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ORIGINAL ARTICLE

Suaahara in Nepal: An at-scale, multi-sectoral nutrition program influences knowledge and practices while enhancing equity

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Abstract

The burden of undernutrition in South Asia is greater than anywhere else. Policies and programmatic efforts increasingly address health and non-health determinants of undernutrition. In Nepal, one large-scale integrated nutrition program, *Suaahara*, aimed to reduce undernutrition among women and children in the 1,000-day period, while simultaneously addressing inequities. In this study, we use household-level process evaluation data (N = 480) to assess levels of exposure to program inputs and levels of knowledge and practices related to health, nutrition, and water, sanitation, and hygiene (WASH). We also assess *Suaahara's* effect on the differences between disadvantaged (DAG) and non-disadvantaged households in exposure, knowledge, and practice indicators. All regression models were adjusted for potential confounders at the child-, maternal-, and household levels, as well as clustering. We found a higher prevalence of almost all exposure and knowledge indicators and some practice indicators in *Suaahara* areas versus comparison areas. A higher proportion of DAG households in *Suaahara* areas reported exposure, were knowledgeable, and practiced optimal behaviors related to nearly all maternal and child health, nutrition, and WASH indicators than DAG households in non-*Suaahara* areas and sometimes even than non-DAG households in *Suaahara* areas. Moreover, differences in some of these indicators between DAG and non-DAG households were significantly smaller in *Suaahara* areas than in comparison areas. These results indicate that large-scale integrated interventions can influence nutrition-related knowledge and practices, while simultaneously reducing inequities.

KEYWORDS

equity, Nepal, nutrition, *Suaahara*

1 | INTRODUCTION

Globally, millions of mothers and children suffer from undernutrition and its short- and long-term physical and cognitive consequences (Hoddinott, Alderman, et al., 2013; Hoddinott, Behrman, et al., 2013; Hoddinott et al., 2011). The determinants of undernutrition are complex and include immediate causes such as inadequate food intake and disease, as well as underlying causes of household food insecurity, inadequate care environments, and lack of access to health services and a healthy environment. Poverty, lack of resources and control of resources, poor infrastructure, and unstable political and economic contexts also contribute to malnutrition (UNICEF, 1990).

Currently, efforts to combat undernutrition increasingly focus on the first 1,000 days, the period between conception and a child's second birthday. After this period, physical and mental stunting may be irreversible, thus it constitutes a window of opportunity to prevent undernutrition (Horton & Lo, 2013). While progress has been made in addressing undernutrition, achieving global goals like the World Health Assembly target of reducing stunting by 40% by 2025 seems unlikely without the acceleration of concerted efforts. In addition to reducing the burden of undernutrition, there is also increasing recognition of the need to focus on equity in development, as socioeconomic differences in mortality and morbidity in most countries are widening (Gwatkin et al., 2007; Victora et al., 2003). This is particularly true in developing countries, where it is predicted that it will take much longer to reduce undernutrition in excluded and disadvantaged groups than in majority populations (UNICEF, WHO, and World Bank Group, 2015).

[Correction added on 22 May 2017, after first online publication: The city and state of affiliation 4 has been corrected in this current version]

The global nutrition community now emphasizes the need to complement nutrition-specific interventions (those primarily delivered through health systems) with nutrition-sensitive interventions that address the diverse underlying determinants of nutritional well-being. Interventions in education, agriculture, and water, sanitation, and hygiene (WASH), for example, may have both direct and indirect linkages with nutrition. However, there is a dearth of information on how to most effectively design and implement integrated programs at scale; the evidence base for what works is encouraging but limited (Bhutta et al., 2008; Menon et al., 2014; Ruel & Alderman, 2013).

Nowhere in the world is stunting as prevalent as in South Asia (Black et al., 2013), where 65 million children under five are estimated to be stunted (Shekar, Dayton Eberwein, & Kakietek, 2016). In Nepal, remarkable rapid progress has been made since the mid-1990s to reduce maternal and child undernutrition. However, undernutrition remains a major public health issue: 41% of children under 5 years of age are stunted and 11% wasted (Ministry of Health and Popualation (MOHP) Nepal, 2012). There is increasing evidence that Nepal's progress in education and WASH has played a key role in the nutrition success Nepal has achieved (Crum et al., 2013; Cunningham et al., 2016; Headey & Hoddinott, 2015; Headey, Hoddinott, & Park, 2016). However, there is substantial subnational variation in improvements to date. For example, the prevalence of child stunting is 42% in rural areas, but only 27% in urban areas. More than half of children in the lowest wealth quintile but only one-fourth of children from the highest wealth quintile are stunted. Child stunting is highest among historically disadvantaged caste groups including Dalits, hill Janajatis, and Muslims, and the prevalence of severe underweight among women is highest among *terai* madhesi Dalits (Ministry of Health and Popualation (MOHP) Nepal, 2012). Access to resources and services, political representation, and the presence of opportunities is unequal due to both geographic isolation and long-standing social and economic inequities. To most effectively address persistent undernutrition in Nepal, an explicit focus on overcoming these disparities in the access to and utilization of services is imperative (Anon, 2006; Crum et al., 2013; Devkota, Adhikari, & Upreti, 2016; Devkota & Bennett, 2014).

In 2012, the Government of Nepal (GoN) endorsed a multi-sectoral nutrition plan (MSNP) to address Nepal's undernutrition problem (Government of Nepal National Planning Commission, 2012; Pokharel et al., 2009). In line with the MSNP, donors and international non-governmental organizations (NGOs) have in turn funded programs that aim to reduce undernutrition. *Suaahara*, a United States Agency for International Development-funded 5-year (2011–2016) integrated nutrition program (Figure 1), aimed to address the poor nutritional status of women and children residing rurally in 41 of Nepal's 75 districts. *Suaahara* had a specific focus on social behavior change and communication (SBCC) and gender and social inclusion (GESI), including the targeting of disadvantaged groups (DAGs), that is, those identified as being food insecure and vulnerable due to socioeconomic, cultural, or physical factors. *Suaahara* integrated its programming across nutrition, health services, family planning, WASH, and agriculture/homestead food production (HFP) with four key objectives: (a) to improve household nutrition, health, and hygiene behaviors; (b) to increase the use of quality nutrition and health services; (c) to increase the production and consumption of diverse and nutritious foods; and (d) to strengthen coordination among nutrition actors (Anon, 2015; Cunningham & Kadiyala, 2013).

Suaahara not only facilitated national- and district-level efforts to improve nutrition policies and coordination among stakeholders but also trained and supported a diverse cadre of GoN and NGO health, agriculture, and WASH frontline workers (FLWs) to improve service quality. The GoN's long-established network of female community health volunteers (FCHVs) served as the primary means of engaging *Suaahara's* target populations with SBCC activities. FCHVs were to use new knowledge and skills they gained from participating in *Suaahara* into routine home visits and mothers' group meetings. *Suaahara* also partnered with district-level NGOs who hired *Suaahara* field supervisors (FS) to support government FLWs. Other FLWs involved in *Suaahara* included the following health, nutrition, WASH, and agriculture-related individuals and groups: health assistants, assistant health workers, assistant nurse midwifes; traditional healers; agricultural extension workers; livestock extension workers; MOFALD social mobilizers; village development committee (VDC) and WASH committees; citizen awareness centers; VDC nutrition and food security steering committees; ward citizen forums; *Suaahara* FS; *Suaahara* HFP mothers' groups; *Suaahara* peer facilitators; and *Suaahara* community hygiene and sanitation facilitators.

