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The role of poultry transfers in diet diversity: A cluster randomized intent to treat analysis

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ABSTRACT

Poultry has gained renewed attention as a promising value chain for women because it is an asset that is widely accessible to women, has low start-up costs, and provides a good source of nutritious animal-sourced foods for children in chicken meat and, especially, eggs. The current study presents evidence from an experimental intervention that randomly provided women either a poultry package transfer of vaccinated, improved-breed chickens and related inputs, or a cash grant of equivalent value within a sample of households participating in a social safety net program. These transfers were embedded in a set of intensive livelihood and enhanced nutrition interventions as part of a broader experiment in rural Ethiopia. We assess the impact of the poultry package transfer as well as the enhanced nutrition intervention on the consumption of eggs by both children and adult women. We find that the poultry transfer increased the frequency of egg consumption as well as the sale of eggs, falling between the extreme of an autarkic household and one in which production decisions are fully separable from consumption choices.

1. Introduction

Projections of the impact of scaling up 10 proven effective nutrition-specific interventions to reach 90 percent of children in the world's most malnourished countries estimate that success in that endeavor would only reduce stunting by 20 percent and decrease child deaths attributed to malnutrition by a third (Bhutta et al., 2013). Although this would be appreciable and appreciated, it would not achieve the nutrition targets of the Sustainable Development Goals (United Nations, 2015). Actions in "nutrition-sensitive" sectors are, thus, additional critical components of any global strategy to eliminate undernutrition (Ruel and Alderman, 2013). Addressing the underlying determinants of undernutrition with nutrition-sensitive agriculture programs is a cornerstone of this broad strategy. Despite the appeal of this concept, supporting evidence has been limited, although the mechanisms for impact and contextual support are becoming clearer (Ruel, Quisumbing, and Balagamwala, 2018).

In order to reach their nutritional objectives, nutrition sensitive agriculture programs often include behavior change communication to complement measures to increase household production. This program element is motivated by the fact that many increases in farmstead production of highly nutritious food may not translate to commensurate changes in household diets (Sibhatu and Qaim, 2018). Under a commonly used model of a farm household, production decisions are separable from consumption; as producers the household seeks to maximize profits and as consumers the decision of how to allocate these profits is independent of the decisions on production (Singh, Strauss, Squire 1986; de Janvry, Fafchamps, and Sadoulet, 1991). Separability requires access to well-functioning markets as well as an absence of quality differences between what the household produces and what is offered in markets (Hoffmann and Gatobu, 2014), conditions that have been tested and sometimes rejected, particularly regarding labor and leisure (LaFave and Thomas, 2016). Even when these market conditions hold, farm production decisions may still not be fully separable from household dietary choices – for example, if either production or consumption decisions are not unitary (Udry et al., 1995). Thus, offering women control over resources is another mechanism for nutrition sensitive programs to be effective (Doss 2013).

The current study presents evidence from an experimental

Abbreviations: IFPRI, International Food Policy Research Institute; ITT, Intention to Treat; IYCF, Infant and Young Child Feeding; PSNP, Productive Safety Net Program; SPIR, Strengthen PSNP 4 Institutions and Resilience; BCC, Behavioral Change Communication.

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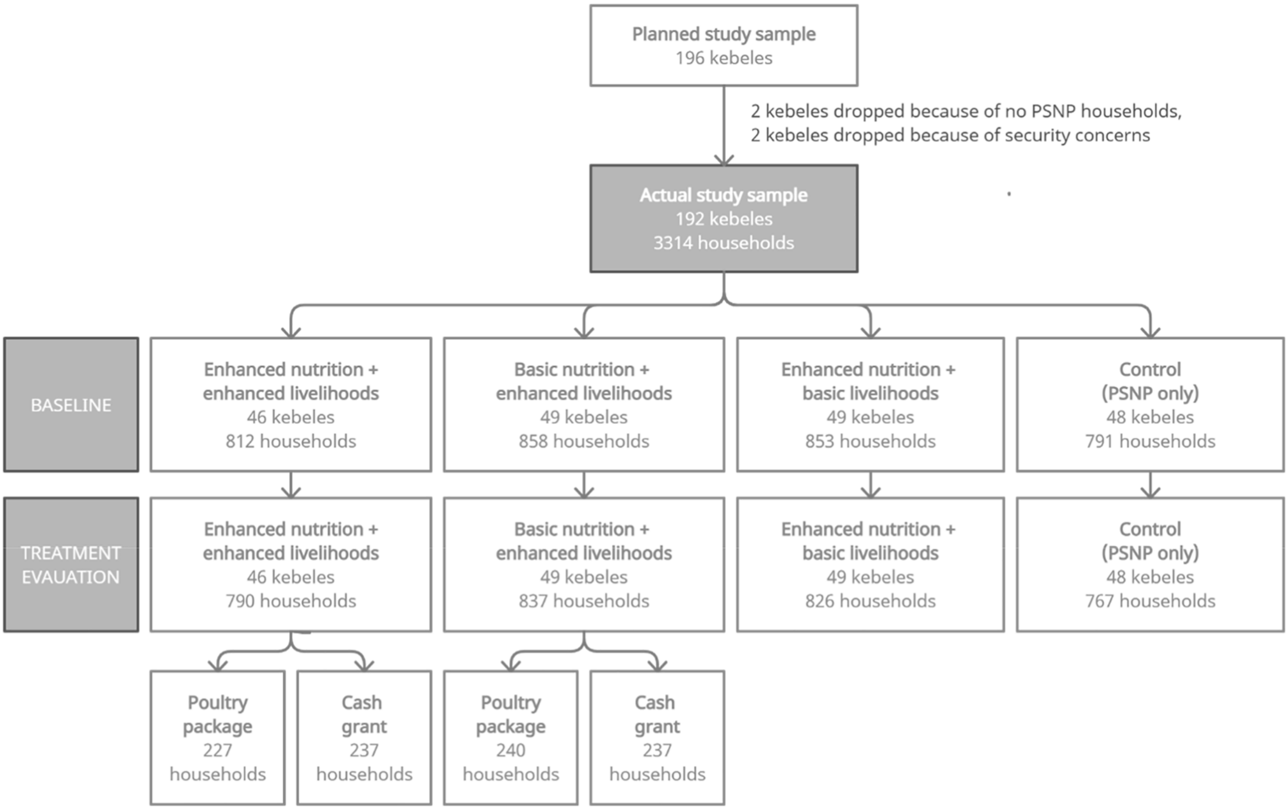

Fig. 1. Experimental impact evaluation design.

intervention that provided women either a poultry package transfer of vaccinated, improved-breed chickens and related inputs, or a cash grant of equivalent value within a sample of households participating in a social safety net program. These transfers were embedded in a set of intensive livelihood and enhanced nutrition interventions as part of a broader experiment in rural Ethiopia. The breed provided to beneficiaries reaches market weight rapidly, quickly providing women the choice over how many of the birds to sell as meat and how many to retain for egg production. We assess the impact of the poultry package transfer on the consumption of eggs by both children and adult women. As such, it goes to a debate between Bill Gates and Chris Blattman regarding the relative value of input specific livelihood transfers – in Gate's case, poultry - and cash transfers (Blattman, 2017). The relative merits of each approach depend, in part, on what outcome - household diets, female agency, sustainable income, etc. – is prioritized.

