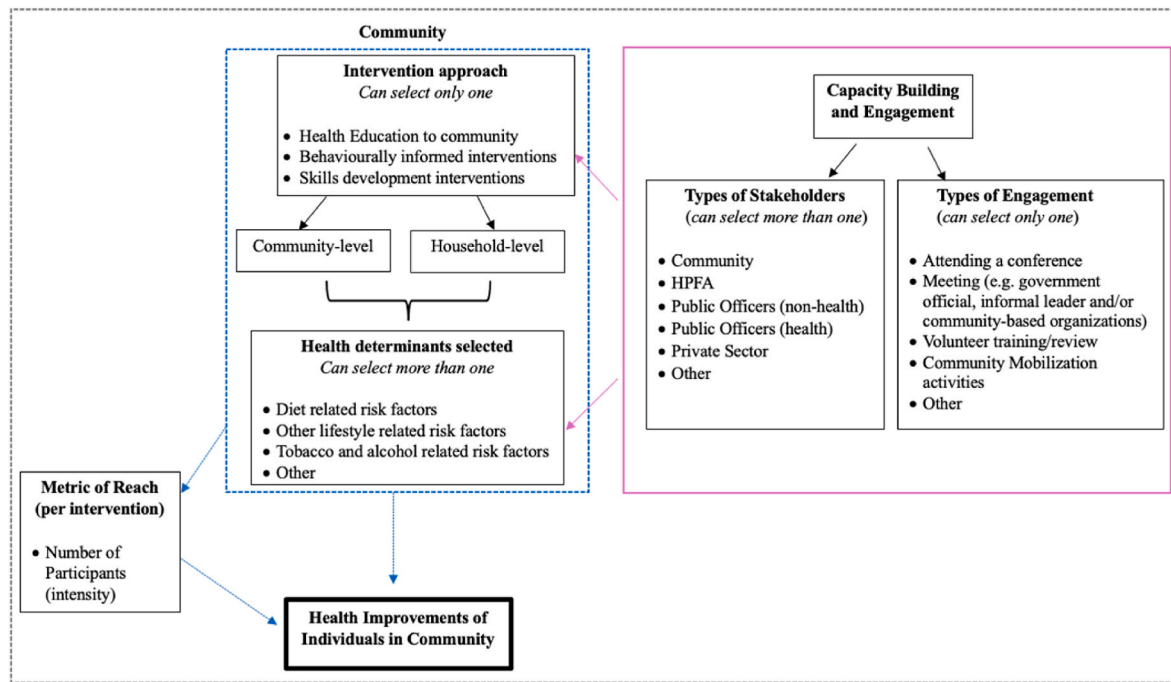


Fig. 2. Visual depiction of HVP data at an aggregated level.

starch, protein, fruits/veg/greens, fats, processed foods), (2) Physical Activity and BMI Related Risk Factors (physical activity & BMI), (3) Tobacco-Related Risk Factors (smoking, chewing tobacco), (4) Alcohol-Related Risk Factors (alcohol), and (5) Other (air pollution, NCDs and prevention, mental health, water consumption, other). For the full list of intervention approaches and health determinants, see [Appendix 3, Table A3.2](#). Finally, some behaviourally inspired interventions were implemented at the household level through visits by HPFAs and consisted of “if-then” statements (e.g., “if I am offered an alcoholic drink, I will ask for a non-alcoholic option”) ([Galizzi, 2014](#); [Gollwitzer, 1999](#); [Gollwitzer and Sheeran, 2006](#)). For the full list of statements, see [Appendix 6](#).

3.2. South Asia Biobank (SAB): individual-level dataset

Intervention data was linked to individual-level surveillance data at the community level (full description of sampling and recruitment in [Appendix 7](#)). We collected individual-level health outcomes for a sample of the population in each of the six intervention communities, who were recruited using a cross-sectional, population-based adult sample from Sri Lanka ([Song et al., 2021](#)). The resident population in each SAB surveillance site—which were centred around local primary community health care centres—was identified through a combination of government census data, lists of households, and house-to-house visits by both research teams and local primary care workers. Individuals, both men and women, were included in the recruitment if they were of self-reported South Asian ethnicity and 18 years or older. They were excluded if they planned to leave the community (no longer resident) within one year, had a reduced life expectancy of one year or less, were women who were currently pregnant, or were unable or unwilling to give consent. All resident adults in each surveillance site who met the inclusion criteria were invited to participate. Across all SAB communities in Sri Lanka, the average response rate was 47.7% ([Song et al., 2021](#)). On average, across the six treated sites (or “communities”) within HVP, 285 participants were recruited, with final numbers ranging from 144 to 346 due to differences in local population size and response rates. Data was collected at baseline before the start of the intervention period between June 2022 and Sept 2023 and included

anthropometrics, self-reported dietary recall, and questions on health and lifestyle. To proxy health needs, we used the following variables: for diet – the prevalence of individuals self-reporting insufficient intake of fruits and vegetables, defined as consuming fewer than five servings per day (0 = less than 5 servings, 1 = 5 or more servings); for physical activity – the prevalence of insufficient physical activity, proxied by 75-150 moderate-vigorous minutes of self-reported physical activity per week in the realm of work, home, travel, and recreation, both moderate and vigorous (0 = less than 150 moderate minutes, 1 = 150 or more moderate minutes); for tobacco – the prevalence of (self-reported) current smokers (0 = non-smoker, 1 = smoker); for alcohol – the prevalence of (self-reported) current drinkers (0 = does not drink alcohol, 1 = drinks alcohol).

3.3. Statistical analyses and metrics

3.3.1. Descriptive statistics

We computed absolute frequencies and relative shares of Capacity Building and Engagement Activities, and Community Interventions, for each community. We split Capacity Building and Engagement Activities into types of activities and types of stakeholders. We also computed the total number of activities. We further split Community Interventions into intervention approach (i.e., type) and health determinants. We also computed the total number of interventions, the total and average number of participants reached, and the total number of household-level interventions. From the individual-level dataset (SAB), we computed the prevalence of health-related needs, as measured by the proportion of each community sample with a given health need (e.g., insufficient fruit and vegetable intake).