At the sub-district level, *Suaahara* worked at the VDC and ward levels, Nepal's two smallest administrative units. A core package of SBCC activities on maternal, infant, and young child nutrition (MIYCN), maternal and child health and family planning, and WASH was implemented throughout *Suaahara* districts for all 1,000-day households. Various platforms were used for SBCC activities: mass media, community mobilization, and interpersonal communication. The mass media platform consisted of a radio program and a complementary call-in show, titled *Bhanchhin Aama* (or "Mother knows best"), featuring a positive mother-in-law role model who communicated evidence-based

Key messages

- *Suaahara* process evaluation results confirm effective scale (on some/many behaviors) and reach can be obtained in multi-sectoral nutrition programs, while simultaneously addressing equity gaps.
- After only 2 years of full program intervention, large differences were found in exposure, knowledge, and some practices between comparison and intervention groups for maternal and child health and nutrition, as well as WASH.
- Progress on difficult to move child nutrition indicators, that is, appropriate sick child feeding, can be made via multi-sectoral integrated at-scale interventions.

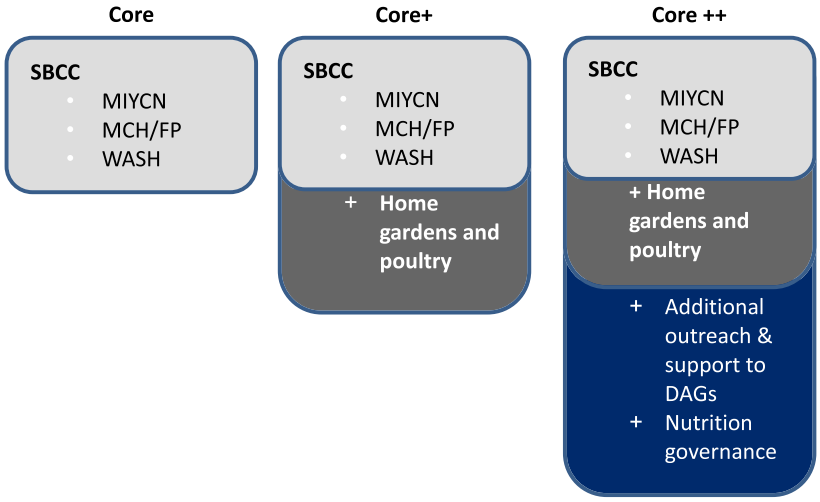

FIGURE 1 *Suaahara's* intervention packages. SBCC = social behavior change and communication; DAGs = disadvantaged groups

health, nutrition, and WASH information. Billboards, posters, and other visual materials, with similar information, were displayed throughout communities. FLWs who worked with *Suaahara* also reinforced key messages during community activities such as food demonstrations and key life event celebrations. The interpersonal communication platform consisted of home visits and mothers' groups, where videos, flip charts, card games, counseling wheels, and other tools and materials were used to promote optimal nutrition-related practices.

Suaahara incorporated an explicit GESI strategy across all program areas. Additional programmatic activities were facilitated for VDCs classified by the GoN into two categories denoting the highest concentration of DAGs. In these areas, material inputs for the construction of toilets and hand washing stations and for HFP were distributed. *Suaahara* also facilitated nutrition governance activities in these DAG VDCs, such as discussion sessions at community-level Citizens Awareness Centers (settlement level platforms composed of socioeconomically disadvantaged community members to increase their awareness relating to rights and entitlements and their engagement in VDC budget planning) and linkages between DAG households and their local Ward Citizen Forums (platforms composed of community members to identify the needs of local people and excluded groups in order to recommend priorities for VDC budget planning; UNDP, 2015). *Suaahara* FS prioritized DAG households for regular home visits to provide counseling, distribute HFP inputs and advice, and assess access to and use of toilets.

As of program end in 2016, *Suaahara's* monitoring data showed that about 2.4 million people across 1,900 VDCs were reached. The total population of Nepal is 27 million, and there were approximately 11.6 million people in the program's 41 districts. There are 51,470 FCHVs nationally, and all FCHVs in *Suaahara* districts were trained. This means that *Suaahara* trained 33,688 FCHVs, and training in key thematic areas was given to additional FLWs: 14,494 in MIYCN, 4,815 in family planning, and 13,475 in WASH. HFP activities reached more than 155,000 households, and an FCHV or a *Suaahara* FS made a home visit to about 160,000 households.

Suaahara is one of the first nutrition programs globally to operate at scale, use a multi-sectoral approach, and have an explicit focus on equity. The research presented here aims to assess *Suaahara's* progress in increasing exposure to nutrition-related information and services and its potential role in improving nutrition-related knowledge and practices among pregnant women and mothers of children under 2 years of age in rural Nepal. We also explore *Suaahara's* potential role in narrowing gaps between DAG and non-DAG households for these same nutrition-related exposure, knowledge, and practices. To the best of our knowledge, this is the first process evaluation (PE) to assess not only overall program progress but also equity-based variation in program coverage and uptake.

2 | METHODS

2.1 | Study design and implementation

For this analysis, we used data from *Suaahara's* household-level PE study, conducted in November–December 2014, about 2 years after the program started. A baseline study was conducted in 2012; however, due to differences in sampling methodology at the household-level, we will not compare our findings to the baseline results. Consistent with other PE studies of nutrition interventions, this mixed-methods PE was theory-driven, carried out after a few years of implementation in all target areas, and aimed to assess program delivery and utilization (Mbuya et al., 2015; Robert et al., 2006; Robert et al., 2007).

The household-level PE study aimed to assess the depth of exposure to the program as well as related knowledge and practices along the pathways to impact, among target beneficiaries in *Suaahara* areas and a similar population in comparison areas. At baseline, 16 districts were matched into intervention-comparison pairs based on social, economic, and agroecological characteristics. Among these districts, eight were subsequently purposively selected for the PE: four intervention-comparison pairs spanning Nepal's three agroecological zones and excluding pairs where a baseline comparison district later became a *Suaahara* district during program scale-up. Within each district, we selected the same five rural VDCs, and within each VDC, the same

three wards, which were all randomly selected for the baseline survey using probability-proportional-to-size techniques. Enumerators consulted with local FCHVs to construct a list of all pregnant women and mothers of children under 2 years of age in the ward and then classified each into one of four categories: (a) DAG pregnant woman, (b) non-DAG pregnant woman, (c) DAG mother of a child under 2 years of age, and (d) non-DAG mother of a child under 2 years of age. FCHVs classified women from disadvantaged castes, living in extreme poverty, and/or food insecure as DAG. Once the listing was complete, enumerators randomly selected one woman per category in each ward. In total, the sample included 472 households (eight non-respondents) from 120 wards, 40 VDCs, and eight districts.