Eggs are a particularly nutritious food source and there is evidence, although mixed, that regular egg consumption augments child growth (Lutter, Iannotti, and Stewart, 2018; Iannotti et al., 2017). Child stunting is a significant public health problem among the population of the current study with stunting prevalence of 36% in children under the age of 3 years. Egg consumption is uncommon as is consumption of other animal sourced foods, despite widespread experience in production of livestock and small ruminants (Alderman et al. 2019). While it appears logical that such a program would increase consumption of animal source foods, this is not necessarily the case. Given the relative cost of both eggs and meat (Headey and Alderman, 2019), poor households may prefer to sell most of their production and purchase less expensive foods. The degree to which the poultry transfer or the cash grant translates into consumption, particularly by young children, then, has a bearing on the nutritional sensitivity of this program component.

A large-sample, cross-country observational study showed that egg consumption as well as consumption of a variety of animal source foods is associated with modestly lower stunting among children aged 6–23 months in Ethiopia (Headey, Hirvonen, and Hoddinott, 2018). Recent experimental evidence points to both the potential and limitations of intervention aimed at increasing egg consumption. For example, a follow-up to a strong proof-of-concept trial in which a program providing daily consumption of eggs reduced stunting in Ecuador (Iannotti et al., 2017) showed no sustained effect after the provision of eggs was discontinued (Iannotti et al., 2020). Mullally et al. (2021) evaluate a program in Guatemala that provides training and poultry transfers and find a large (23.5 percentage point) reduction in stunting of girls despite no significant reduction for boys and no impact on potentially mediating household level egg or chicken production, nor increased expenditure or changes in diets (calories, protein, eggs). Passarelli et al. (2020) provide additional experimental evidence from Ethiopia that indicates that a poultry program with or without nutrition behavior change communication increased child growth in Ethiopia, depending on the study round and intervention package in unadjusted but not in adjusted regressions.

The present study provides experimental evidence that compares the provision of a $200 cash grant to an equivalent value poultry package (16 vaccinated, improved-breed chickens, feed, housing and handwashing station materials, cash for veterinary services and training) provided to mothers of young children with a particular focus on improvements in child diets, a plausible necessary condition for the program to improve child nutrition through a dietary pathway. Measured effects are compared to an experimental control group of households that also participate in the public works based social safety net program, but who received no additional lump sum transfer or complementary nutrition counseling. We also present evidence on the effect of the intervention on poultry stocks and sales, to inform the potential tradeoff between the poultry business and dietary benefits. Our study provides this evidence using a comparatively large sample of poor households, many of whom did not own chickens prior to the intervention and who may be a high priority for targeted child nutrition interventions. In addition, we are able to compare the effects of the poultry transfer relative to a cash grant of comparable magnitude and also relative to an enhanced nutritional counseling program implemented in the absence of any lump sum transfer, and to evaluate complementarities between the transfers and the nutritional counseling.

2. Intervention and evaluation design

This analysis is part of a larger body of research investigating strategies to improve livelihoods, nutrition, and gender empowerment among beneficiaries of Ethiopia's Productive Safety Net Program (PSNP). Initiated in 2005, the PSNP is one of the largest safety net programs in Africa. It provides a combination of public works payment transfers for food insecure households and direct cash support to pregnant and lactating women. The program covers a total of 8 million beneficiaries and provides a mix of cash and food with a mean transfer value of $126 per household per public works season (Berhane et al., 2020). The 4th phase, begun in 2015, integrated a nutrition component into the livelihood orientation of the program. To support implementation of this program World Vision and its partners, CARE and ORDA, are providing services to more than 500,000 PNSP clients in 15 food insecure *woredas* (districts) in Amhara and Oromia regions of Ethiopia with funding from USAID's Bureau for Humanitarian Assistance and in close collaboration with the Government of Ethiopia.

This five-year project (2016–2021), Strengthen PSNP 4 Institutions and Resilience (SPIR), includes a clustered[1] randomized controlled trial design to learn about the effect of combinations of the primary components of SPIR programming: a basic livelihoods package, a basic nutrition package, and enhanced programs for both livelihoods and nutrition. The enhanced nutrition program includes, among other aspects, additional behavioral change communication (BCC) strategies of household-level counseling for pregnant and lactating women. The suite of enhanced nutrition services also includes efforts targeted to increase male engagement and support for these improved nutrition practices. These interventions were combined and randomized into four treatment arms: T1: combined intensive livelihood and enhanced nutrition, T2: intensive livelihood and basic nutrition, T3: basic livelihood and enhanced nutrition, and T4: a control group.

One of the provisions included in the PSNP4 design was a livelihood transfer ($200 equivalent in local currency) targeted to the poorest households among the already food insecure PSNP client households. As an adaptation on this provision, SPIR provided either the cash grant or an equivalent-value poultry transfer in a cross-randomized fashion across the experimental arms receiving the intensive livelihoods intervention. Half of the *kebeles* (sub-districts) in these two arms of the study were randomly selected to receive a one-time, targeted cash grant and half were randomly selected to receive a one-time, targeted poultry package. In each of these kebeles the 10 poorest households of the baseline survey sample of 18 households were chosen to receive these transfers through a ranking assessment based on an asset index. The asset index included ownership data on more than 30 asset categories, including consumer durables, productive assets, livestock, and land. It was constructed using principal components analysis, in which the first component maximizes the variation of all variables explained by that component, and therefore gives high weights to variables that are highly correlated with each other (Filmer and Pritchett, 2001). While the PSNP often targets the poorest 10–15% in these food insecure areas, the additional targeting of these transfers can be considered as distinguishing the very poor in terms of asset ownership from among an overall poor target group. Fig. 1 illustrates the overlap of the different treatment components.

The poultry package and cash grants were targeted exclusively to women. The improved poultry package (16 Sasso breed 6–8 week-old chickens from EthioChicken[2], 75 kg of feed, chicken coop construction materials, a feeding trough, simple handwashing station materials and $35 to purchase veterinarian services) was provided in April and early May 2019. Prior to receiving the package, participants received training on basic aspects poultry production. The Sasso is a dual-purpose, hybrid breed that can produce four times as many eggs per year as indigenous breeds (240 vs. 60 on average), while those reared for meat take a quarter of the time to reach market weight. Recipients were encouraged to sell the males (half of their flock) at maturation (4 months) and to keep the hens for egg production. In as much as poultry near the household can increase intestinal illness (Headey et al. 2016), a hygiene component was included in the initial training and materials were provided for simple handwashing stations to be set-up near the poultry pen. In addition, the improved poultry package included materials to construct a sturdy poultry pen (poles, nails, wire mesh, iron roof sheeting, etc.) that enabled HHs to avoid free-range mixing of chickens and children around the household premises.