3.3.2. Assessment of the association between interventions chosen relative to health-related needs

To assess whether the selection of interventions matched community health-related needs, we conducted a logistic regression by health determinant group (i.e., diet, physical activity and BMI, smoking, and alcohol) with intervention-determinant choice as dependent variable (1 = chosen, 0 = not chosen) and the respective health-related need (i.e., prevalence of insufficient daily fruit and vegetable consumption,

prevalence of insufficient physical activity, prevalence of smokers, and prevalence of drinkers, respectively) as independent variable, by intervention approach (health education to community, behaviourally informed interventions, and skills development interventions). In all model specifications, we control for the cumulative sum of stakeholders in capacity building and engagement activities over time. To assess the robustness of our findings, across model specifications we sequentially add community fixed effects, cluster standard errors at the community level, and controls for intervention approach.

Specifically, Model 1 displays results from the baseline specification, estimated using standard (non-clustered) errors and without any fixed effects or controls for the intervention approach. Model 2 builds on the baseline by adding community fixed effects, which absorb time-invariant differences across communities. Model 3 further extends Model 2 by using cluster-robust standard errors at the community level, improving inference by accounting for within-community correlation. Model 4 adds controls for the type of intervention approach in addition to fixed effects and clustered standard errors, allowing a more complete adjustment for observed heterogeneity. Models 5 through 7 are subgroup specifications, each restricting the sample to a single intervention approach category (education-only, behavioural-only, or skills-only, respectively) while retaining fixed effects and cluster-robust standard errors (as specified in Model 3). These final models estimate the association between health-related needs and intervention implementation within each specific intervention approach, enabling a more targeted interpretation of heterogeneity across intervention types. For models 1-4, the observations for the regressions are at the community-approach-date level; for models 5-7, they are at the community-date level. The regression specification for Model 4 is as follows:

$$\Pr(\text{InterventionChosen}_{cdj} = 1) = F\left(\beta_1 \text{Prevalence}_{cd} + \delta_1 \text{Stakeholders}_c + \delta_2 \text{Approach}_j + \gamma_c + \epsilon_{cdj}\right)$$

Where $F(\cdot)$ is the logistic function, $\Pr(\text{InterventionChosen}_{cdj} = 1)$ is the probability of a community c choosing an intervention j directed at addressing the respective health determinant d , as a function of the key variable of interest, Prevalence_{cd} , the prevalence (as a share) of community health-related needs for community c for the determinant group d . Stakeholders_c is the cumulative number of stakeholders in community c over time. Approach_j is the approach used when implementing intervention j . γ_c represents the community fixed effects and ϵ_{cdj} is the error term.

4. Results

4.1. Capacity Building and Engagement Activities

Table 1 presents the descriptive statistics for Capacity Building and Engagement Activities. Gangaboda implemented the most Capacity Building and Engagement Activities of all the communities ($n = 457$); the rest implemented around one-third as many ($n = 104$ to $n = 194$). For each Capacity Building and Engagement Activity, only one type could be selected. In contrast, for the types of stakeholders engaged, more than one could be selected for each activity.

Types of Capacity Building and Engagement Activities. Across communities, we observe that the most frequently occurring type of Capacity Building and Engagement Activity is Meeting with a Government Officer (35.3%, $n = 429$), followed by Volunteer Training and Review (32.9%, $n = 401$). Within the communities, for four of the communities, the most frequently occurring type of activity was Meeting with a Government Officer: Thalgaasmote (54.1%, $n = 105$), Dahampura (38.3%, $n = 67$), Jamburaliya (36.5%, $n = 38$), and Gangaboda (33.9%, $n = 155$). For the other two communities, the most frequently occurring type of activity was Volunteer Training and Review: Rukmale (56.2%, $n = 90$) and Narampola (47.2%, $n = 60$). For all communities, there

Table 1
Engagement Activities conducted and Stakeholders engaged.

Communities	Total Number of Engagement Activities	Type of Engagement ^a				Type of Stakeholder ^b									
		Attended monthly conference	Meetings			Volunteer training / review	Community mobilization activity	Other	Community	HPFA	Public Officers (non-health)	Public Officers (health)	Private Sector	Other	
			Attended other meeting	Meeting a government officer	Meeting informal leader										Meeting with CBOs
Dahampura	175	7 (4.0%)	4 (2.3%)	67 (38.3%)	48 (27.4%)	2 (1.1%)	42 (24.0%)	4 (2.3%)	1 (0.6%)	77 (44.0%)	171 (97.7%)	33 (18.9%)	50 (28.6%)	7 (4.0%)	34 (19.4%)
Gangaboda	457	25 (5.5%)	72 (15.8%)	155 (33.9%)	31 (6.8%)	17 (3.7%)	130 (28.4%)	11 (2.4%)	16 (3.5%)	182 (39.8%)	451 (98.7%)	137 (30.0%)	198 (43.3%)	64 (14.0%)	179 (39.2%)
Thalgasmote	194	2 (1.0%)	6 (3.1%)	105 (54.1%)	16 (8.2%)	6 (3.1%)	56 (28.9%)	2 (1.0%)	1 (0.5%)	108 (55.7%)	190 (97.9%)	64 (33.0%)	70 (36.1%)	2 (1.0%)	28 (14.4%)
Narampola	127	7 (5.5%)	10 (7.9%)	39 (30.7%)	5 (3.9%)	0 (0.0%)	60 (47.2%)	6 (4.7%)	0 (0.0%)	74 (58.3%)	123 (96.9%)	32 (25.2%)	69 (54.3%)	8 (6.3%)	27 (21.3%)
Rukmale	160	23 (14.4%)	4 (2.5%)	25 (15.6%)	9 (5.6%)	5 (3.1%)	90 (56.2%)	4 (2.5%)	0 (0.0%)	114 (71.3%)	155 (96.9%)	11 (6.9%)	81 (50.6%)	8 (5.0%)	12 (7.5%)
Jamburaliya	104	15 (14.4%)	9 (8.7%)	38 (36.5%)	14 (13.5%)	2 (1.9%)	23 (22.1%)	3 (2.9%)	0 (0.0%)	44 (42.3%)	104 (100%)	25 (24.0%)	47 (45.2%)	5 (4.8%)	16 (15.4%)
Total	1217	79 (6.5%)	105 (8.6%)	429 (35.3%)	123 (10.1%)	32 (2.6%)	401 (32.9%)	30 (2.5%)	18 (1.5%)	599 (49.2%)	1194 (98.1%)	302 (24.8%)	515 (42.3%)	94 (7.7%)	296 (24.3%)