Twenty local enumerators and supervisors were hired and trained for 2 weeks on interview techniques, study details, and mobile data collection. The training included field practice to test and refine study instruments. Women were interviewed using precoded, structured questionnaires, translated into Nepali. Questions were included on a range of topics: (a) demographics and socio-economic characteristics; (b) exposure to *Suaahara* intervention platforms, including FLWs, project information, tools, materials, and key messages; (c) knowledge about nutrition, health, WASH, and family planning; and (d) practices related to nutrition, health, WASH, and family planning. Spot-check observations were used to examine household construction materials and to assess WASH facilities and practices. Supervisors remained in the field to oversee data collection processes, and data quality controllers visited study areas to ensure the collection of valid and reliable data.

Ethical approval for the study was obtained from the Nepal Health Research Council. All respondents gave their informed consent prior to participating in the survey.

2.2 | Data analysis

Data were analyzed using Stata 13 (StataCorp, 2013). Descriptive statistics and bivariate and multivariate regression analyses were conducted to examine differences in prevalence rates for exposure to FLWs; information, tools, and materials; and messages, as well as levels of knowledge and practices between intervention and comparison areas. For equity analyses, we used an interaction term between study arm and DAG status in order to examine how differences between DAG and non-DAG households in *Suaahara* areas contrasted with those same differences in comparison areas. In all regression models, we controlled for VDC-level clustering and reported statistical significance if $P < .05$. In final multivariate regression models, we also controlled for the following potentially confounding factors: women's age, education, and pregnancy status, as well as household agroecological zone of residency, number of children <5 years, asset ownership, and quality of roof materials.

3 | RESULTS

3.1 | Characteristics of *Suaahara* and comparison households

Table 1 presents an overview of study participants ($n = 472$). Nearly all women were married, and their mean age was 24 years. Among women who were mothers ($n = 363$), the youngest child was, on average, 17 months. Households had one child under 5 years of age, on average. Close to 90% of the households were Hindu, almost all owned their home and some land, and they owned an average of 7 or 8 out of a possible 22 types of assets included in the questionnaire. The only significant difference among the demographic and socioeconomic characteristics were that in *Suaahara* areas, women were nearly 1 year older at first pregnancy and more households had improved roof materials (S:97%; C:83%; $p < .001$).

3.2 | Exposure to *Suaahara* interventions

Table 2 presents results for exposure to three aspects of *Suaahara*: (a) frontline workers; (b) information, tools, and materials; and (c) key messages, contrasting women in *Suaahara* and comparison areas. Women in *Suaahara* areas, compared with women in comparison areas, reported to have met more regularly with an FLW in the 6 months preceding the survey (S: 4.5; C: 3.1 times; $p < .001$) and were more likely to report to have received family planning counseling from a health worker (S: 88%; C: 55%; $p < .001$). The FCHV-related results varied, although more women in *Suaahara* areas reported interacting with an FCHV outside of a home visit or health mothers' group meeting (S:87%; C:65%; $p < .001$), there were no significant differences between study areas on whether an FCHV ever made a home visit and frequency of meeting with an FCHV in the previous 6 months.

Women in *Suaahara* areas reported having heard information from a greater number of sources for nutrition (S: 3.5; C: 1.6; $p < .001$), and similar results were found for health, family planning, WASH, and agriculture/HFP. Women in *Suaahara* areas also reported exposure to more tools and materials both for health and nutrition (S: 2.8; C: 0.3; $p < .001$) and WASH (S: 1.7; C: 0.2; $p < .001$). A larger percentage of women in *Suaahara* areas than in comparison areas recalled having ever been exposed to all eight key MIYCN messages included in the survey, and all of these differences were highly statistically significant ($p < .001$): maternal diet during pregnancy and lactation; putting a baby to the breast immediately after birth; not putting anything into the child's mouth before breast milk; feeding only breast milk up to 6 months; not giving the child any liquids or foods up to 6 months; starting to feed mashed foods at 6 months; feeding animal source foods to children above 6 months; and how to feed a sick child. A similar pattern was found for WASH and healthy timing and spacing for pregnancy (HTSP) messages.

3.3 | Knowledge related to nutrition, health, and water, sanitation, and hygiene

Table 3 presents findings contrasting knowledge levels between women in *Suaahara* and comparison areas. More women in *Suaahara* areas had higher knowledge levels about key maternal health and nutrition, and some differences were significant: eating more than usual during pregnancy (S: 96%; C: 79%; $p < .001$), taking iron/folic acid (IFA) tablets for 180 days during pregnancy (S: 89%; C: 64%; $p < .001$), and taking 45 IFA tablets during the postpartum period (S: 85%; C: 50% ; $p < .001$). The difference between groups on knowledge that a pregnant woman needs four ANC visits was only borderline significant.

TABLE 1 Sample child, mother, and household characteristics

	Comparison N = 240 Mean (SD)/%	Intervention N = 232 Mean (SD)/%	Significance[a] P value
Children (*N* = 197-C, 166-I)			
Age (in months)	16.9 (14.6)	16.9 (15.6)	.982
Sex: percent boys	52.1	53.0	.862
Mother			
Marital status: percent married	99.6	100.0	N/A
Age (in years)	24.4 (5.1)	24.3 (4.8)	.813
Age at first pregnancy (in years)	19.3 (2.6)	20.1 (2.6)*	.018
Formal schooling (in years)	4.9 (4.2)	6.3 (4.3)	.081
Household			
Number of children <5 years	1.1 (0.8)	1.0 (0.8)	.299
Religion: percent Hindu	88.8	88.4	.950
Home: percent owning	97.9	97.8	.964
Number of bedrooms in the house	2.6 (1.4)	2.7 (1.4)	.624
Electricity: percent with access	66.7	82.8	.129
Floor material: percent improved (observation)	12.5	20.3	.352
Exterior wall material: percent improved (observation)	15.0	33.6	.061
Roof material: percent improved (observation)	83.3	97.0***	.001
Agricultural land: percent owning	97.1	94.8	.323
Total types of assets owned (range: 0–22)	7.3 (3.2)	7.6 (3.0)	.577
Total types of animals owned (range: 0–8)	3.3 (1.7)	2.8 (1.5)	.146

Note. ANC = antenatal care; FCHV = female community health volunteers; FP = family planning; TT = tetanus toxiod..

Assets included stove/gas burner; refrigerator; bed; sofa; cupboard; table/chair; radio; dvd player; cassette/CD player; motorcycle/scooter; bike; tv; mobile phone; small agricultural tools; solar energy panels; machine sprayer for agriculture; hand tube well; low life pump; masonry equipment; carpentry equipment; manual wooden thresher; manual flour mill; animals included the following: poultry; beehives; goat/sheep; cow; buffalo; other cattle; donkey/mule/horse; and pig/boar.