2.1. Data

Initially 196 kebeles in Amhara (115 kebeles) and Oromia (81 kebeles) regions were selected for the trial and subsequently randomized into treatment groups. However, two kebeles had no PSNP beneficiaries and thus were not eligible for the program. Two other kebeles experienced ongoing civil unrest and were necessarily dropped from the project. Thus, the evaluation sample comprises 192 kebeles. In each kebele, 18 households were randomly sampled, leading to a planned baseline sample of 3,474 households. The inclusion criteria for the sample were that households had to (1) be a PSNP client household, (2) have at least one child aged 0–35 months, and (3) have the mother or primary female caregiver[3] of the 0–35-month-old child as a member of the household. The last criterion enabled measurement of maternal and child diets as well as child-care for nutritionally vulnerable ages in all sample households. As some listed and initially sampled households did not meet the inclusion criteria, the eventual sample was 3,314 households.

IFPRI received approval from its Institutional Review Board (IRB) at baseline for the SPIR quantitative evaluation design. This approval was updated for the second-round survey. IFPRI also received ethics approval from the Institutional Review Board (IRB) at Hawassa University, which also hosts the national Academic Center of Excellence for Human Nutrition. Informed oral consent was collected from all participants prior to the start of the interviews. Before beginning a household survey, enumerators read the respondent a brief description of the study that was being conducted, informed them that their participation in the study was voluntary and that they could discontinue participating at any time, and asked whether they agreed to respond to the household interview questions.

The baseline survey was undertaken between February 8 and April 25, 2018, with a small number of additional interviews and callbacks completed in the ensuing weeks. Fieldwork for the second-round survey data collection was completed from July 25 to October 23, 2019. Only 114 households from the original survey were not available for interview in the second-round survey, implying a 3.4% attrition rate.

Both surveys were structured in three parts: a brief household-level interview for identification and household demographics, a male respondent questionnaire and a female respondent questionnaire. The

[1] Clustered at the *kebele* (sub-district) level

[2] EthioChicken produces and sells day-old chicks. These day-old chicks are then raised by independent entrepreneurs and sold to small-scale farmers when they are 45–56 days old.

[3] As 99.1% and 97.9% of children under 24 months and under 36 months respectively were cared for by their mother, the word mother will used instead of caregiver in the rest of this study. Similarly, father is used in lieu of primary male caregiver irrespective of biological roles.

Table 1
Balance in baseline characteristics.

	Mean and Standard Deviation				P-Value	
	Poultry transfer	Cash transfer	Non-transfer very poor	Others	Poultry vs Cash	Poultry vs Non-transfer very poor
Male reports household owns any poultry	0.400 (0.491) [467]	0.374 (0.485) [462]	0.370 (0.483) [918]	0.497 (0.500) [1,373]	0.622	0.493
Total number of poultry owned by household	1.407 (3.113) [467]	1.201 (2.252) [462]	1.159 (2.136) [918]	2.350 (10.006) [1,373]	0.366	0.211
[of which number of poultry owned by female or jointly]	1.156 (2.356) [467]	1.084 (2.204) [462]	1.054 (2.016) [918]	1.779 (2.827) [1,373]	0.730	0.565
Index child consumed eggs in last 24 h	0.046 (0.211) [194]	0.039 (0.195) [178]	0.043 (0.203) [396]	0.053 (0.224) [623]	0.740	0.847
Mother consumed eggs in last 24 h	0.009 (0.092) [467]	0.018 (0.132) [452]	0.010 (0.099) [918]	0.030 (0.171) [1,365]	0.384	0.826
Log of total food and non-food expenditure last month (adult equivalents)	6.032 (0.752) [466]	6.132 (0.722) [448]	6.079 (0.753) [917]	6.150 (0.702) [1,362]	0.247	0.533
Distance to household's nearest town (km)	12.609 (7.300) [467]	12.808 (7.979) [462]	13.560 (7.696) [918]	13.178 (7.379) [1,372]	0.898	0.464
Household size	5.681 (2.008) [467]	5.470 (2.001) [462]	5.358 (1.861) [918]	6.192 (1.910) [1,373]	0.419	0.122
Mother has some education	0.213 (0.410) [460]	0.193 (0.395) [457]	0.216 (0.412) [898]	0.195 (0.396) [1,339]	0.584	0.929
Father has some education	0.322 (0.468) [373]	0.299 (0.458) [345]	0.350 (0.477) [671]	0.346 (0.476) [1,285]	0.611	0.466
Age of mother	30.403 (7.547) [462]	30.561 (7.932) [460]	29.917 (7.809) [908]	30.931 (7.221) [1,348]	0.794	0.364
Age of father	37.772 (8.612) [373]	37.608 (8.867) [347]	36.893 (8.359) [671]	39.070 (9.177) [1,287]	0.835	0.196
Child age in months	18.586 (10.545) [467]	18.546 (10.533) [462]	18.700 (10.293) [918]	18.645 (10.296) [1,373]	0.956	0.865
Male child	0.500 (0.501) [464]	0.522 (0.500) [460]	0.527 (0.500) [917]	0.499 (0.500) [1,367]	0.544	0.342

Notes: Estimates from the SPIR baseline survey sample. Standard deviations are in parentheses and sample sizes in square brackets. P-value is from the test of difference of means between the treatment arms. Standard errors are clustered at the kebele level.

female survey instrument included information on various aspects of her livelihood strategy including participation in self-help groups and poultry raising. The survey also asked about child-care and included questions on the number of food groups consumed in the previous day for a child chosen as the index child and for the mother. These are standard questions used to study diet diversity and do not indicate quantities, only whether or not any items from the food group were consumed. The surveys did not ascertain illness or assess hygiene practices. Each household in the baseline had a child under age 36 months designated as the baseline index child. However, information on feeding practices and the child's diet collected in the baseline survey and second-round survey focused on weaning age children 6–23 months.

As mentioned, data collected on assets in the baseline were used to target the subsequent poultry and cash intervention. To do this, a wealth (asset) index was constructed using Stata's *pca* command for principal component analysis of the correlation matrix. We combined consumer durable assets, productive assets, livestock assets, and size of land owned, scores from which the first component explained 11.3% of the variance. Using the scores of this wealth index, we ranked all households within their kebele and selected the poorest ten households.

These assets were also used to sweep out attenuation due to measurement error in household expenditures . This entailed regressing the logarithm of household expenditures against assets reported in the baseline, including human capital (potential adult supply and education). The predicted expenditures were used as covariates in subsequent analysis (see Appendix Table 1).

2.2. Analytic approach

The analysis uses the random assignment into treatment groups and transfer modalities to identify program impact based on intention to treat [ITT] assignment. The primary outcomes of interest are the probability that the child [mother] consumed a food category in the previous day, with a particular emphasis on egg consumption. We test whether households in the enhanced nutritional treatment arms or in the intensive livelihood arms have higher consumption of eggs compared to households who were in the control. We include dummy variables for the random assignment into the two livelihood transfer programs and, in some models, the interaction of the nutrition program and the treatment.

$$Y_{ivd} = \beta_0 + \beta_1 P_{vd} + \beta_2 C_{vd} + \beta_3 N_{vd} + \beta_4 L_{vd} + \beta_5 Y_{0ivd} + \delta X_{ivd} + \mu_d + \varepsilon_{ivd,} \quad (1)$$

Where Y_{ivd} is the outcome of interest, either egg consumption or diet diversity for children or their mother. P_{vd} is an indicator for whether

