Supplemental information

Outcome 1, households with hygienic food preparation spaces, was quantified and verified through direct observation. The presence of a hygienic food preparation area was analyzed based on the operational definition that a hygienic food preparation space will have at all of the following features: 1) a cleanable/wipeable food preparation surface, 2) a space that is inaccessible to animals, 3) clean utensils: stored in a place that is not accessible by animals, stored dry and visible free of dirt/debris, and 4) has a handwashing station within 10m of the food preparation area.

Outcome 2, households who store food hygienically, was quantified and verified through direct observation. The presence of hygienically stored food was analyzed based on operational definition that hygienically stored food will have the following features: 1) food inaccessible to animals, 2) food inaccessible to young children, 3) food covered, and 4) food free of flies.

Outcome 3, hygiene was primarily measured with a proxy measure of having a functional handwashing station; we also asked about handwashing knowledge. A functional handwashing station was quantified and verified through direct observations. The presence of functional handwashing station was defined based on the operational definition as a handwashing station (anywhere in the compound) with the following two features: 1) presence of water, and 2) presence of soap. In addition, we included a measurement of functional handwashing station, defined as a handwashing station (anywhere in the compound) with soap and water present.

Outcome 4, provision of a safe play environment for children under 5, was defined as one which was free of human feces, free of animal feces including chicken feces, free of garbage and other household wastes, and free of sharp objects and other potential harms. Presence or absence of a safe play environment was verified by direct observation for all households having a child under the age of 5. Specific indicators observed included 1) presence or absence of animals in the compound especially chicken/duck, whether they were kept in a pen and if they could go in and out of the house, 2) presence or absence of animal feces including chicken/duck, 3) method of disposing animal/human feces including ownership of latrine, access to latrines and functionality of latrines, 4) tool for disposing of animal/ child feces, 5) compound swept which included compound swept every day, household swept every day and compound looking swept. Safe play environment was analyzed separately by age group, broken down into children under 6 months of age and those between 6 and 24 months of age, as younger children are often placed in a safer environment without the ability to move, explore, and expose themselves to greater risks on their own. Both age groups were analyzed by the operational definition that a safe play environment is one which is 1) free from garbage and other household wastes, 2) free from animal feces including chicken feces, 3) free from human feces, and 4) free from sharp objects and other harms.

Outcomes 5 and 6 measured dietary diversity for pregnant and lactating women and for children between the ages of 6 and 24 months, respectively. These were quantified using the 24-hour food intake recall, a method adapted by the FAO from the FANTA Household Dietary Diversity Score Indicator. Survey participants were asked to recount every meal, snack, and beverage that was consumed in the previous 24 hours; enumerators then categorized consumed foods into 16 categories (see Appendix C for 24-hour recall forms). Lactating and expectant mothers also reported how many times they would eat in a day while pregnant or lactating and if they would eat more than if they were not lactating or pregnant. The 24-hour recall strategy was utilized to measure dietary diversity for pregnant and/or lactating women; analysis was conducted using the Women's Diet Diversity Score (WDDS), which is tailored to measure micronutrient intake for the respondent.[1] The 24-hour recall survey data (16 food groups total) was grouped according to the WDDS format into the following 9 micronutrient-based groups:

Table 1. WDDS micronutrient-based categories used for dietary diversity analysis for pregnant and/or lactating women.

WDDS CATEGORIES	24-HOUR RECALL CATEGORIES
Starchy staples	Cereals White roots and tubers
Dark green leafy vegetables	Dark green leafy vegetables
Vitamin A rich fruits and vegetables	Vitamin A rich fruits Vitamin A rich vegetables
Other fruits and vegetables	Other fruits Other vegetables
Organ meat	Organ meat
Meat and fish	Meat Fish and other seafood
Eggs	Eggs
Legumes, nuts and seeds	Legumes, nuts and seeds
Milk and milk products	Milk and milk products

The 24-hour recall strategy was utilized to measure dietary diversity in children between the ages of 6 and 24 months; analysis was conducted using the WHO guidelines for minimum dietary diversity for children 6-24 months of age.[2] The 24-hour recall survey data was grouped according to the WHO infant and young child feeding format into the following 7 food group score variables:

Table 2. Minimum dietary diversity food group scores used for dietary diversity analysis for children 6-24 months.