Note.

^a Type of Engagement (uniquely selected per Activity).

^b Type of Stakeholder (more than one could be selected per Activity – so percentages across types sum up to more than 100%).

were few activities (0-5% each) for Community Mobilization Activities, and Meetings with Community-Based Organisations (CBOs).

Types of Stakeholders Engaged. In all communities and for nearly all Capacity Building and Engagement Activities, there were HPFAs present (97-100%). However, there was variation across communities in the level of involvement of the other types of stakeholders. Across the communities together, results show that the most frequently involved stakeholder type is HPFA (n = 1194, 98.1%), followed by Community (n = 599, 49.2%), followed by Public Officer (Health) (n = 515, 42.3%), Public Officer (non-Health) (n = 302, 24.8%), and Other (n = 296, 24.3%), with Private Sector (n = 94, 7.7%) being the least frequently involved stakeholder type. Within the communities, results show for four of the communities, the next most often involved stakeholder type after HPFA was the Community: Rukmale (71.3%, n = 114), Narampola (58.3%, n = 74), Thalgaasmote (55.7%, n = 108), and Gangaboda (39.8%, n = 182). For the other two communities, the most often involved stakeholder type was Public Officers of Health: Jamburaliya (45.2%, n = 47) and Dahampura (28.6%, n = 50). For all communities, the least often involved stakeholder type was the Private Sector, from Gangaboda (14.0%, n = 64) down to Thalgaasmote (1.0%, n = 2).

4.2. Community Interventions

Table 2 presents the descriptive statistics for Community Interventions, split by intervention approach types, health determinant groups, and the total and average number of participants reached. For each Community Intervention, only one intervention approach could be selected. In contrast, for the health determinants, more than one could be selected for each intervention.

Intervention Approaches. The most frequently implemented intervention approach across all communities was Health Education to Community (49.6%, n = 484), followed by Skills Development Interventions (35.3%, n = 344), and Behaviourally Informed Interventions (15.1%, n = 147). Within four communities, the most frequently implemented approach was Health Education to Community: Thalgaasmote (76.2%, n = 138), Rukmale (56.9%, n = 128), Narampola (45.5%, n = 60), and Dahampura (41.6%, n = 57). For the other two communities, it was Skills Development Interventions: Jamburaliya (63.8%, n = 81) and Gangaboda (45.1%, n = 78).

Health-Related Determinants Selected. Across all communities, the most commonly health-related determinant targeted was Diet

(45.0%, n = 439), followed by Physical Activity & BMI (31.0%, n = 302). Within four communities, the most frequently addressed determinant was Diet: Thalgaasmote (62.4%, n = 113), Rukmale (52.9%, n = 119), Dahampura (46.0%, n = 63), and Narampola (41.7%, n = 55). For the other two communities, it was Physical Activity & BMI: Jamburaliya (57.5%, n = 73) and Gangaboda (33.5%, n = 58). Alcohol was the least frequently implemented health determinant across all communities, with percentages ranging from 0.8% (n = 1) in Jamburaliya to 8.3% (n = 11) in Narampola.

Participants Reached. The total number of participants reached varied across communities. The highest number of participants reached was by Gangaboda (n = 4170), followed by Rukmale (n = 3434), Jamburaliya (n = 3261), Dahampura (n = 3125), Thalgaasmote (n = 2793), and ending with Narampola (n = 1942). When looking at the average number of participants reached per intervention, we see the order of the communities change: Jamburaliya (avg = 25.7), Gangaboda (avg = 24.1), Dahampura (avg = 22.8), Thalgaasmote (avg = 15.4), Rukmale (avg = 15.3), and Narampola (avg = 14.7).

Household-level Community Interventions, by Community. Rukmale was the community that had the most household visits (n = 213), followed by Gangaboda (n = 150), Jamburaliya (n = 148), Thalgaasmote (n = 144), Narampola (n = 96), and ending with the fewest visits in Dahampura (n = 64) (see Table 3). Across all communities, all but one household visit addressed diet-related topics (99.9% of all visits), whereas the other determinant groups were addressed only in some visits. For Thalgaasmote and Rukmale, all the determinant groups were very frequently addressed (87-100% of visits). Three communities had fairly consistent shares of the visits that addressed different determinant groups: Jamburaliya (26-31%), Gangaboda (45-63%), and Narampola (61-66%). Finally, Dahampura had the most range in shares of visits that addressed a given determinant group, ranging from only 22% of visits addressing Physical activity and BMI to 69% of visits addressing Tobacco.

4.3. Health-related needs

Table 4 presents the descriptive statistics for the health-related needs, along with mean age and share of females by community, based on the individual-level SAB data. For Diet, Narampola (42.2%) has the highest prevalence of individuals with insufficient daily consumption of fruit and vegetable servings, followed by Jamburaliya

Table 2
Community interventions.