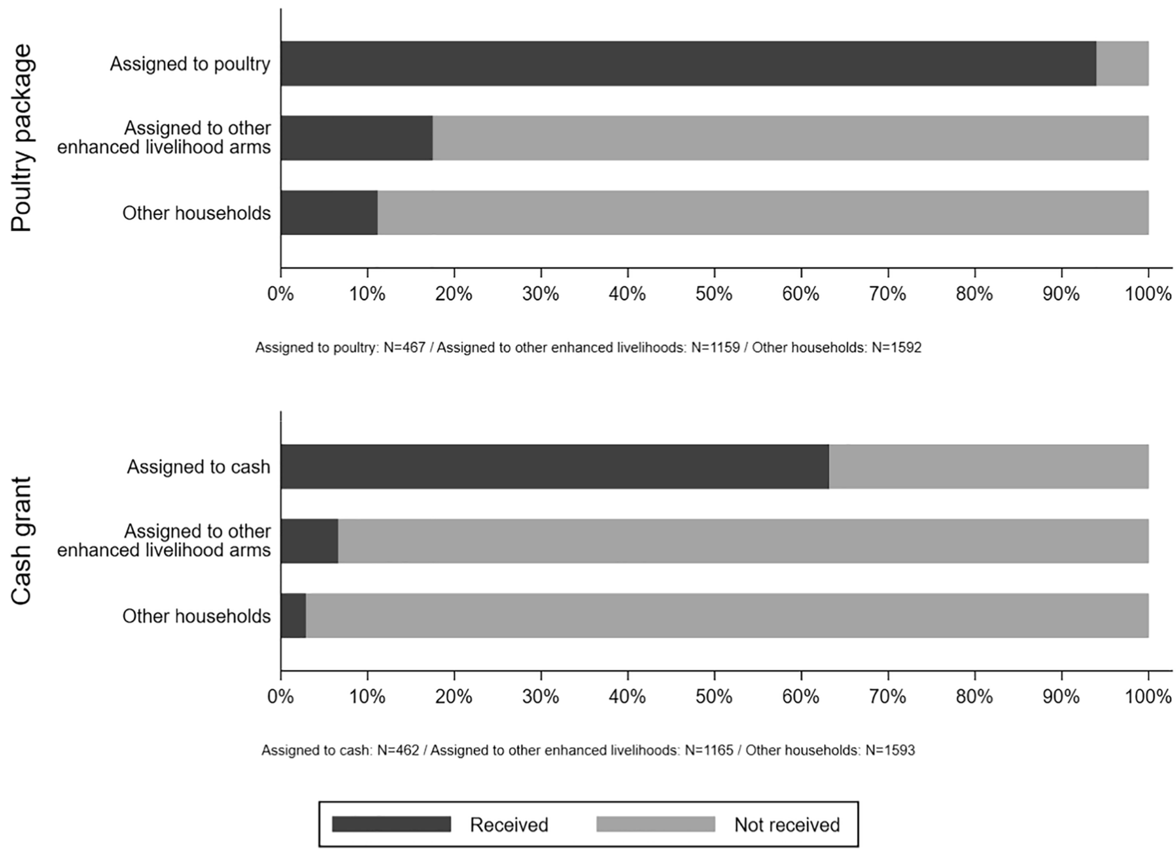

Fig. 2. Receipt of poultry package and cash grant by original treatment assignment, reported by household.

individual i – either the index child or the child's mother – in kebele v in woreda d was in a household that was randomly assigned to receive the poultry transfer, C_{vd} indicates randomized assignment to the cash transfer, N_{vd} indicates randomized assignment to enhanced nutritional programs and L_{vd} reflects assignment into intensive livelihood support without the additional grants. Some specifications also include terms for $P_{vd}*N_{vd}$ and $C_{vd}*N_{vd}$ to capture interaction effects of the poultry transfer or cash grant with the enhanced nutrition programs. The regressions also include the baseline observation of the outcome of interest. This ANCOVA approach increases efficiency (defined as retaining unbiasedness with lower variance) in estimating average treatment effects with experimental data (McKenzie, 2012). This is straight-forward when the observation refers to the mother or the household. However, as few children in the second round data were also in the age range necessary for the anaysis of young child diet diversity in the baseline, the mean of the baseline outcome for the corresponding research strata within the kebele is used in lieu of the child's baseline observation.

In addition, μ_d is a vector of dummy variables controlling for woreda fixed effects. Some regressions also includes a vector of control variables, X, including the predicted logarithm of household consumption, the education of the primary male and female members of the household, household size and whether or not the dietary recall covered a day in which fasting to avoid animal products is customary[4]. Moreover, the child regressions include variables for the child's gender and age, the former to test for gender discrimination and the latter to account for the fact that some of the youngest children may not yet be fully weaned.

These regressions provide a measure of the marginal impact of each program and subprogram interventions and their interactions. While this is a standard approach to ITT evaluation of programs, we also seek to directly assess the impact of poultry ownership on egg consumption as a local average treatment effect. To do this we use transfer assignment to instrument poultry ownership. Angrist et al. (2002) use a similar approach to distinguish the impact of scholarship take up from that of winning a scholarship in a lottery and Hoddinott et al. (2013) use random treatment assignment as an instrument to assess the impact of height on schooling and cognitive skills. Similarly, Linnemayr and Alderman (2011) use random assignment and interactions to control for program crossover in a randomized nutrition trial in Senegal. The underlying assumption in such a model is that the random assignment affects the outcome of interest only through the program take up. In the current context, the assumption is that the randomization of poultry transfers, controlling for intensive livelihood and enhanced nutrition program placement, has no direct impact on egg consumption except through bird ownership.

3. Results

Table 1 reports baseline balance and mean value of the variables in the study in the baseline survey. As some children aged out of the 6–23-month target population, the number of observations in the table differs from the regression sample. Nevertheless, the table serves to test whether the recipients of the poultry transfer differ in household composition and assets (other than chickens) from the recipients of the cash transfer. We also test that the very poor in the communities that received livelihood transfers of poultry or cash are similar to those who were deemed very poor in terms of assets in other communities. Finally, the table indicates the means for those who were not eligible for

[4] The variable is defined as one if the household is Orthodox Christian and the interview recall period covers a fast day. Orthodox Christians fast by avoiding meat and dairy products on Wednesdays and Fridays as well as during Lent and two weeks prior to the Feast of the Dormition in August. Weekday fasts are not observed in the week after Easter.

Table 2
Treatment effects on probability of egg consumption by mother & index child (6–23 months) Full sample.