WHO MINIMUM DIET DIVERSITY CATEGORIES FOR CHILDREN 6-24 MOS.	24-HOUR RECALL CATEGORIES
Grains, roots, and tubers	Cereals White roots and tubers
Vitamin A rich fruits and vegetables	Vitamin A rich fruits Vitamin A rich vegetables
Other fruits and vegetables	Other fruits Other vegetables
Flesh foods	Meat Organ meat Fish and other seafood
Eggs	Eggs
Legumes, nuts and seeds	Legumes, nuts and seeds
Milk and milk products	Milk and milk products

Using the WHO standards for minimum dietary diversity, the analysis categorized CU2 by those who consumed 4 or more WHO categories of foods, and those who consumed 3 or fewer categories of foods.[2]

Outcome 7, caretakers feeding children thickened porridge to improve energy density, was measured through porridge thickness picture-based methods.[3] Porridge of sufficient energy density is defined as any which has a minimum of 0.8kcal/g.[4]. A set of pictures displaying 5 different porridge thicknesses were shown to survey participants with CU2 for baseline and CU5 for endline, who were asked to point to whichever porridge is most like the one that they serve to the CU2/CU5. In order to make these comparable within the report, we only included the measures for CU2. Pictures numbered 1, 2, and 3 have insufficient energy densities (below 0.8 kcal/g) according to WHO standards, while pictures numbered 4 and 5 provide sufficient energy.[4] Porridge thickness and the associated energy density were analyzed as a binomial, either having

sufficient energy (0.8kcal/g or more, according to WHO standards), or having insufficient energy (less than 0.8kcal/g).[4]

Outcome 1: Hygienic food preparation area

At endline, 36% of intervention households had a hygienic food preparation area, as compared to 10% of control households. Hygienic food preparation areas were found in 26% more households in intervention compared to controls (Table S1). The odds ratio [OR] comparing intervention to control households at endline was 8.10, with a 95% confidence interval [CI] of 2.12, 30.8. Handwashing stations were found in 28% more intervention households compared to control (OR:6.56, 95% CI: 2.24, 9.24).

Table S1. Hygienic food preparation area attributes as per the study's operational definition. A hygienic food preparation space was defined as having 6 out of the 7 attributes.

	Baseline		Endline			
	Intervention N=134	**Control n=133**	**Intervention N =126**	**Control n=121**	**RDD**	**OR (95% CI)**
Food preparation surface that is cleanable	11 (8%)	4 (3%)	118 (94%)	102 (84%)	5%	2.53 (0.76, 8.40)
Food preparation space is inaccessible to animals	21 (16%)	12 (9%)	84 (67%)	80 (67%)	-7%	0.97 (0.49, 1.93)
Handwashing station located within 10m	5 (4%)	1 (1%)	61 (48%)	20 (17%)	28%	6.56 (2.24, 19.24)
Clean Utensils (defined as the three following indicators together)	96 (72%)	90 (68%)	85 (68%)	58 (48%)	16%	2.54 (1.10, 5.93)
Utensils stored in a place that is inaccessible to animals	112 (84%)	105 (77%)	89 (71%)	66 (55%)	9%	2.19 (0.88, 5.47)
Utensils stored dry	113 (85%)	110 (81%)	118 (94%)	107 (88%)	2%	2.98 (0.80, 11.2)
Utensils visibly free of dirt	112 (84%)	105 (77%)	117 (94%)	98 (81%)	6%	1.60 (0.70, 3.64)

significant at 0.05

Outcome 2: Hygienic food storage

Of intervention households interviewed, 43% at endline stored food hygienically, so that the food was inaccessible by animals and children, as well as covered and free of flies at the time of observation; the risk double difference shows an increase of 27% in intervention households (OR:1.63, 95% CI: 0.52, 5.11; Table S2). Control households show a decrease in food hygiene storage from 52% to 34%.

Table S2. Hygienic food storage is defined as demonstrating all 4 of these attributes, as per the operational definition.

	Baseline	Endline

	Intervention n=39	Control n=33	Intervention n=51	Control n=41	RDD	OR (95% CI)
Food is not accessible by animals	22 (57%)	25 (76%)	41 (80%)	31 (76%)	23%	1.32 (0.41, 4.28)
Food is not accessible by children	19 (49%)	23 (70%)	31 (61%)	23 (70%)	12%	0.77 (0.26, 2.25)
Food is covered	26 (67%)	23 (70%)	31 (61%)	19 (46%)	18%	1.90 (0.67, 5.42)
Food is free of flies	23 (59%)	28 (85%)	36 (71%)	25 (61%)	36%	1.67 (0.48, 5.80)

**significant at 0.05*

Outcome 3: Handwashing (functional handwashing station)

21% more mothers in intervention households named 5 of 6 key handwashing times than mothers in control households (OR:3.59, 95% CI: 1.15, 11.28; Table S3). In the intervention, 14% more mothers listed handwashing before food preparation (OR:2.79, 95% CI: 1.08, 7.21; Table 10), 25% more listed handwashing after cleaning up animal feces (OR:3.37, 95% CI: 1.18, 6.95; Table 10), and 21% more listed handwashing after cleaning up child feces (OR:2.47, 95% CI: 0.97, 2.68; Table 10) compared to controls.