[a]Controlling for village development committee-level clustering.

*$P < .05$.

**$P < .01$.

***$P < .001$.

More women in *Suaahara* areas were also knowledgeable regarding all three indicators of child malnutrition causes, prevention opportunities, and consequences, and these differences were highly significant ($p < .001$). Knowledge on infant and young child feeding (IYCF) was also stronger in *Suaahara* areas with more women being aware that breast feeding should be initiated within 1 hr of birth (S: 91%; C: 73%; $p < .001$); the correct definition of exclusive breastfeeding (S: 68%; C: 16%; $p < .001$); colostrum should be given (S: 95%; C: 88%; $p < .001$); and various types of complementary foods should be introduced between 6 and 8.9 months. Furthermore, in *Suaahara* areas, nearly three times the percentage of women than in comparison areas knew that sick children should receive additional food (S: 54%; C: 19%; $p < .001$) and continued or increased breastfeeding (S: 41%; C: 13%; $p < .001$). The difference between areas for knowledge on age to introduce solid foods was minimal and not significant.

Women in *Suaahara* areas were also significantly more likely than their counterparts in comparison areas to know when a young child's caretaker should wash their hands (S: 22%; C: 8%; $p < .01$) and the appropriate drinking water treatment methods (S: 97%; C: 91%; $p < .05$).

3.4 | Practices related to nutrition, health, and water, sanitation, and hygiene

Table 4 presents findings related to maternal and child health, nutrition, and WASH practices. Differences between study arms for three ANC indicators were insignificant, but more women in *Suaahara* areas than in comparison areas used FCHVs as a source for ANC services/counseling (S: 70%; C: 53%; $p < .001$). The prevalence of consuming IFA tables for 180 days during pregnancy (S: 60%; C: 42%; $p < .01$) and eating more than usual during pregnancy (S: 76%; C: 32%; $p < .001$) were higher in *Suaahara* areas than in comparison areas. Consumption of other fruits and vegetables (S: 80%; C: 66%; $p < .05$), dairy (S: 69%; C: 39%; $p < .001$), and eggs (S: 17%; C: 11%; $p < .01$) was also significantly higher in *Suaahara* areas, but consumption of meats was significantly more common among women in comparison areas (S: 28%; C: 38%; $p < .01$).

All child health and nutrition practices promoted by *Suaahara* were more prevalent in *Suaahara* areas than in comparison areas, and many were significant including both vitamin A indicators ($p < .01$); exclusive breastfeeding (S: 77%; C: 51%; $p < .01$); and the introduction of five of six types of complementary foods between 6 and 8.9 months of age

TABLE 2 Exposure by women to *Suaahara*'s multi-sectoral interventions

	Comparison *N* = 240 Mean (SD)/%	Intervention *N* = 232 Mean (SD)/%	Basic Model Significance[a] *P* value	Full Model Significance[b] *P* value
Frontline workers[c]				
Total number of times met with FLWs in the last 6 months	3.1 (1.6)	4.5 (2.2)***	<.001	.001
Number of times met with FCHV in the last 6 months	3.9 (3.9)	4.6 (3.5)	.224	.699
Home visit by FCHV: percent ever received	64.6	63.8	.919	.695
Interaction with FCHV, other than home visit or health mothers' group: percent ever received	65.4	87.1***	.002	.001
HTSP counseling by health professional: percent ever received	54.6	87.5***	<.001	<.001
Information,[d] tools, and materials				
Health: number of information sources in the last 6 months	2.0 (1.2)	3.6 (1.5)***	<.001	<.001
Nutrition: number of information sources in the last 6 months	1.6 (1.1)	3.5 (1.5)***	<.001	<.001
FP: number of information sources in the last 6 months	1.7 (1.3)	3.2 (1.4)***	<.001	<.001
WASH: number of information sources in the last 6 months	1.3 (1.2)	3.4 (1.7)***	<.001	<.001
Agriculture/HFP: number of information sources in last the 6 months	0.6 (0.8)	2.7 (1.7)***	<.001	<.001
Health and nutrition: number of tools/materials seen[e]	0.3 (0.8)	2.8 (2.5)***	<.001	<.001
WASH: number of tools/materials seen[f]	0.2 (0.6)	1.7 (1.8)***	<.001	<.001
Key messages				
Waiting 2 years between each pregnancy: percent heard in last counseling session	49.6	86.2***	<0.001	<.001
FP method of woman's choice for 2 years between pregnancies: percent heard in last counseling session	50.0	82.3***	<0.001	<.001
Waiting until 20 years of age before trying to become pregnant: percent heard in last counseling session	22.1	72.0***	<0.001	<.001
What a pregnant and lactating woman's diet should include (foods, frequency, amount, etc.): percent ever heard	63.3	96.1%***	<0.001	<.001
Putting a baby to the breast immediately after birth: percent ever heard	87.9	97.4***	.001	<.001
Not putting anything into the child's mouth before breast milk or colostrum: percent ever heard	65.8	78.9***	.046	<.001
Feeding only breast milk up to 6 months of age: percent ever heard	77.9	99.6***	<.001	.001
Not giving the child any water, liquids, or foods up to 6 months of age: percent ever heard	60.0	89.2***	<.001	<.001
Start feeding mashed family foods at 6 months: percent ever heard	60.0	92.7***	<.001	<.001
Feeding eggs, fish, and meat (any animal source foods) to children older than 6 months: percent ever heard	31.7	86.6***	<.001	<.001
How to feed a child when he or she is sick: percent ever heard	37.9	65.5***	.001	<.001
Washing hands with water and soap before feeding the child: percent ever heard	77.5	99.6***	<.001	<.001

Note. FCHV = female community heath volunteer; FLWs = frontline workers; FP = family planning; HFP = homestead food production; VDC = village development committee; WASH = water, sanitation, and hygiene.

[a]Controlling for VDC-level clustering.

[b]Controlling for VDC-level clusering as well as various potential confounders: women's age and education level; household agroecological zone of residency, total number of children <5 years, asset ownership, and roof materials.

[c]FLWs asked about the following: FCHVs; Health assistant/assistant health worker/assistant nurse midwife; traditional healer; agricultural extension worker; livestock extension worker; MOFALD social mobilizer; VDC WASH committee representative; citizen awareness center representative; VDC nutrition and food security steering committee member; ward citizen forum representative; *Suaahara* field supervisor; *Suaahara* HFP mothers' group representative; *Suaahara* peer facilitator; and *Suaahara* community hygiene and sanitation facilitator.

[d]Potential sources of information asked about include the following: newspaper/magazine; radio/FM; television; brochure/leaflet/poster/banner; FCHV; village model farmer; agriculture/livestock extension worker; village WASH committee member; VDC nutrition and food security steering committee member; social mobilizer; *Suaahara* field supervisor; ward citizen forum; and citizen awareness center.

[e]Potential health and nutrition tools/material asked about include the following: discussion cards; pictorial books; posters; locally available food; training aid pictures; crop calendar; poultry flip chart; garden-to-plate materials; and coop game cards.