	(1) Index child consumed eggs in the previous day	(2) Mother consumed eggs in the previous day	(3) Index child consumed eggs in the previous day	(4) Mother consumed eggs in the previous day	(5) Index child consumed eggs in the previous day	(6) Mother consumed eggs in the previous day	(7) Index child consumed eggs in the previous day	(8) Mother consumed eggs in the previous day
Randomized to poultry sub-arm	0.110***	0.057***	0.116***	0.057***	0.122***	0.071***	0.109***	0.056***
	(0.038)	(0.017)	(0.034)	(0.015)	(0.046)	(0.022)	(0.035)	(0.015)
Randomized to cash sub-arm	0.023	0.001	0.030	0.004	0.033	−0.008	0.028	0.004
	(0.025)	(0.013)	(0.024)	(0.012)	(0.034)	(0.012)	(0.023)	(0.012)
Enhanced Livelihood arms (excluding poultry and cash)	0.010	−0.005	0.012	−0.005	0.012	−0.005	0.007	−0.006
	(0.022)	(0.011)	(0.021)	(0.010)	(0.021)	(0.010)	(0.021)	(0.010)
Enhanced Nutrition arms	0.042**	0.013	0.046**	0.011	0.049***	0.012	0.014	0.016
	(0.019)	(0.010)	(0.018)	(0.009)	(0.019)	(0.010)	(0.037)	(0.019)
Interaction of Enhanced Nutrition and poultry					−0.011	−0.029		
					(0.069)	(0.027)		
Interaction of Enhanced Nutrition and cash					−0.007	0.025		
					(0.047)	(0.022)		
Distance to nearest town (x0.1 km)							−0.051***	−0.011
							(0.019)	(0.010)
Enhanced Nutrition × Distance to nearest town							0.028	−0.002
							(0.023)	(0.012)
Predicted baseline expenditure			0.081	0.044	0.081	0.042	0.057	0.033
			(0.067)	(0.034)	(0.067)	(0.034)	(0.067)	(0.034)
Interview was on a day after fast			−0.024	−0.070***	−0.024	−0.069***	−0.025	−0.071***
			(0.028)	(0.014)	(0.027)	(0.014)	(0.027)	(0.014)
Mother has some education			0.031	0.010	0.031	0.010	0.031	0.009
			(0.028)	(0.013)	(0.028)	(0.013)	(0.028)	(0.013)
Father has some education			0.002	0.002	0.002	0.003	0.002	0.003
			(0.021)	(0.011)	(0.021)	(0.011)	(0.021)	(0.011)
Household size			0.009	0.005	0.009	0.005	0.006	0.004
			(0.009)	(0.004)	(0.009)	(0.004)	(0.008)	(0.004)
Child age in months			0.003**		0.003**		0.003*	
			(0.002)		(0.002)		(0.001)	
Male child			0.012		0.012		0.010	
			(0.018)		(0.018)		(0.018)	
Baseline value of outcome	0.039	−0.002	0.063	0.006	0.064	0.005	0.072	0.004
	(0.073)	(0.027)	(0.081)	(0.029)	(0.084)	(0.028)	(0.077)	(0.028)
Constant	0.039**	0.045***	−0.622	−0.310	−0.619	−0.299	−0.392	−0.236
	(0.017)	(0.009)	(0.416)	(0.235)	(0.418)	(0.233)	(0.418)	(0.231)
R^2	0.02	0.01	0.06	0.04	0.06	0.04	0.07	0.04
N	1,009	3,114	1,009	3,114	1,009	3,114	1,009	3,113
Wald test: Poultry = Enhanced Nutrition	0.093	0.039	0.062	0.013	0.12	0.01	0.045	0.097
Mean of control	0.041	0.039	0.041	0.039	0.041	0.039	0.041	0.039

Notes: Estimates from the SPIR second-round survey sample. Standard errors are in parentheses and adjusted for kebele and treatment. Baseline values for children are the baseline means of the outcome within the respective kebele and sub-treatment group. Where mother's/father's education is missing, it is replaced with 0 and respectively controlled for.
* p < 0.1 ** p < 0.05 *** p < 0.01

transfers in the communities where others received the livelihood transfers or would not have been eligible on the basis of the asset criterion in the other treatment or control arms. These household are still poor enough for participation in the PSNP but less poor than their neighbors; there is no prior reason that these individuals should have the same education and assets as their neighbors, and thus no balance tests are needed. As indicated, roughly 40% of the households owned poultry at baseline with no differences among treatment arms. Households classified as very poor had on average<1.4 birds, with the males indicating that virtually all birds were owned by a female or jointly owned with the male respondent. Females were not asked directly about ownership of birds in the baseline.

Fig. 2 shows that there was modest cross over in program assignment as reported by the household. 89.0% of the women randomly assigned to receive the poultry grant claimed to have obtained the birds and other inputs. However, the union of male reports of a grant and female reports is 94.0%. Whether the difference reflects recall errors or a few women not claiming ownership of household poultry is not clear. However, the small difference is not relevant to the ITT results that are based on the offer, not the receipt. Some women in the intensive livelihood project sites and a smaller share of women in the other project sites (combined here with the control communities) also report receiving chickens, although almost exclusively<16. Various other programs run concurrently in rural Ethiopia and these reported grants likely reflect participation in a similar – albeit smaller – program. This may have a modest downward impact on the ITT results.

The figure also shows reported receipt rates of the cash grant, which are lower than those of the poultry package with 63.2% of the

Table 3
Treatment effects on children's dietary diversity 6–23 months.

	(1) Total food groups consumed in the previous day	(2) Consumed grains, roots and tubers in the previous day	(3) Consumed legumes and nuts in the previous day	(4) Consumed dairy products in the previous day	(5) Consumed flesh foods in the previous day	(6) Consumed vitamin A fruits and vegetables in the previous day	(7) Consumed other fruits and vegetables in the previous day
Randomized to poultry sub-arm	0.239*	0.022	0.109**	−0.008	−0.018	0.015	−0.012**
	(0.129)	(0.034)	(0.042)	(0.053)	(0.016)	(0.029)	(0.005)
Randomized to cash sub-arm	0.004	−0.020	0.103**	−0.023	−0.005	−0.048	−0.004
	(0.104)	(0.028)	(0.047)	(0.050)	(0.016)	(0.031)	(0.006)
Enhanced Livelihood arms (excluding poultry and cash)	0.070	0.012	0.090**	−0.005	−0.016	0.004	−0.003
	(0.086)	(0.024)	(0.039)	(0.039)	(0.014)	(0.031)	(0.006)
Enhanced Nutrition arms	0.139*	0.005	0.006	0.062*	0.015	0.015	−0.001
	(0.073)	(0.020)	(0.032)	(0.033)	(0.012)	(0.021)	(0.005)
Predicted baseline expenditure	0.076	−0.080	−0.023	0.246**	−0.031	−0.002	−0.010
	(0.264)	(0.077)	(0.110)	(0.101)	(0.047)	(0.082)	(0.018)
Interview was on a day after fast	−0.097	−0.022	0.058	−0.055	−0.032	−0.056*	0.008
	(0.094)	(0.029)	(0.045)	(0.038)	(0.020)	(0.029)	(0.007)
Mother has some education	−0.027	−0.032	−0.078*	0.035	0.006	0.017	−0.001
	(0.101)	(0.028)	(0.040)	(0.038)	(0.015)	(0.032)	(0.007)
Father has some education	0.162**	0.001	0.087**	0.021	0.005	0.041	−0.004
	(0.081)	(0.022)	(0.034)	(0.035)	(0.018)	(0.026)	(0.007)
Household size	0.017	−0.011	0.001	0.022*	−0.007	0.012	−0.004
	(0.033)	(0.010)	(0.015)	(0.013)	(0.005)	(0.011)	(0.003)
Child age in months	0.048***	0.030***	0.019***	0.001	0.003***	0.007***	0.001
	(0.006)	(0.002)	(0.003)	(0.003)	(0.001)	(0.002)	(0.001)
Male child	−0.062	−0.009	−0.076***	0.007	0.015	0.014	0.003
	(0.064)	(0.019)	(0.027)	(0.029)	(0.012)	(0.019)	(0.005)
Baseline value of outcome	−0.049	0.057	−0.079	−0.029	−0.005	0.082	0.076
	(0.108)	(0.062)	(0.061)	(0.094)	(0.057)	(0.110)	(0.051)
Constant	1.294	1.048**	−0.031	−1.261*	0.233	−0.195	0.074
	(1.774)	(0.524)	(0.743)	(0.683)	(0.312)	(0.567)	(0.125)
R^2	0.12	0.25	0.22	0.12	0.05	0.07	0.03
N	1,009	1,009	1,009	1,009	1,009	1,009	1,009
Wald test: Poultry = Enhanced Nutrition	0.473	0.652	0.058	0.211	0.143	0.996	0.103
Mean of control	2.715	0.875	0.386	0.311	0.030	0.129	0.008