Communities	Total Interventions	Intervention Approaches ^a			Health Determinant ^b					Reach	
		Health education to community	Behaviourally informed interventions	Skills development interventions	Diet	Physical Activity & BMI	Tobacco	Alcohol	Other	Total Number of Participants ^c	Average Number of Participants
Dahampura	137 (100%)	57 (41.6%)	41 (29.9%)	39 (28.5%)	63 (46.0%)	40 (29.2%)	11 (8.0%)	6 (4.4%)	50 (36.5%)	3125	22.8
Gangaboda	173 (100%)	69 (39.9%)	26 (15.0%)	78 (45.1%)	59 (34.1%)	58 (33.5%)	18 (10.4%)	13 (7.5%)	91 (52.6%)	4170	24.1
Thalgaasmote	181 (100%)	138 (76.2%)	25 (13.8%)	18 (9.9%)	113 (62.4%)	13 (7.2%)	17 (9.4%)	11 (6.1%)	52 (28.7%)	2793	15.4
Narampola	132 (100%)	60 (45.5%)	34 (25.8%)	38 (28.8%)	55 (41.7%)	29 (22.0%)	19 (14.4%)	11 (8.3%)	45 (34.1%)	1942	14.7
Rukmale	225 (100%)	128 (56.9%)	7 (3.1%)	90 (40.0%)	119 (52.9%)	89 (39.6%)	18 (8.0%)	9 (4.0%)	88 (39.1%)	3434	15.3
Jamburaliya	127 (100%)	32 (25.2%)	14 (11.0%)	81 (63.8%)	30 (23.6%)	73 (57.5%)	2 (1.6%)	1 (0.8%)	47 (37.0%)	3261	25.7
Total	975 (100%)	484 (49.6%)	147 (15.1%)	344 (35.3%)	439 (45.0%)	302 (31.0%)	85 (8.7%)	51 (5.2%)	373 (38.3%)	18 725	19.7

Note.

^a Intervention Approaches (uniquely selected per Intervention).

^b Health Determinant (more than one could be selected per Intervention – so percentages across types sum up to more than 100%).

^c Since participants could participate in more than one intervention, these values should be considered more like participant-intervention units.

Table 3

Household-level community interventions.

Community	Total Household Visits	Diet	Physical Activity & BMI	Tobacco	Alcohol	Other
Dahampura	64	64 (100%)	14 (21.88%)	44 (68.75%)	20 (31.25%)	10 (15.62%)
Jamburaliya	148	148 (100%)	38 (25.68%)	41 (27.70%)	46 (31.08%)	39 (26.35%)
Narampola	96	96 (100%)	60 (62.50%)	59 (61.46%)	59 (61.46%)	63 (65.62%)
Gangaboda	150	150 (100%)	88 (58.67%)	68 (45.33%)	71 (47.33%)	94 (62.67%)
Rukmale	213	212 (99.53%)	193 (90.61%)	187 (87.79%)	185 (86.85%)	198 (92.96%)
Thalgasmote	144	144 (100%)	138 (95.83%)	139 (96.53%)	140 (97.22%)	141 (97.92%)
Total	810	809 (99.88%)	529 (65.31%)	535 (66.05%)	517 (63.83%)	543 (67.04%)

Table 4

Health-related needs.

Community	Prevalence of Needs Variables					Demographics	
	N	Diet: share of individuals reporting eating less than 5 servings of fruits and vegetables per day	Physical Activity & BMI: share of those insufficiently physically active (not meeting WHO weekly guideline)	Smoking: share of current smokers	Alcohol: share of current drinkers	Age: Mean (SD)	Percent Female
Dahampura	308	27.9%	22.4%	2.0%	6.2%	56.4 (14.4)	70.5%
Gangaboda	296	28.0%	31.8%	2.4%	8.7%	52.1 (15.1)	72.0%
Thalgasmote	346	36.4%	13.0%	16.0%	20.1%	56.6 (13.2)	67.6%
Narampola	325	42.2%	28.9%	1.9%	3.1%	50.6 (12.9)	73.5%
Rukmale	293	20.8%	22.2%	3.2%	9.6%	56.7 (14.0)	76.1%
Jamburaliya	144	38.2%	22.2%	4.2%	16.9%	54.9 (13.0)	71.5%

(38.2%), Thalgasmote (36.4%), Gangaboda (28.0%), Dahampura (27.9%), and ending with Rukmale (20.8%). For Physical Activity & BMI, Gangaboda (31.8%) has the highest prevalence of insufficiently physically active individuals, followed by Narampola (28.9%), Dahampura (22.4%), Rukmale and Jamburaliya (22.2%), and Thalgasmote (13.0%). For Smoking, Thalgasmote (16.0%) has the highest prevalence of current smokers, followed by Jamburaliya (4.2%), Rukmale (3.2%), Gangaboda (2.4%), Dahampura (2.0%), and Narampola (1.9%). For Alcohol, Thalgasmote (20.1%), has the highest prevalence of current drinkers, followed by Jamburaliya (16.9%), Rukmale (9.6%), Gangaboda (8.7%), Dahampura (6.2%), and Narampola (3.1%). Table 4 also presents the mean age and share of female participants by community, with average age ranging from 50.6 years (Narampola) to 56.7 years (Rukmale), and percentage of females ranging from 67.6% (Thalgasmote) to 76.1% (Rukmale).