[f]Potential WASH tools/material asked about include the following: discussion cards; pictorial books; posters; handwashing demonstration at a handwashing station; WASH DVDs; and PA vial.

($p < .001$). In *Suaahara* areas, among children 6–23 months, overall dietary diversity was higher (S: 4.2 food groups; C: 3.5 food groups; $p < .05$), and more children consumed dairy (S: 76%; C: 46%; $p < 0.01$) and eggs (S: 24%; C: 6%; $p < .001$). More women in *Suaahara* areas than in comparison areas increased feeding of foods/liquids for a young child during illness (S: 42%, C: 29%, $p < .001$). Differences between study arms, which were not significant, included the following: age-appropriate breastfeeding, minimum dietary diversity,

TABLE 3 Women's knowledge on key *Suaahara*-promoted health, nutrition, and water, sanitation, and hygiene practices

	Comparison *N* = 240 Mean (SD)/%	Intervention *N* = 232 Mean (SD)/%	Basic Model Significance[a] *P* value	Full Model Significance[b] *P* value
Maternal health and nutrition: percent reported correctly				
4 ANC check-ups needed for pregnant woman	68.3	81.9	.015	.060
180 days of iron/folic acid tablets need for pregnant woman	64.2	88.8***	<.001	<.001
45 iron/folic acid tablets needed for partpartum woman	50.0	85.3***	<.001	<.001
Eating more than usual during pregnancy	79.2	96.1***	<.001	<.001
Child health and nutrition: percent reported correctly				
Being short/small for age as a sign of malnutrition	12.9	51.7***	<.001	<.001
Prevention window of opportunity: first 1,000 days (pregnancy or children <2 years)	47.5	81.0***	<.001	<.001
Consequences of child malnutrition: mental development, physical development, poor health, or productivity	79.2	96.6***	<.001	<.001
Breastfeeding initiation within 1 hr	72.5	91.4***	<.001	<.001
Give colostrum to the baby	87.5	95.3**	.018	.008
Exclusive breastfeeding definition: breast milk and nothing else (not even water)	16.3	68.1***	<.001	<.001
Age to introduce water/clear liquids (6–8.9 months)	67.1	93.5***	<.001	<.001
Age to introduce milk/milk products (6–8.9 months)	70.4	92.2***	.001	<.001
Age to introduce semi-solid foods (6–8.9 months)	81.7	94.8***	.001	<.001
Age to introduce solid foods (6–8.9 months)	67.9	72.0	.594	.353
Age to introduce eggs (6–8.9 months)	57.1	74.1**	.028	.009
Age to introduce animal meat/fish (6–8.9 months)	40.0	67.7**	.001	.006
For child illness, feed an extra meal daily/more food/more liquids	18.8	53.5***	<.001	<.001
For child illness, continue/increase breastfeeding	12.5	41.4***	<.001	<.001
WASH: percent reported correctly				
All five critical times caretaker of a young child should wash hands	8.3	22.0**	.004	.002
Water treatment: boiling, adding bleach/chlorine, filtering, or SODIS	90.8	97.4*	.013	.049

Note. ANC = antenatal care; FCHV = female community health volunteers; FP = family planning; SODIS =solar disinfection system; TT = tetanus toxoid; VDC = villege development committee; WASH = water, sanitation, and hygiene.

[a]Controlling for VDC-level clustering.

[b]Controlling for VDC-level clusering as well as various potential confounders: women's age and education level; household agroecological zone of residency, total number of children <5 years, asset ownership, and roof materials.

*$P < .05$.

**$P < .01$.

***$P < .001$.

consumption of iron-rich foods, and introduction of solid foods at 6 to 8.9 months.

Some household-level WASH indicators were higher in *Suaahara* areas than in comparison areas: presence of a hand washing station with water and soap/ash (S: 87%; C: 50%; $p < .001$); having a clean toilet (S: 68%; C: 19%; $p < .001$); and keeping the drinking water covered (S: 80%; C: 49%; $p < .001$). Differences between study arms for all other WASH practice indicators were not significant.

3.5 | An equity analysis: exposure to *Suaahara* and knowledge and practices related to nutrition, health, and water, sanitation, and hygiene among disadvantaged and non-disadvantaged households

Table 5 presents differences (gaps) in exposure, knowledge, and practices between DAG and non-DAG households and how these gaps differ between *Suaahara* and comparison areas. To formally test the significance of these differences in DAG gaps, we calculated an interaction effect for all indicators presented in Tables 2–4 (results available upon request). Although patterns were similar for most indicators, in the final adjusted models, the interaction term was only significant at the 95% level for indicators included in the table and discussed below.

Gaps between DAG and non-DAG households in intervention areas were smaller than those in comparison areas for number of information sources exposed to for health (S: 0.2; C: 0.7, $p < .01$), nutrition (S: 0.3; C: 0.6, $p < .01$), and family planning (S: 0.3; C: 0.6; $p < .001$). In comparison areas, there was no gap in exposure to health and nutrition tools and materials, but the levels of exposure for both DAGs and non-DAGs in *Suaahara* areas were nearly three times higher (S: 0.4; C: 0.0; $p < .05$). The DAG/non-DAG gap was narrower in *Suaahara* areas for number of FLW meet-ups in the 6 months prior to the survey (S: 0.0; C: 0.4; $p < .01$). DAGs in *Suaahara* areas also reported greater exposure than DAGs in comparison areas, and the DAG/non-DAG gap in *Suaahara* areas was narrower and sometimes showing even greater exposure among DAG households than non-DAG households, for

TABLE 4 Household practices on key *Suaahara*-promoted health, nutrition, and water, sanitation, and hygiene practices