Notes: Estimates from the SPIR second-round survey sample. Standard errors are in parentheses and adjusted for kebele and treatment. Baseline value is the baseline mean of the outcome within the respective kebele and sub-treatment group. Where mother's/father's education is missing, it is replaced with 0 and respectively controlled for.
* $p < 0.1$ ** $p < 0.05$ *** $p < 0.01$

households selected for the grant reporting a receipt. Similarly, few households that were not selected for the grant claimed actually receiving some amount of cash transfer (4.5%). World Vision and their partners undertook further investigations of the cash transfer program and found a mismatch between self-reported recall and administrative records. Without a third tie breaker it is not possible to be certain of the discrepancy. To provide some reassurance that the discrepancy did not drive results on the role of the cash grant we include balance tests to assess if there were any observable differences between the households that were scheduled to receive the cash but claimed they had not and those that acknowledged the grant (Appendix Table 2). This includes observations from both the baseline and the follow-up survey. Of the 11 comparisons in the first round and 9 in the follow up survey – including poultry ownership and egg consumption – only household size differed by a p value of < 0.1 (unadjusted for multiple hypotheses).

Table 2 reports the impact of being assigned to receive the poultry package on the probability of egg consumption by children 6–23 months and by the mother of the index child. The first two columns are unadjusted with any covariates; the next two columns repeat the model with covariates and indicate very slight differences. For children whose mothers were assigned to receive chickens, column 3 indicates that the probability of consuming eggs in the previous day has higher by 11.6 percentage points to 15.7%, a more than threefold increase from the mean of the control of only 4.1%. Thus, after the poultry transfer, young children in the recipient households consume more than 3.8 times the baseline mean. Similarly, the women in these poultry transfer receiving households increased their own consumption, albeit by a smaller proportion (5.7 percentage points). Not all these women had children of age 6–23 months. As indicated, most children aged out between surveys, but in some cases new children were born to the mothers of initial sampled children. The inclusion of a dummy variable for mothers of children in this age bracket indicated there was no significant difference between those mothers who had young children between 6 and 23 months and those that did not. [This regression is not reported; the dummy variable has a coefficient of 0.003 with a standard error of 0.008.] Thus, the sample using all mothers is reported for precision. As indicated in Table 2, there is no evidence that the similarly sized cash grant influenced egg consumption for children or mothers. While the increased availability of eggs in the community might have spillover effects, the absence of any changes in consumption among children whose mothers

Table 4
Treatment effects on poultry ownership by household Full sample.

	(1) Total number of poultry owned by female	(2) Total number of poultry owned by household	(3) Total number of poultry owned by household
Randomized to poultry sub-arm	7.833***	7.560***	7.516***
	(0.534)	(0.496)	(0.496)
Randomized to cash sub-arm	0.245	0.358	0.335
	(0.273)	(0.269)	(0.270)
Enhanced Livelihood arms (excluding poultry and cash)	0.633***	0.714***	0.683***
	(0.218)	(0.223)	(0.227)
Enhanced Nutrition arms	0.375	0.289	−0.161
	(0.230)	(0.221)	(0.465)
Distance to nearest town (x0.1 km)			−0.167
			(0.253)
Interaction of Enhanced Nutrition and distance to nearest town			0.339
			(0.288)
Predicted baseline expenditure	0.105	0.263	0.280
	(0.569)	(0.548)	(0.551)
Mother has some education	0.062	−0.011	−0.013
	(0.178)	(0.163)	(0.162)
Father has some education	0.043	0.086	0.087
	(0.171)	(0.160)	(0.161)
Household size	0.160**	0.154**	0.151**
	(0.070)	(0.064)	(0.066)
Total number of poultry owned by household, baseline	0.188***	0.180***	0.181***
	(0.034)	(0.033)	(0.033)
Constant	1.146	0.497	0.652
	(3.871)	(3.751)	(3.834)
R^2	0.41	0.40	0.40
N	3,071	3,114	3,113
Mean of control	1.856	1.814	1.814

Notes: Estimates from the SPIR second-round survey sample. Standard errors are in parentheses and adjusted for kebele and treatment.
Where primary female's/male's education is missing, it is replaced with 0 and respectively controlled for.
* $p < 0.1$ ** $p < 0.05$ *** $p < 0.01$

received cash or were in the intensive livelihood program but did not receive either grant is consistent with there not being any significant spillover. Indeed, as an average kebele has 5–6000 individuals, the poultry grant to 10 individuals was not anticipated to have general effect on prices that would encourage consumption over a wider population.

Moreover, the presence of the enhanced nutrition program independently influenced the frequency of egg consumption for children but not their mothers. However, there is no indication of a synergistic effect of enhanced nutrition and access to either the poultry grant or the cash transfer above the standard PSNP support. In column 5, the interaction terms are small in magnitude and statistically insignificant, suggesting that the impact of targeted nutrition programming on this aspect of diets is not contingent on household's budgetary resources. The enhanced nutrition program is provided to mothers in the appropriate treatment arms regardless of whether or not she received a poultry grant. Conversely, the training that is part of the poultry package focuses on caring for the birds and does not include any messaging on infant and young child feeding (IYCF). Thus, synergy for diet diversity is not an inherent component of the program design.

In a sensitivity analysis, we ran the same regressions that are reported in Table 2 using only those very poor households who qualified for transfers based on their asset indices (including both households in the treatment arms who in fact received transfers, and those in the arms that did not include transfers). These results are reported in Appendix Table 3. The treatment point estimates for the models in columns 1 and 2 were 0.100 and 0.057 respectively. The samples are necessarily smaller – with sample sizes of 542 and 1793 observations – but the coefficients estimated for the effect of poultry transfers remain significant ($p < 0.05$). As the control sample in these regressions includes only households classified as very poor, it can be considered a stricter comparison than that in Table 2. However, the smaller sample reduces power of the assessment for the role of the enhanced nutritional counseling, hence the preference for including the full sample in the main results.

Consistent with Hirvonen and Hoddinott (2017) the distance to the nearest town, or the location of the closest market – which effectively lowers the net returns to sales as well as increasing the resource cost of purchases – is negatively associated with egg consumption for children. Household expenditures had no significant impact on the probability of egg consumption by children or adult women nor does education of the primary adults in the household influence the probability of egg consumption. While, as expected, the probability of egg consumption increases for older child children but there is no indication of difference by gender. As indicated in the row referring to interviews after fast days and in keeping with previous studies (Kim, et al. 2019), women in Orthodox Christian households reported virtually no eggs consumed on a fast day. This fasting behavior, however, does not translate to children.