4.4. Do community interventions match health-related needs?

Fig. 3 presents the association between the prevalence (as a share) of community health-related needs and the likelihood of selecting interventions directed at addressing the respective health determinant (e. g. prevalence of insufficient intake of fruits and vegetables versus interventions addressing diet), controlling for the cumulative sum of stakeholders in capacity building and engagement activities over time. The figure presents the main results aggregated at the community-approach level (Model 3). The results, along with alternative specifications, are presented in table format in Appendix 8, Table A8. The logistic regression results show a positive and significant association between health-related needs and respective interventions chosen ($b = 1.364$, 95% CI [1.263 to 1.465], $p < 0.001$, model 1). Fig. 3 also presents results split by intervention approach. It presents Models 5 through 7, which are subgroup specifications, each restricting the sample to a single intervention approach category (education-only, behavioural-only, or skills-only, respectively) while retaining fixed effects and cluster-robust standard errors. The positive association holds across all intervention approaches (Models 5-7). While not shown in the figure, the positive

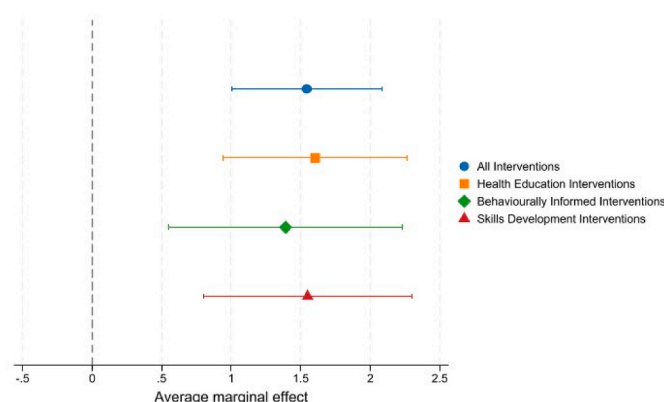


Fig. 3. Association between Community Prevalence of Health-Related Needs and Probability of Implementing Community Interventions

Note: The figure displays average marginal effects (AMEs) and 95% confidence intervals. The dependent variable is binary and indicates whether a community intervention was implemented for a given health determinant group; the independent variable is the prevalence of the health-related need corresponding to the health determinant group. “All Interventions” (Model 3 in Appendix Table A8) is the main specification estimated across all intervention approaches. “Health Education Interventions” (Model 5 in Appendix Table A8), “Behaviourally Informed Interventions” (Model 6 in Appendix Table A8), and “Skills Development Interventions” (Model 7 in Appendix Table A8). All specifications include community fixed effects and cluster-robust standard errors at the community level, and control for engagement intensity (i.e. cumulative sum of stakeholders in capacity building and engagement activities over time in each community).

association holds when including community-level fixed effects (Model 2), when clustering the standard errors at the community-level (Model 3), and when controlling for approach (Model 4), see Appendix 8, Table A8 for details. In other words, our results suggest that higher levels of disease prevalence in a community are associated with an increase in

the likelihood of selecting an intervention that addresses the health-related need.

The regression formally tests whether higher disease prevalence in a community is systematically associated with a greater probability of selecting a corresponding intervention, after accounting for community-level heterogeneity (through community fixed effects) and engagement intensity. The consistent positive and significant association across all seven model specifications – progressively adding fixed effects and approach controls – provides evidence that communities are not selecting interventions arbitrarily but are responding to observable health needs.

5. Discussion

5.1. Summary of results

This study describes Happy Village Plus, a community-level, grassroots, health promotion approach adopted in Sri Lanka, which draws on multiple conceptual frameworks (Green and Kreuter, 2005; Mertens et al., 2022; Nutbeam, 1996). HVP demonstrated how health promotion interventions can incorporate community engagement and behavioural components, and can be developed for low-and-middle-income countries. Our results show that all six communities engaged with a variety of activity types and stakeholders, with Gangaboda adopting more than twice as many engagement activities as any other community. Our results also show that a wide range of community interventions were selected and implemented, varying by approach and health determinants. Correspondingly, most interventions chosen by the community addressed diet determinants, followed by physical activity and BMI, and to a lesser extent, tobacco and alcohol. In turn, our health-related needs assessment revealed that the most prevalent health-related need was insufficient daily fruit and vegetable consumption, followed by insufficient weekly physical activity, alcohol drinking, and smoking. Finally, the regression results support that community interventions were chosen to match communities' health-related needs.

HVP represents a departure from the standard approach to NCD prevention in Sri Lanka in several respects. The dominant model for NCD prevention in the country has historically been clinic-based, disease-specific, and provider-led, centred on individual risk factor management through the primary healthcare system (Ministry of Health Sri Lanka, 2010, 2023). HVP differs by operating at the community level prior to clinical contact, by deliberately targeting multiple risk factors simultaneously, and by placing the selection and implementation of interventions in the hands of community members rather than health professionals. The integration of behavioural insights, including if-then implementation intentions at the household level, into what is typically a health education model is also novel in the Sri Lankan context.

5.2. Policy implications

Our study can inform policymakers and health practitioners. Previous research shows that addressing multimorbidity in NCDs can be complex (Prathapan et al., 2020), with multiple studies finding limited evidence on the impacts of targeting single NCDs or risk factors (Marmot and Bell, 2019). By providing an evaluation framework – centred on community engagement (Green and Kreuter, 2005; Nutbeam, 1996), with the addition of behavioural elements (Mertens et al., 2022) –, we show that it is possible to implement grassroots, community-level interventions targeting multiple NCDs and their risk factors within lower-and-middle-income countries. Our study, therefore, offers concrete guidance for policymakers and health practitioners seeking to implement community-based NCD prevention in LMICs settings. For policymakers, the key finding is that communities demonstrably select interventions aligned with their measurable health needs when given the tools and infrastructure to do so, suggesting that investment in

community needs assessment and bottom-up programme design is not merely aspirational but produces observable prioritisation behaviour. The implication is that top-down, one-size-fits-all NCD prevention programmes may be replaced or supplemented by community-responsive frameworks such as HVP, particularly where local health needs diverge across communities (as observed here between, for example, Thalagasmote's high tobacco and alcohol burden and Gangaboda's high share of insufficient physical activity). For health practitioners, the HVP framework illustrates how standard health education campaigns can be augmented with low-cost behavioural tools, such as if-then household-level implementation intentions and community mapping. These enhancements align with WHO NCD Best Buys, including behaviour-change communication for healthy diets and community-based programmes to support physical activity (World Health Organization, 2024d). The Health Promotion Field Assistant model provides a practical template for deploying such approaches through existing primary care channels.