In addition to the knowledge of key handwashing times, we also chose to compare the number of functional handwashing stations in intervention and control households. Adjusted with RDD, 44% more of intervention households had water present at the handwashing station than did control households (OR 7.7, 95% CI: 3.7, 15.9; Table S4). At endline, 46% of intervention households had soap present at their handwashing station, as compared to 2% of control households; adjusted with RDD, households experienced a 49% positive change.

Table S3. Knowledge of key handwashing times. Sufficient knowledge of key handwashing times is the ability to recall at least 5 of the 6 key times without prompting, as per the study operational definition.

	Baseline		Endline			
	Intervention N=134	Control N=136	Intervention N=126	Control N=122	RDD	OR (95% CI)
Caretakers who can name at least 5 of 6 key HW times	37 (28%)	33 (24%)	62 (49%)	29 (24%)	21%	3.59 (1.15, 11.28)
Before preparing food	101 (75%)	102 (75%)	114 (91%)	94 (77%)	14%	2.79 (1.08, 7.21)
Before eating	125 (93%)	124 (91%)	123 (98%)	113 (93%)	3%	3.33 (0.84, 13.2)
Before feeding a child/infant	77 (58%)	83 (61%)	82 (65%)	74 (61%)	7%	1.12 (0.48, 2.59)
After defecating	108 (81%)	105 (77%)	107 (85%)	98 (81%)	0%	1.38 (0.71, 2.67)
After cleaning up animal feces	25 (19%)	27 (20%)	60 (48%)	31 (25%)	25%	3.37 (1.18, 9.65)
After cleaning up child feces	50 (37%)	49 (36%)	78 (62%)	49 (40%)	21%	2.47 (0.97, 6.28)

Presence of water	11 (8%)	19 (15%)	52 (47%)	11 (10%)	44%	7.7 (3.7, 15.9)
Presence of soap	6 (5%)	13 (10%)	51 (46%)	2 (2%)	49%	44.6 (10.5, 189.5)

Outcome 4: Safe play environment for children under 6-24 months

Due to vastly differing mobilities at different ages, safe play environment observations were broken down into two categories: play environments for children under 6 months and those for children 6-24 months. However, there were only 22 children from 0-6 months, so we have chosen not to present this data. In endline intervention households with a child 6 months to 2 years, 69% provided a space for their child to play which was free of garbage, human feces, animal feces, and sharp or otherwise harmful objects as compared to 47% of endline control households; however, when adjusted with the RDD, intervention households experienced a positive change of 29% (OR:2.50, 95% CI: 1.13, 5.55; Table 11). Intervention households experienced a 19%(RDD) positive change in areas that were free from animal feces, including chicken feces (OR:2.62, 95% CI: 1.07, 6.38; Table 11). Intervention households also experienced a 30%(RDD) positive change in areas that were free from sharp objects and other potential harms (OR: 4.86, 95% CI: 1.0, 22.60; Table S5).

Table S4. Safe play environment for children between 6 and 24 months of age at baseline and endline, broken down by attribute. The operational definition considers a safe play environment one which provides all 4 of these attributes.

	Baseline		**Endline**			
	Intervention N=64	**Control N=71**	**Intervention N=58**	**Control N=51**	**RDD**	**OR (95% CI)**
Households with a safe play environment for children 6-24 months of age	15 (24%)	23 (32%)	40 (69%)	24 (47%)	30%	2.50 (1.13, 5.55)
Area is free of garbage and other household wastes	30 (47%)	40 (56%)	47 (81%)	33 (65%)	8%	5.48 (0.05, 588.9)
Area is free from human feces	54 (84%)	62 (87%)	56 (97%)	48 (95%)	5%	2.97 (1.19, 7.41)
Area is free from animal feces (including chicken feces)	27 (42%)	29 (41%)	49 (85%)	33 (65%)	19%	2.62 (1.07, 6.38)
Area is free of sharp objects and other potential harms	33 (52%)	43 (61%)	50 (87%)	33 (65%)	31%	4.86 (1.04, 22.6)

Outcome 5: Dietary diversity for pregnant and lactating women

Among PLW in intervention households, at baseline 27% were receiving an adequate diversity of foods in their diets as defined by WDDS; at endline this had increased to 52%. Considering the RDD, women in intervention households increased their dietary diversity by 14% in five months (OR:2.41, 95% CI: 1.11, 5.20; Table S6). The food group that intervention women most increased intake of was milk or dairy products, the risk double difference showed an increase of 27% (OR:5.45, 95% CI: 2.22, 13.38)