Table 3 addresses the question as to whether increased egg consumption by children results partially from reductions in other animal sourced foods or, conversely, whether it increases overall diet diversity. As indicated in Columns 4 and 5, there is no reduction in the low levels of consumption of either milk or animal sourced foods in the households that received poultry transfers. The category of flesh foods common in IYCF analysis includes poultry as well as other meat and fish (WHO and UNICEF, 2017). In a separate regression (not shown) it was confirmed that there was also no increase in the subcategory of poultry. There is, however, an increase in the consumption of pulses that contributes to the overall increase in diet diversity. Indeed, the point estimate for the change in total diet diversity in the poultry treatment is close to the sum of the point estimates for legumes and for eggs. This contrasts with the displacement of legumes by eggs in Malawi as observed by Lutter et al. (2021). This increased pulse consumption is also statistically significant for the households receiving the cash transfer, as well as for the other households in the intensive livelihoods arm who have not received transfers. Thus, this particular change in diet diversity is not specifically attributed to the poultry transfer, as this effect does not differ statistically across all households in the intensive livelihood arm, regardless of receiving a poultry transfer or cash grant. As with eggs, dairy consumption also increases in the communities that received enhanced nutrition BCC, although the increase is only marginally significant.

Table 4 explores poultry ownership as a first step in an instrumental variables model. Clearly participating in the poultry program accounts for a highly significant increase in the number of birds owned at the time of the second-round survey. As a reminder, at baseline, only forty percent of respondents owned any poultry, and the average flock size among these households was less than four birds. The increase of slightly less than eight birds, half of the sixteen received, is consistent with the recommendation that all male birds should be sold upon reaching peak market weight. Individuals not receiving poultry transfers but residing in the communities where the intensive livelihood program is implemented also report increased ownership of birds. This is not, however, seen among the recipients of the cash grant; they do not seem to be inspired to use their cash grant to emulate the recipients of the poultry transfers. Moreover, there is a significant increase in poultry ownership attributed to being in an intensive livelihood treatment kebele that is independent of any poultry ownership at the time of the baseline survey,

Table 5
Treatment effects on probability of egg consumption in the previous day by mother & index child (6–23 months)

	OLS		Instrumental variable models					
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Index child consumed eggs in the previous day	Mother consumed eggs in the previous day	Index child consumed eggs in the previous day	Mother consumed eggs in the previous day	Index child consumed eggs in the previous day	Mother consumed eggs in the previous day	Index child consumed eggs in the previous day	Mother consumed eggs in the previous day
Total number of poultry owned by household	0.007***	0.005***	0.011**	0.007***	0.035	−0.005	0.011**	0.007***
	(0.003)	(0.001)	(0.005)	(0.002)	(0.050)	(0.016)	(0.005)	(0.002)
Enhanced Nutrition × Number of poultry					−0.049	0.024		
					(0.103)	(0.033)		
Distance to nearest town (x0.1 km)							−0.033**	−0.014**
							(0.013)	(0.006)
Enhanced Nutrition arms	0.039**	0.007	0.033*	0.006	0.202	−0.075	0.037**	0.008
	(0.019)	(0.009)	(0.018)	(0.009)	(0.362)	(0.113)	(0.018)	(0.009)
Predicted baseline expenditure	0.099	0.053	0.102	0.053	0.084	0.065	0.075	0.041
	(0.069)	(0.034)	(0.068)	(0.034)	(0.078)	(0.041)	(0.067)	(0.033)
Interview was on a day after fast	−0.016	−0.068***	−0.013	−0.068***	−0.014	−0.068***	−0.015	−0.068***
	(0.029)	(0.014)	(0.027)	(0.014)	(0.030)	(0.014)	(0.027)	(0.014)
Mother has some education	0.013	0.001	0.010	0.001	0.011	0.002	0.009	0.001
	(0.027)	(0.012)	(0.027)	(0.012)	(0.028)	(0.012)	(0.027)	(0.012)
Father has some education	0.005	0.001	0.008	0.001	0.006	0.002	0.010	0.001
	(0.020)	(0.010)	(0.020)	(0.010)	(0.023)	(0.011)	(0.019)	(0.010)
Household size	0.008	0.005	0.009	0.004	0.008	0.005	0.006	0.003
	(0.009)	(0.004)	(0.009)	(0.004)	(0.010)	(0.005)	(0.009)	(0.004)
Child age in months	0.003**		0.003**		0.002		0.003*	
	(0.002)		(0.002)		(0.002)		(0.001)	
Male child	0.008		0.012		0.013		0.009	
	(0.019)		(0.018)		(0.019)		(0.018)	
Baseline value of outcome	0.059	0.007	0.061	0.008	0.132	0.008	0.069	0.006
	(0.090)	(0.030)	(0.086)	(0.030)	(0.198)	(0.030)	(0.084)	(0.029)
Constant	−0.768	−0.252	−0.741	−0.303	−0.682	−0.357	−0.518	−0.204
	(0.475)	(0.217)	(0.491)	(0.243)	(0.511)	(0.271)	(0.488)	(0.235)
N	974	3,013	972	3,008	972	3,008	972	3,007

Notes: Estimates from the SPIR second-round survey sample. Standard errors are in parentheses and adjusted for kebele and treatment. For children's outcomes, baseline value is the baseline mean of the outcome within the respective kebele and sub-treatment group.
Where primary female's/male's education is missing, it is replaced with 0 and respectively controlled for.
* $p < 0.1$ ** $p < 0.05$ *** $p < 0.01$

which is controlled for in the regression.

The first 4 columns in Table 5 offer a comparison of an OLS approach to the ownership of birds (columns 1 and 2) with simultaneous IV estimates of the number of birds owned (columns 3 and 4). The three randomized assignments into poultry, cash, and enhanced livelihood arms (excluding poultry and cash) in Table 4[5] are used as instruments along with the lagged endogenous round 1 poultry ownership and have F-statistics of 56.0 and 67.4 for the 3rd and 4th columns respectively, well above the rule of thumb for 4 instruments in Stock and Yogo (2002). The coefficients of birds owned in the IV regressions are larger than the OLS coefficients. If there was a reverse causal chain – that is, those who prioritize egg consumption obtain more chickens – then the OLS estimates would be the larger pair. Possibly, the smaller OLS coefficients reflect garden variety errors in variables attenuation. This cannot be directly tested, but it is both reasonable and useful to assume that OLS estimates are lower bounds. The coefficient of program assignment in column 1 of Table 2 (0.116) is somewhat below the product of the IV coefficient of birds owned in Table 5 (0.011) and the coefficient of program assignment in Table 4 (7.56). There is an unexplained difference that raise the question of whether the program affects consumption entirely through the ownership of birds.[6] The OLS version does not lead to as close a calculated effect.