	Comparison *N* = 240 Mean (SD)/ %	Intervention *N* = 232 Mean (SD)/ %	Basic Model Significance[a] *P* value	Full Model Significance[b] *P* value
Maternal health and nutrition: percent reported				
Received any ANC	86.3	95.3	.005	.165
Received ANC from a skilled provider* (among those who received any ANC; *N* = 207-C, 222-I)	96.1	93.7	.160	.757
Received four ANC check-ups* (among mothers who reported; *N* = 222-C, 209-I)	44.6	40.7	.553	.318
Iron/Folic acid tablets for 180 days (pregnancy*; among mothers who reported; *N* = 206-C, 205-I)	41.8	60.0**	.023	.010
FCHV as source of ANC services/counseling	52.9	69.8***	.011	<.001
Eating more than usual during pregnancy	32.1	75.9***	<.001	<.001
Institutional delivery (hospital, center or post*; *N* = 196-C, 164-I)	48.5	68.3	.018	.092
Any delivery assistance* (*N* = 196-C, 164-I)	95.9	100.0	N/A	N/A
Skilled delivery assistance* (*N* = 196-C, I64-I)	51.5	67.1	.05	.327
Women's dietary diversity: percent reported consumption in previous 24 hr				
Starchy staples	100.0	100.0	N/A	.743
Beans, lentils, and nuts	88.3	88.8	.908	.363
Dairy	39.2	68.5***	<.001	<.001
Meat	38.3	27.6**	.116	.002
Eggs	10.8	17.2**	.070	.017
Dark green leafy vegetables	62.9	75.0	.216	.391
Vitamin A rich fruits and vegetables	25.8	16.0	.136	.211
Other fruits and vegetables	65.8	79.7**	.058	.023
Child health and nutrition: percent reported				
Vitamin A received within 6 weeks post delivery* (*N* = 197-C, 166-I)	65.0	83.7**	.003	.011
Vitamin A received in last distribution* (*N* = 197-C, 166-I)	62.4	71.1**	.124	.006
Colostrum given* (among mothers; *N* = 197-C, 166-I)	74.6	94.0***	<.001	<.001
Exclusive breastfeeding (0–5.9 m*; *N* = 53-C, 43-I)	50.9	76.7**	.017	.003
Ever breastfed (0–23.9 m*; *N* = 148-C, 129-I)	98.7	99.2	.640	N/A
Age-appropriate breastfeeding (0–23.9 m*; *N* = 148-C, 129-I)	57.4	59.7	.726	.392
Minimum dietary diversity (at least four food groups) (6–23.9 m*; *N* = 95-C, 86-I)	51.6	77.9	.004	.075
Consumption of iron-rich foods (6–23.9 m*; *N* = 95-C, 86-I)	28.4	26.7	.828	.094
Introduced water/clear liquids at 6–8.9 months (*N* = 95-C, 86-I)	54.7	81.4***	.001	<.001
Introduced milk/milk products (excluding breast milk) at 6–8.9 months (*N* = 95-C, 86-I)	44.2	79.1***	<.001	.001
Introduced semi-solid foods at 6–8.9 months (*N* = 95-C, 86-I)	65.3	90.7***	<.001	<.001
Introduced solid foods at 6–8.9 months (*N* = 95-C, 86-I)	62.1	72.1	.247	.296
Introduced eggs at 6–8.9 months (*N* = 95-C, 86-I)	34.7	66.3***	.001	<.001
Introduced animal meat/fish at at 6–8.9 months (*N* = 95-C, 86-I)	30.5	57.0**	.006	.002
Child given more food/liquid during illness* (among mothers reporting child has had diarrhea in last 2 weeks; *N* = 160-C, 159-I)	28.8	41.5***	.111	.001
Child's dietary diversity (6–23.9 months of age*; *N* = 95-C, 86-I): percent reported consumption				
Dietary diversity scores (0–7 food groups)	3.5 (1.3)	4.2 (1.3)*	.003	.049
Grains (cereals and tubers)	94.7	94.2	.857	.529
Pulses (legumes and nuts)	85.3	86.1	.876	.450
Dairy	46.3	75.6**	.001	.003
Flesh foods	24.2	22.1	.774	.094
Eggs	6.3	24.4**	.001	.007
Vitamin A rich fruits and vegetables	56.8	79.1	.018	.407
Other fruits and vegetables	35.8	43.0	.419	.316
WASH: percent reported or observed				
	49.6	86.6***	<.001	<.001

(*Continues*)

TABLE 4 (Continued)

	Comparison N = 240 Mean (SD)/ %	Intervention N = 232 Mean (SD)/ %	Basic Model Significance[a] P value	Full Model Significance[b] P value
Handwashing station with water and soap/ash available (observation*; among those with observable handwashing station; N = 239-C, 232-I, 471-A)				
Toilet at household (observation)	81.7	91.4	.117	.179
Flush toilet facility (observation*; among those who have a toilet; N = 196-C, 212-I, 408-A)	68.9	88.2	.040	.117
Toilet cleanliness (observation*; among those who have a toilet; N = 196-C, 212-I, 408-A)	19.4	68.4***	<.001	<.001
Handwashing: all five key times	59.2	57.8	.902	.192
Water treatment—boiling, adding bleach/chlorine, filtering, or SODIS	55.0	64.2	.343	.285
Drinking water pot covered (observation)	48.8	80.2***	<.001	.001
No animal or human feces in house/compound (observation)	46.7	61.6	.160	.372

Note. ANC = antenatal care; FCHV = female community health volunteer; WASH = water, sanitation, and hygiene; SODIS = solar disinfection system.

All five key times for handwashing assessed include the following: before eating, before feeding a child, before preparing food/cooking, after defecation, and after cleaning a child's bottom of feces; All five key steps for handwashing assessed include the following: running or clean water; soap or ash; rubs hands together at least three times; washes both hands; dries by air or with clean cloth

[a]Controlling for VDC-level clustering

[b]Controlling for VDC-level clusering as well as various potential confounders: women's age and education level; household agroecological zone of residency, total number of children <5 years, asset ownership, and roof materials.

*$P < .05$.

**$P < .01$.

***$P < .001$.

having ever received counseling on HTSP (S: −9%; C: 9%; $p < .001$) and for exposure to two key messages: heard in the last counseling session about waiting 2 years between pregnancies (S: −7%; C: 13%; $p < 0.05$) using a family planning method of the woman's choice for 2 years between pregnancies (S: 2%; C: 13%; $p < .01$) and ever heard to not give the child any water, other liquids, or other foods up to 6 months of age (S: 6%; C: 15%; $p < .05$).

Furthermore, DAGs in *Suaahara* areas were more likely to report accurate knowledge for some key maternal and child health and nutrition knowledge variables than DAGs in comparison areas, and the gap between DAG and non-DAG households in *Suaahara* areas was much smaller than in comparison areas. However, there were only a few knowledge variables for which the interaction term was significant in adjusted models. These included the percentage aware that pregnant women need to take IFA tablets for 180 days; in this case, the gap was slightly bigger in *Suaahara* areas, but the percentage of both DAGs and non-DAGs with this knowledge was more than 20% higher for each group in *Suaahara* areas than in comparison areas (S: 14%; C: 12%; $p < .05$). Differences between DAGs and non-DAGs were also smaller in *Suaahara* areas for the following: appropriate age for introduction of water and clear liquids (S: −3%; C: 15%; $p < .01$) and milk and milk products (S: −3%; C:15%; $p < .01$), as well as knowledge that a sick child should be fed more (S: −6%; C: 8%; $p < .01$).

The interaction term was significant in fully adjusted models for the following maternal health and nutrition practice indicators: seeking ANC-related services or counseling from FCHVs (S: −13%; C: 13%; $p < .01$), eating more during pregnancy (S: −3%; C: 19%; $p < 0.01$), and exclusive breastfeeding for children under 6 months (S: −32%; C: 14%; $p < 0.05$). There was one variable for which the significant interaction term favored the comparison areas. Consumption of "other fruits and vegetables" was higher among DAG children in comparison areas than in *Suaahara* areas, but higher among non-DAGs in *Suaahara* areas than in comparison areas. The DAG/non-DAG gap was much smaller (actually in favor of DAGs) in comparison areas for this one feeding practice (S: 28%; C: −7%; $p < .05$).