Our study has several limitations. First, there are only six intervention communities, which limits the generalizability of our findings and our inference efforts. Second, we cannot ascertain whether the engagement activities and community interventions comprehensively targeted the community. Third, health-related needs were captured for a subset of each community, thus limiting the representativeness of our needs assessment. Likewise, it is difficult to assess real health-related needs. There may be other needs or more nuanced issues behind certain identified needs that we cannot identify. This could be a concern since communities may have selected interventions based on additional local knowledge we do not have, and thus possibly misinterpret how well the interventions align with needs we have identified. Fourth, our data captures each intervention as a distinct event without accounting for the duration of individual sessions. An intervention that was delivered for one hour would appear identical in our data to one that was delivered for several hours. This limits our ability to assess whether the intensity matters. We suggest such data should be considered for collection in future rollouts of HVP using more granular activity tracking.

While we show positive results in relation to intervention selection and engagement, it remains to be seen whether HVP translates into improved population health and individual literacy and agency. While the SAB dataset provides baseline prevalence data that we use as a proxy for community needs, the intervention was still ongoing at the time of data collection, and a follow-up assessment of individual-level behaviour change, and associated health benefits is planned as a subsequent study. Qualitative evidence on participant experiences and perceived impacts would substantially enrich the evaluation of HVP and is among the research outputs planned from this programme. Finally, HPB is currently evaluating options to scale HVP beyond the six pilot communities in Western Province. A key design principle of HVP is that it uses existing health system infrastructure, particularly Health Promotion Field Assistants, rather than creating parallel programme structures, which is intended to lower the cost of scale-up and improve the programme's sustainability. Whether the level of community engagement observed in this pilot can be maintained at scale is an open question that will require ongoing monitoring and evaluation.

Finally, future studies can adapt the HVP framework proposed in this paper to plan and implement community-based, bottom-up, multi-faceted health interventions suited to their local community needs. Health practitioners, in turn, can develop comprehensive frameworks to address NCDs in their communities, adding the key elements of community engagement, introducing behavioural sciences to traditional educational campaigns, and focusing on the most pressing health-related local needs.

6. Conclusion

This paper highlights the potential strengths of community-based

interventions addressing NCDs. Our results across six HVP communities in Western Province, Sri Lanka, show that it is possible to implement a grass-roots approach to health promotion efforts, especially in low-and-middle-income countries. Our descriptive results underscore the efforts made in that regard, showing that community engagement can be a powerful tool in fostering health promotion activities. Finally, our results indicate that communities selected interventions in line with their health-related needs, suggesting that a bottom-up approach can be effective in helping to address community health needs.

Looking ahead, this study points to several priorities for future practice and research. Health promotion programmes in similar LMIC settings should invest in baseline community needs assessments as a prerequisite to programme design, rather than implementing standardised packages: our results support the value of this investment by showing that communities respond to measured needs when given structured choice. Future evaluations should build in longitudinal data collection to assess individual-level behaviour change and health outcomes following community intervention, as well as qualitative evidence on participant experience, both of which are absent from the current study. Finally, the intensity of interventions, which we were unable to capture in this analysis, should be tracked in future implementations to determine the minimum intensity required for measurable community-level impact.

Human ethics approvals

For HVP:

- Institutional Review Board (Ethics Review Committee) of the University of Kelaniya, Sri Lanka. ERC P/29/03/2021

For SAB:

- University of Colombo, Sri Lanka. EC-18-094
- Imperial College London CREC 18IC4698.

Declaration of generative AI and AI-assisted technologies in the writing process

During the preparation of this work the authors used the GPT-4 Mini model to assist in making the text more concise. After using this tool/service, the authors reviewed and edited the content as needed and take full responsibility for the content of the publication.

Funding

This research was funded by the National Institute for Health Research (NIHR 16/136/68 and 132960) using UK aid from the UK Government to support global health research.

The funder had no role in the study design, data collection, analysis, interpretation, writing of the manuscript, or the decision to submit the paper for publication. The views expressed in this publication are those of the author(s) and not necessarily those of the NIHR or the UK government.

CRedit authorship contribution statement

Ajith Alagiawanna: Conceptualization, Investigation, Methodology, Writing – review & editing. **Zoey Verdun:** Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Software, Validation, Visualization, Writing – original draft, Writing – review & editing. **Bernardo Andretti:** Data curation, Formal analysis, Investigation, Validation, Visualization, Writing – original draft, Writing – review & editing. **Lathika Athauda:** Investigation, Supervision, Writing – review & editing. **Ranjith Batuwanthudawa:** Project administration, Writing – review & editing. **Madawa Chandratilake:** Project

administration, Writing – review & editing. **Laksara De Silva:** Data curation, Writing – review & editing. **Palitha Karunapema:** Writing – review & editing. **Indeewara Muthiarachchi:** Writing – review & editing. **Chathura Palangasinghe:** Data curation, Writing – review & editing. **Ashan Pathirana:** Writing – review & editing. **Kusal Weerasinghe:** Writing – review & editing. **Nalinda Wellappuli:** Conceptualization, Investigation, Methodology, Software, Writing – review & editing. **Dilukshi Wickramasinghe:** Writing – review & editing. **Millawage Supun Dilara Wijesinghe:** Conceptualization, Methodology, Writing – review & editing. **Prasad Katulanda:** Funding acquisition, Resources, Supervision, Writing – review & editing. **Anuradhani Kasturiratne:** Funding acquisition, Resources, Supervision, Writing – review & editing. **Gary Frost:** Funding acquisition, Project administration, Resources, Supervision, Validation, Writing – review & editing. **Franco Sassi:** Funding acquisition, Project administration, Resources, Supervision, Validation, Writing – review & editing. **Marisa Miraldo:** Conceptualization, Funding acquisition, Investigation, Methodology, Project administration, Resources, Supervision, Validation, Writing – review & editing.

Declaration of interest statement

The authors declare no competing interests.