Table S5. Dietary diversity for pregnant and lactating women and baseline and endline, categorized by Women's Dietary Diversity Score (WDDS) food groups[1]

	Baseline		Endline			
	Intervention n=81	**Control n=80**	**Intervention n=65**	**Control n=53**	**RDD**	**OR (95% CI)**
PLW who consumed 5+ WDDS food categories in previous 24 hours	22 (27%)	17 (21%)	34 (52%)	17 (32%)	14%	2.41 (1.11, 5.20)
Starchy staples	81 (100%)	79 (99%)	63 (99%)	52 (98%)	9%	1.24 (0.08, 20.37)
Dark green leafy vegetables	63 (78%)	53 (66%)	50 (77%)	43 (81%)	-16%	0.67 (0.16, 2.72)
Vitamin A rich fruits and vegetables	2 (3%)	4 (5%)	15 (23%)	9 (17%)	8%	1.47 (0.58, 3.68)
Other fruits and vegetables	73 (90%)	74 (93%)	64 (99%)	52 (98%)	5%	1.23 (0.08, 20.16)
Meat and fish	55 (68%)	60 (75.0%)	54 (83%)	39 (74%)	16%	1.77 (0.72, 4.33)
Eggs	5 (6%)	0 (0.0%)	5 (8%)	5 (9%)	-7%	0.80 (0.20, 3.25)
Legumes, nuts, and seeds	14 (17%)	17 (21%)	14 (22%)	8 (15%)	11%	1.54 (0.59, 4.02)
Milk and milk products	26 (32%)	20 (25%)	32 (49%)	8 (15%)	27%	5.45 (2.22, 13.4)

Outcome 6: Dietary diversity for children 6-24 months

For children aged 6-24 months within intervention households, 55% were consuming a sufficient diversity of foods to provide proper micronutrient intake in their diets, as compared to 30% at baseline[2] (Table S7). The RDD was 20% (OR:2.28, 95% CI: 0.92, 5.65). The RDD was 10% increase for milk and milk products (OR:1.69, 95% CI: 0.40, 7.18), an increase of 11% in vitamin A rich fruits and vegetables (OR:1.90, 95% CI: 0.55, 6.52), and an increase of 20% in flesh foods, including meat, fish, and organ meats (OR:2.08, 95% CI: 0.94, 4.61).

Table S6. Dietary diversity for children 6-24 months of age at baseline and endline categorized by WHO guidelines for minimum dietary diversity for children 6-24 months.[2]

	Baseline		Endline			
	Intervention N=68	**Control N=73**	**Intervention N=58**	**Control N=52**	**RDD**	**OR (95% CI)**
Children 6-24 months who consumed 4+ WHO food categories in previous 24 hours	20 (30%)	23 (32%)	32 (55%)	19 (37%)	20%	2.28 (0.92, 5.65)
Grains, roots, and tubers	64 (94%)	71 (97%)	54 (93%)	50 (96%)	0%	0.54 (0.09, 3.08)

Vitamin A rich fruits and vegetables	5 (7%)	7 (10%)	13 (22%)	7 (14%)	11%	1.90 (0.55, 6.52)
Other fruits and vegetables	53 (78%)	57 (78%)	49 (85%)	43 (83%)	2%	1.24 (0.37, 4.11)
Flesh foods (meat, fish, organ meats)	38 (56%)	4 (60%)	42 (72%)	29 (56%)	20%	2.08 (0.94, 4.61)
Eggs	5 (7%)	3 (4%)	4 (7%)	1 (2%)	2%	4.04 (0.13, 124.1)
Legumes, nuts, and seeds	9 (13%)	11 (15%)	9 (16%)	10 (19%)	-1%	0.77 (0.29, 2.08)
Milk and milk products	22 (32%)	23 (32%)	37 (64%)	28 (54%)	10%	1.69 (0.40, 7.18)

References

1. Kennedy G, Ballard T, Dop MC. Guidelines for measuring household and individual dietary diversity: Food and Agriculture Organization of the United Nations 2011.
2. World Health Organization. Indicators for assessing infant and young child feeding practices: part 2: measurement. 2010
3. Faerber EC, Weiss J, Kedera E, et al. Household food insecurity and complementary feeding in Malawi. *The FASEB Journal* 2016;30(1_supplement):294.7-94.7.
4. Dewey K. Guiding principles for complementary feeding of the breastfed child. 2002