4 | DISCUSSION AND CONCLUSIONS

These results provide encouraging evidence that an integrated intervention with multiple delivery platforms can address exposure, knowledge, and practice barriers to nutritional well-being among mothers and children under 2 years of age. Large significant differences were observed between intervention and comparison groups after only 2 years of program implementation. In *Suaahara* areas, the prevalence was higher for almost all exposure and knowledge indicators and some practice indicators for maternal and child health and nutrition and WASH. Although our data did not allow for direct comparison and estimation of effects, major differences between *Suaahara* and comparison areas were not evident in the baseline survey (Cunningham & Kadiyala, 2013). Our equity analysis showed that a greater percentage of DAG households in *Suaahara* areas was exposed to nutrition information than in comparison areas. DAG households in *Suaahara* areas were also more knowledgeable about nutrition and more likely to practice almost all of the behaviors promoted by *Suaahara*. Finally, the gaps between DAG and non-DAG households were significantly smaller in *Suaahara* areas than in comparison areas for many of the same exposure, knowledge, and practice indicators. This examination of several steps along *Suaahara's* implementation pathways, and the equity analysis, exemplifies the possibilities of using detailed PE studies to assess programs (Mbuya et al., 2015).

TABLE 5 Exposure, knowledge, and practices on key *Suaahara*-promoted health, nutrition, and water, sanitation, and hygiene practices, among disadvantaged and non-disadvantaged households

	Comparison		Non-DAG to DAG	Intervention		Non-DAG to DAG	Interaction term
	DAG (*N* = 122) Mean (SD)/%	Non-DAG (*N* = 118) Mean (SD)/%	Difference Mean/%	DAG (*N* = 115) Mean (SD)/%	Non-DAG (*N* = 117) Mean (SD)/%	Difference Mean/%	Significance[a] *P* value
Exposure to *Suaahara*							
Total number of times met with FLWs in last the 6 months	2.9 (1.4)	3.3 (1.7)	0.4	4.5 (2.1)	4.5 (2.3)	0.0**	.008
HTSP counseling by health professional: percent ever received	50.0%	59.3%	9.3%	92.2%	82.9%	−9.3%***	<.001
Health: number of information sources in the last 6 months	1.6 (1.1)	2.3 (1.3)	0.7	3.5 (1.6)	3.7 (1.5)	0.2**	.002
Nutrition: number of information sources in the last 6 months	1.3 (1.0)	1.9 (1.2)	0.6	3.3 (1.5)	3.6 (1.5)	0.3**	.032
FP: number of information sources in the last 6 months	1.4 (1.2)	2.0 (1.4)	0.6	3.1 (1.4)	3.4 (1.5)	0.3^	.097
Health and nutrition: number of tools/materials seen	0.3 (0.9)	0.3 (0.7)	0.0	2.6 (2.4)	3.0 (2.6)	0.4**	.020
Key message: waiting 2 years between each pregnancy: percent heard in last counseling session	43.4%	55.9%	12.5%	89.6%	82.9%	−6.7*	.049
Key message: FP method of woman's choice for 2 years between pregnancies; percent heard in last counseling session	43.4%	56.8%	13.3%	87.0%	77.8%	1.9%*	.011
Key message: not putting anything into the child's mouth before breast milk or colostrum: percent ever heard	61.5%	70.3%	8.8%	83.5%	74.4%	−9.1*	.045
Key message: not giving the child any water, other liquids, or other foods up to six months of age: percent ever heard	52.5%	67.8%	15.3%	93.0%	85.5%	5.7%*	.037
Knowledge: percent reported correctly							
Knowledge: 180 days of iron/folic acid tablets need for pregnant woman	58.2%	70.3%	12.1%	81.7%	95.7%	14.0%*	.046
Knowledge: 45 iron/folic acid tablets needed for part partum woman	41.0%	59.3%	18.3%	76.5%	94.0%	17.5^	.096
Knowledge: child malnutrition prevention	39.3%	55.9%	16.6%	79.1%	82.9%	3.8^	.067
Age to introduce water/clear liquids (6–8.9 months)	59.8%	74.6%	14.7%	94.8%	92.3%	−2.5%**	.008
Age to introduce milk/milk products (6–8.9 months)	63.1%	78.0%	14.9%	93.9%	90.6%	−3.3%**	.008
For child illness, feed an extra meal daily/more food/more liquids	14.8%	22.9%	8.1%	56.5%	50.4%	−6.1%**	.006
Practices: percent reported correctly							
FCHV as source of ANC services or counseling	46.7%	59.3%	12.6%	76.5%	63.3%	−13.3%**	.006
Eating more than usual during pregnancy	23.0%	41.5%	18.6%	77.4%	74.4%	−3.0%**	.004
Dairy: consumed by woman in previous 24 hr	27.1%	51.7%	24.6%	61.7%	75.2%	13.5%^	.076
Exclusive breastfeeding (0–5.9 m)	44.8%	58.3%	13.5%	94.7%	62.5%	−32.2*	.051
Introduced milk/milk products (excluding breast milk) at 6–8.9 months	30.4%	57.1%	26.7%	81.8%	76.2%	−5.6^	.091
Dairy: consumed by children 6–23.9 months	37.0%	55.1%	18.1%	72.7%	78.6%	5.9^	.062
Other fruits and vegetables consumed by children 6–23.9 months	39.1%	32.7%	−6.5%	29.6%	57.1%	27.6%*	.026
Handwashing station with water and soap/ash available (observation*; among those with observable handwashing station; *N* = 239-C, 232-I, 471-A)	38.5%	61.0%	22.5%	84.4%	88.9%	4.5%^	.055

Note. DAG = disadvantaged group; FCHV = female community health volunteers; FLSs = frontline workers; FP = family planning; HTSP =healthy timing and spacing for pregnancy; WASH = water, sanitation, and hygiene.

Potential sources of information asked about include the following: newspaper/magazine; radio/FM; television; brochure/leaflet/poster/banner; FCHV; village model farmer; agriculture/livestock extension worker; village WASH committee member; VDC nutrition and food security steering commmittee member; social mobilizer; *Suaahara* field supervisor; ward citizen forum; citizen awareness center; potential health and nutrition tools/material asked about include: discussion cards; pictorial books; posters; locally available food; training aid pictures; crop calendar; poultry flip chart; garden-to-plate materials; coop game cards; All five key times for handwashing assessed include: before eating, before feeding a child, before preparing food/cooking, after defecation, and after cleaning a child's bottom of feces.

[a]Controlling for VDC-level clusering as well as various potential confounders: women's age and education level; household agroecological zone of residency, total number of children <5 years, asset ownership, and roof materials.

^*P* < .10.