Acknowledgements

We acknowledge the six Health Promotion Field Assistants (Lakshani Hettiarachchi, Nimesha Karunarathna, Thamali Kolongahapitiya, Udara Kitulagoda, Tharuka Sewwandi, and Thanudi Weerasekara) for their work in collecting the HVP intervention data. We also acknowledge Dilshani Karunarathne for her work as coordinator of the HVP project.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.socscimed.2026.119455>.

Data availability

South Asia Biobank data: request via Data Access Committee (manuja.kaluarachchi@imperial.ac.uk). HVP data: contact CHEPI (jack.olney@imperial.ac.uk). More info on SAB: www.ghru-southasia.org

References

- Alagiawanna, Ajith, Verdun, Zoey, Pathirana, Ashan, Pragharatna, Teshan, Weerasinghe, Kusal, Wickramasinghe, Dilukshi, Muthiarachchi, Indeewara, Gunawardana, Indika, Batuwanthudawa, Ranjith, Karunapema, Palitha, Andretti, Bernardo, Wellappuli, Nalinda, Katulanda, Prasad, Kasturiratne, Anuradhani, Kusuma, Dian, Frost, Gary, Sassi, Franco, Miraldo, Marisa, Wijesinghe, Millawage Supun Dilara, 2025. Protocol of a community-based intervention targeting health promoting village settings in Sri Lanka: happy village plus project. Health Promotion Bureau [Unpublished manuscript].
- Atanasova, P., Kusuma, D., Pineda, E., Anjana, R.M., De Silva, L., Hanif, A.A.M., Hasan, M., Hossain, M.M., Indrawansa, S., Jayamanne, D., Jha, S., Kasturiratne, A., Katulanda, P., Khawaja, K.I., Kumarendran, B., Mrida, M.K., Rajakaruna, V., Chambers, J.C., Frost, G., et al., 2022a. Food environments and obesity: a geospatial analysis of the South Asia Biobank, income and sex inequalities. *SSM Popul. Health* 17, 101055. <https://doi.org/10.1016/j.ssmph.2022.101055>.
- Atanasova, P., Kusuma, D., Pineda, E., Frost, G., Sassi, F., Miraldo, M., 2022b. The impact of the consumer and neighbourhood food environment on dietary intake and obesity-related outcomes: a systematic review of causal impact studies. *Soc. Sci. Med.* 299, 114879. <https://doi.org/10.1016/j.socscimed.2022.114879>.
- Galizzi, M.M., 2014. What is really behavioral in behavioral health policy? And does it work? *Appl. Econ. Perspect. Pol.* 36 (1), 25–60. <https://doi.org/10.1093/aep/ppt036>.
- Gollwitzer, P.M., 1999. Implementation intentions: strong effects of simple plans. *Am. Psychol.* 54 (7), 493–503. <https://doi.org/10.1037/0003-066X.54.7.493>.
- Gollwitzer, P.M., Sheeran, P., 2006. Implementation intentions and goal achievement: a meta-analysis of effects and processes. *Adv. Exp. Soc. Psychol.* 38, 69–119. [https://doi.org/10.1016/S0065-2601\(06\)38002-1](https://doi.org/10.1016/S0065-2601(06)38002-1).