**P* < .05.

****P* < .01.

******P* < .001.

New evidence points out that if reductions in stunting in South Asia are to be achieved, progress is needed in child diets and nutrition in the first 1,000 days, maternal diet and nutrition during pregnancy and lactation, and WASH (Aguayo & Menon, 2016)—three areas in which we focus our analysis. The magnitude of the differences between intervention and comparison areas varied across selected indicators. This is likely due, at least in part, to *Suaahara's* gradual roll-out of key themes per year, resulting in the emphasis of certain desired behavior changes for a longer total period of time than others. Unsurprisingly, most knowledge differences between intervention and comparison areas are larger than the practice differences. This may reflect that additional time is needed for knowledge to translate into certain behaviors, or that for some behaviors, translation from knowledge into practice may require addressing other constraints, for instance, those related to income, social norms, and self-efficacy, as well as availability, affordability and accessibility of foods or health, and nutrition and family planning products or services (Adhikari, 2016; Affleck & Pelto, 2012; Yates et al., 2012). Finally, one result was surprising—that 38% of women in comparison areas and only 28% of women in *Suaahara* areas reported to consume meat. This could be due to unmeasured caste and ethnic differences or unidentified socioeconomic differences. However, given that consumption of meat was much higher in *Suaahara* areas (69% vs. 39%), as was consumption of all other nutritious foods, it is quite likely that it is due to *Suaahara's* promotion of dairy as an alternative animal source food if eggs or meat are too costly and programmatic emphasis on consuming as many diverse foods as possible. With scarce resources, households in *Suaahara* areas may have opted to consume dairy plus other nutrient-rich foods rather than just meat. Without qualitative research, these reasons remain hypothetical and in need of further research to understand household decision-making.

This study adds to the evidence base that achieving nutrition-related behavior change at scale is possible with intensive interventions. For instance, progress in IYCF indicators is consistent with evidence from the Alive & Thrive program in Bangladesh, which documented significant progress in several breastfeeding and complementary feeding indicators (Sanghvi et al., 2016). *Suaahara* activities, once fully rolled-out, took place in more than half of Nepal's 75 districts and within each district, included all households with a woman in the 1,000-day period. The time-intensive nature of full programmatic roll-out in a staged manner and using context-specific approaches per district should not be minimized. For at-scale implementation to be possible, investments in time and human resources are required. The *Suaahara* PE data shows high levels of program coverage and utilization with at-scale implementation. *Suaahara's* combination of nutrition-specific and nutrition-sensitive approaches, and explicit focus on social inclusion, enabled *Suaahara* to tackle multiple determinants of under nutrition at once, in line with current regional recommendations (Vir, 2016). Furthermore, *Suaahara's* approach of using FLWs from the same communities likely contributed to the communities' engagement with programmatic activities. For example, the fact that FCHVs are highly respected and a valued source of health information has been theorized to be an important factor in the success of other programs that used this cadre to deliver child health and nutrition services (Thapa, 2014).

Our results show that an integrated at-scale nutrition program can reduce inequities in health- and nutrition-related knowledge and practices. This is consistent with evidence that increasing the coverage of interventions helps to ameliorate disparities in health related to socioeconomic status (Victora et al., 2012). Few nutrition programs globally have attempted to operate with such wide geographic coverage, and even fewer have explicitly focused on equity, but there is an increasing call for large-scale nutrition programs to close equity gaps for vulnerable populations (Aguayo & Menon, 2016). In addition to operating at scale, *Suaahara's* explicit targeting and GESI approach to program implementation allowed FLWs to provide appropriate support and follow-up so that support of situation-specific knowledge and optimal practices for both advantaged and disadvantaged women could be maximized. Other data also suggest that rapid increases in program coverage accompanied by purposeful targetting can reduce inequalities (Victora et al., 2003). Nepal's successful vitamin A distribution was also at scale and with explicit attention to coverage barriers related to equity (Thapa, 2014). Although similarities can be seen in scale and equity focus, the vitamin A campaign was a single health sector intervention, whereas *Suaahara* involved a package of multisectoral interventions. Therefore, in addition to challenges relating to Nepal's difficult terrain, extreme topographical differences, weak infrastructure, tremendous cultural and linguistic diversity, and long-standing inequities which all initiatives must face, *Suaahara* was also challenged by political instability, weak governance, limited capacity of government functionaries, particularly outside of the health sector, for development of nutrition-related services, and coordination at all levels and across sectors.

There were several study limitations that should be noted. First, the cross-sectional nature of this study makes causal inferences impossible. However, for this PE analysis, we used fully adjusted models including an interaction term to estimate the effect of *Suaahara* on reducing inequalities. *Suaahara's* PE involved careful matching of intervention and comparison districts, ensuring that there were no similar large-scale nutrition programs, and using random sampling at the VDC and ward level. In the last several years, scientists have emphasized the need for rigorous PE studies to generate evidence on both the design of complex programs and meaningful findings on program implementation and uptake (Mbuya et al., 2015; Menon, Rawat, & Ruel, 2013). Second, the household-level sampling relied on FCHVs to accurately identify DAG households, which may have introduced bias and misclassification. However, FCHVs are long-standing community leaders, known to be familiar with households' socioeconomic and cultural status in their own wards. Furthermore, our study is novel in our explicit sampling approach: our sample provides group-specific estimates, thereby facilitating equity analysis in *Suaahara* and non-*Suaahara* areas. The statistical significance of the interaction term exhibits heterogeneity based on the model implemented, perhaps in part due to lack of statistical power for some models; however, the direction of the impact is consistent across specification, providing evidence of an effective program and robust results.

Several critical questions remain, and further research is needed to determine whether these results are specific to this context, or are also applicable to similar settings in South Asia or other low- and middle-income countries. It would also be interesting to know which program

components are most responsible for differences seen between intervention and comparison areas. Finally, whether and how these changes in nutrition-related knowledge and practices translate into changes in nutritional status should be investigated. With greater global focus on multi-sectoral nutrition interventions, answering these additional research questions is urgent and requires commitment by development partners in rigorous evaluation studies.

The *Suaahara* experience is instructive both for Nepal and for the global context, as it provides evidence that complex integrated programs can work to reduce health- and nutrition-related inequities, even while operating at scale. Given that Nepal's current policy environment is supportive of addressing food and nutrition insecurity, as seen in the MSNP, Zero Hunger Challenge, Food and Nutrition Security Plan of Action, and increased interest and communittment by the GoN and development partners alike, Nepal is uniquely positioned to scale-up the implementation of both nutrition-specific and nutrition-sensitive interventions to further address the problem of persistent undernutrition, in a way that benefits all sections of Nepalese society. Development partners and the GoN should use findings from *Suaahara* in the design and implementation of emerging initiatives to address inequities in health and nutrition, which would also be consistent with the recently endorsed sustainable development goals.

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CONFLICTS OF INTEREST

K C was an independent research consultant during *Suaahara* I, but is now employed by *Suaahara* II. All other authors worked for one of the non-governmental organizations involved with *Suaahara* I.

CONTRIBUTIONS

K C designed the study, conducted the statistical analyses, and prepared the first draft of the manuscript. A S, P P, K L, S A, R K, B G, and C U provided revisions and additional text to manuscript drafts. K C prepared the final manuscript and all authors read and approved the final version for submission.

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