- Green, L., Kreuter, M., 2005. *Health Program Planning: an Educational and Ecological Approach*. McGraw-Hill Education.
- Jauho, M., 2021. The North Karelia project (1972–1997) and the origins of the community approach to cardiovascular disease prevention. *Am. J. Publ. Health* 111 (5), 890–895. <https://doi.org/10.2105/AJPH.2020.306016>.
- Khatiri, R.B., Endalamaw, A., Erku, D., Wolka, E., Nigatu, F., Zewdie, A., Assefa, Y., 2024. Enablers and barriers of community health programs for improved equity and universal coverage of primary health care services: a scoping review. *BMC Prim. Care* 25 (1), 385. <https://doi.org/10.1186/s12875-024-02629-5>.
- Kim, J., Jang, J., Kim, B., Lee, K.H., 2022. Effect of the PRECEDE-PROCEED model on health programs: a systematic review and meta-analysis. *Syst. Rev.* 11 (1), 213. <https://doi.org/10.1186/s13643-022-02092-2>.
- KoboToolbox, 2026. Introduction to KoboToolbox. <https://support.kobotoolbox.org/welcome.html>.
- Kusuma, D., Atanasova, P., Pineda, E., Anjana, R.M., De Silva, L., Hanif, A.A., Hasan, M., Hossain, Md M., Indrawansa, S., Jayamanne, D., Jha, S., Kasturiratne, A., Katulanda, P., Khawaja, K.I., Kumarendran, B., Mridha, M.K., Rajakaruna, V., Chambers, J.C., Frost, G., et al., 2022. Food environment and diabetes mellitus in South Asia: a geospatial analysis of health outcome data. *PLoS Med.* 19 (4), e1003970. <https://doi.org/10.1371/journal.pmed.1003970>.
- Marmot, M., Bell, R., 2019. Social determinants and non-communicable diseases: time for integrated action. *BMJ* 1251. <https://doi.org/10.1136/bmj.1251>.
- Mertens, S., Herberz, M., Hahnel, U.J.J., Brosch, T., 2022. The effectiveness of nudging: a meta-analysis of choice architecture interventions across behavioral domains. *Proc. Natl. Acad. Sci.* 119 (1), e2107346118. <https://doi.org/10.1073/pnas.2107346118>.
- Ministry of Health and Department of Census and Statistics, 2021. Non communicable diseases risk factor survey (STEPS Survey) Sri Lanka. https://ncd.health.gov.lk/images/pdf/20230817_STEPS_Survey_new_1_compressed.pdf.
- Ministry of Health Sri Lanka, 2010. The National Policy and Strategic Framework for Prevention and Control of Chronic Non-communicable Diseases. Ministry of Health. https://www.health.gov.lk/wp-content/uploads/2022/10/13_NCD.pdf.
- Ministry of Health Sri Lanka, 2023. National Policy and Strategic Framework for Prevention and Control of Chronic Non-communicable Diseases. Ministry of Health. https://www.cabinetoffice.gov.lk/cab/images/Downloads/national_policies/2023-06-05/national_policy_1750750981_685a5705af82c_E.pdf.
- Moore, G., Campbell, M., Copeland, L., Craig, P., Movsisyan, A., Hoddinott, P., Littlecott, H., O' Cathain, A., Pfadenhauer, L., Rehfuess, E., Segrott, J., Hawe, P., Kee, F., Couturiaux, D., Hallingberg, B., Evans, R., 2021. Adapting interventions to new contexts—The ADAPT guidance. *BMJ* n1679. <https://doi.org/10.1136/bmj.n1679>.
- Murray, L.K., Dorsey, S., Skavenski, S., Kasoma, M., Imasiku, M., Bolton, P., Bass, J., Cohen, J.A., 2013. Identification, modification, and implementation of an evidence-based psychotherapy for children in a low-income country: the use of TF-CBT in Zambia. *Int. J. Ment. Health Syst.* 7 (1), 24. <https://doi.org/10.1186/1752-4458-7-24>.
- Nutbeam, D., 1996. Achieving 'best practice' in health promotion: improving the fit between research and practice. *Health Educ. Res.* 11 (3), 317–326. <https://doi.org/10.1093/her/11.3.317>.
- Payán, D.D., Sloane, D.C., Illum, J., Vargas, R.B., Lee, D., Galloway-Gilliam, L., Lewis, L. B., 2017. Catalyzing implementation of evidence-based interventions in safety net settings: a clinical–community partnership in south Los Angeles. *Health Promot. Pract.* 18 (4), 586–597. <https://doi.org/10.1177/1524839917705418>.
- Pilkington, G., Panday, S., Khatib, M., Kotas, E., Hill, R., Simkhada, P., Jones, L., 2017. The Effectiveness of Community Engagement and Participation Approaches in Low and Middle Income Countries: a Review of Systematic Reviews with Particular Reference to the Countries of South Asia. EPPI Centre, Social Science Research Unit, Institute of Education, University of London. <https://eppi.ioe.ac.uk/cms/Portals/0/PDF%20reviews%20and%20summaries/DFID%20Community%20Engagement%20Approaches%20final.pdf?ver=2018-04-25-102829-547>.
- Prathapan, S., Fernando, G.V.M.C., Matthias, A.T., Charuni, Y.B.M.A., Abeygunawardhana, H.M.G., Somathilake, B.G.G.K., 2020. The rising complexity and burden of multimorbidity in a middle-income country. *PLoS One* 15 (12), e0243614. <https://doi.org/10.1371/journal.pone.0243614>.
- Prochaska, J.J., Prochaska, J.O., 2011. A review of multiple health behavior change interventions for primary prevention. *Am. J. Lifestyle Med.* 5 (3), 208–221. <https://doi.org/10.1177/1559827610391883>.
- Sarrafzadegan, N., Kelishadi, R., Esmailzadeh, A., Mohammadifard, N., Rabiei, K., Roohafza, H., Azadbakht, L., Bahonar, A., Sadri, G., Amani, A., Heidari, S., Malekafzali, H., 2009. Do lifestyle interventions work in developing countries? Findings from the Isfahan healthy heart program in the Islamic Republic of Iran. *Bull. World Health Organ.* 87, 39–50.
- Shreedhar, G., Galizzi, M.M., 2021. Personal or planetary health? Direct, spillover and carryover effects of non-monetary benefits of vegetarian behaviour. *J. Environ. Psychol.* 78, 101710. <https://doi.org/10.1016/j.jenvp.2021.101710>.
- Song, P., Gupta, A., Goon, I.Y., Hasan, M., Mahmood, S., Pradeepa, R., Siddiqui, S., Frost, G.S., Kusuma, D., Miraldo, M., Sassi, F., Wareham, N.J., Ahmed, S., Anjana, R. M., Brage, S., Forouhi, N.G., Jha, S., Kasturiratne, A., Katulanda, P., et al., 2021. Data resource profile: understanding the patterns and determinants of health in South Asians—The South Asia Biobank. *Int. J. Epidemiol.* 50 (3), 717–718e. <https://doi.org/10.1093/ije/dyab029>.
- Tran, V.D., Lee, A.H., Jancey, J., James, A.P., Howat, P., Mai, L.T.P., 2017. Physical activity and nutrition behaviour outcomes of a cluster-randomized controlled trial for adults with metabolic syndrome in Vietnam. *Trials* 18 (1), 18. <https://doi.org/10.1186/s13063-016-1771-9>.
- World Health Organization, 1986. Ottawa charter for health promotion. In: First International Conference on Health Promotion, Ottawa. https://www.afro.who.int/sites/default/files/2017-06/hpr%20ottawa_charter.pdf.
- World Health Organization, 2017. Determinants of health. <https://www.who.int/news-room/questions-and-answers/item/determinants-of-health>.
- World Health Organization, 2023. Noncommunicable diseases. <https://www.who.int/news-room/fact-sheets/detail/noncommunicable-diseases>.
- World Health Organization, 2024a. Cardiovascular diseases. <https://www.who.int/health-topics/cardiovascular-diseases>.
- World Health Organization, 2024b. Global health estimates 2021: deaths by cause, age, sex, by country and by region, 2000–2021. <https://www.who.int/data/gho/data/themes/mortality-and-global-health-estimates/ghe-leading-causes-of-death>.
- World Health Organization, 2024c. Noncommunicable diseases in the South-East Asia. <https://www.who.int/southeastasia/health-topics/noncommunicable-diseases>.
- World Health Organization, 2024d. Tackling NCDs: best buys and other recommended interventions for the prevention and control of noncommunicable diseases. <https://iris.who.int/server/api/core/bitstreams/f6f90d96-8688-42e9-87ba-5c86e7f8e0e1/content>.