Columns 5 and 6 include an instrumented interaction of the number of birds and enhanced nutrition, again passing the Stock and Yogo test for 2 instrumented outcomes. While enhanced nutrition and its interaction with poultry are jointly significant neither are independently significant. Similarly, a model that has both the number of birds and the interaction of birds and market distance results in coefficients for distance and the interaction term that are jointly significant but not independently so (results not illustrated). It is, thus, difficult to assess whether the negative effect of distance on consumption is moderated by owning larger flocks. However, the result in columns 7 and 8 confirm the influence of distance in the IV model that was noted in OLS model in Table 2.

Table 6 indicates that the households that received the poultry

[5] While randomization into the enhance nutrition arms is also exogenous, it has a direct role in consumption and, thus, does not satisfy the exclusion restriction.

[6] The outcome variable in Table 4 excludes value greater than 3 SD above the mean. If these are included, the coefficient of program assignment increases to 8.5.

Table 6
Treatment effects on poultry and egg sales by household.

	(1) Total number of poultry sold by household in last 12 months	(2) Value of sold poultry (self-reported current prices in Birr)	(3) Number of eggs sold in last 30 days	(4) Amount of income earned from egg sales in last 30 days (Birr)
Randomized to poultry sub-arm	3.112***	460.459***	4.467***	14.397***
	(0.479)	(70.464)	(1.596)	(5.105)
Randomized to cash sub-arm	−0.505***	−7.983	1.603*	8.069**
	(0.157)	(52.260)	(0.881)	(3.446)
Enhanced Livelihood arms (excluding poultry and cash)	0.100	−31.439	1.363	3.509
	(0.278)	(28.038)	(0.880)	(2.498)
Enhanced Nutrition arms	0.226	22.721	2.323***	5.844**
	(0.212)	(34.450)	(0.774)	(2.413)
Distance to nearest market or town (x0.1 km)	−0.095	−20.976	0.066	0.664
	(0.115)	(17.844)	(0.596)	(2.125)
Predicted baseline expenditure	−1.400*	−185.722	2.032	7.628
	(0.763)	(113.105)	(2.198)	(6.675)
Mother has some education	1.013**	111.429*	−0.571	0.378
	(0.508)	(65.530)	(0.820)	(2.614)
Father has some education	−0.182	−25.634	2.712***	8.770***
	(0.328)	(39.234)	(0.906)	(2.494)
Household size	−0.104	−19.957*	0.536*	2.446***
	(0.082)	(11.897)	(0.317)	(0.887)
Interview was on a day after fast			−1.725**	−6.022**
			(0.722)	(2.385)
Baseline value of outcome				0.019**
				(0.008)
Constant	9.559**	1,280.515*	−15.043	−60.983
	(4.774)	(721.820)	(15.082)	(42.416)
R^2	0.07	0.06	0.05	0.05
N	3,126	3,126	3,097	3,079

Notes: Estimates from the SPIR second-round survey sample. Standard errors are in parentheses and adjusted for kebele and treatment.
Where primary female's/male's education is missing, it is replaced with 0 and respectively controlled for.
* $p < 0.1$ ** $p < 0.05$ *** $p < 0.01$

transfer are not autarkic; while egg consumption increased, so did sales.[7] The results also indicate that poultry transfer recipient households sold on average three more birds than did other households. Given that they received 16 birds and the treatment effect on birds owned at the time of the survey was nearly 8 birds, this implies that approximately five birds were consumed by family members, lost to illness or predators, or otherwise not accounted for. Roughly, the annualized sales of eggs plus that of birds provides $20 a year of cash in addition to home consumption. Curiously, the enhanced nutrition program encourages additional sales of eggs beyond that associated with the poultry transfer, although there is no significant association of this program with bird ownership. These are possibly sales to neighbors and are consistent with the consumption increase attributed to that program in Table 2. The distance to a market or town does not affect sales. [8]A final observation from Table 6, is that fasting days appear to influence egg sales. While the

Table 7
Treatment effects on poultry and egg sales by household Instrumental variable models.

	(1) Total number of poultry sold by household in last 12 months	(2) Value of sold poultry (self-reported current prices in Birr)	(3) Number of eggs sold in last 30 days	(4) Amount of income earned from egg sales in last 30 days (Birr)
Total number of poultry owned by household	0.373***	54.523***	0.483***	1.515***
	(0.072)	(10.491)	(0.176)	(0.576)
Enhanced Nutrition arms	0.112	5.693	2.176***	5.488**
	(0.239)	(38.382)	(0.749)	(2.350)
Distance to nearest market or town (x0.1 km)	−0.131	−26.330	−0.002	0.422
	(0.144)	(22.516)	(0.567)	(2.046)
Predicted baseline expenditure	−1.466*	−219.002*	2.384	8.280
	(0.776)	(119.133)	(2.176)	(6.540)
Mother has some education	1.031**	113.776*	−0.642	0.080
	(0.500)	(65.068)	(0.804)	(2.609)
Father has some education	−0.316	−47.698	2.490***	8.388***
	(0.330)	(41.002)	(0.896)	(2.445)
Household size	−0.167*	-33.201**	0.493	2.263***
	(0.087)	(13.559)	(0.310)	(0.853)
Interview was on a day after fast			−1.544**	−5.217**
			(0.714)	(2.337)
Baseline value of outcome				0.016*
				(0.008)
Constant	10.925**	1,563.908*	−12.567	−48.835
	(5.536)	(852.227)	(15.589)	(46.832)
R^2	0.02	0.00	0.09	0.09
N	3,095	3,095	3,066	3,048

Notes: Estimates from the SPIR second-round survey sample. Standard errors are in parentheses and adjusted for kebele and treatment.
Where primary female's/male's education is missing, it is replaced with 0 and respectively controlled for.
* $p < 0.1$ ** $p < 0.05$ *** $p < 0.01$.

[7] As with Tables 4 and 5, the regressions in Table 6 and Table 7 exclude outliers greater than three standard deviations, resulting in a removal of 0.1 to 0.6% of the sample for the four variables in Table 6 and 7. These households were likely contracted to raise pullets for distribution. Thus, they have sales of hundreds of birds yet no current ownership and do not represent the general population.

[8] The inclusion of an interaction with distance of either program assignment or number of birds owned was not significant in an alternative model (not reported).

Appendix Table A1

OLS estimates from baseline data used for addressing errors in variables in household consumption expenditure.

	(1)
	Log of total food and non-food expenditure last month (adult equivalents)
Number of male household members aged 0–17 years	−0.133***
	(0.011)
Number of male household members aged 18–60 years	−0.057*
	(0.030)
Number of male household members aged over 60 years	−0.006
	(0.062)
Number of female household members aged 0–17 years	−0.099***
	(0.010)
Number of female household members aged 18–60 years	−0.136***
	(0.045)
Number of female household members aged over 60 years	−0.090
	(0.056)
Number of male household members that completed class 4 to 8	0.048*
	(0.027)
Number of male household members that completed class 9 or more	0.057
	(0.053)
Number of female household members that completed class 4 to 8	0.034
	(0.037)
Number of female household members that completed class 9 or more	0.208***
	(0.065)
Age of primary female	−0.001
	(0.002)
Age of household head	−0.001
	(0.002)
Number of bedrooms per household member	0.225**
	(0.097)
Household has improved source of water (rainy season)	−0.007
	(0.036)
Household has improved roof material	0.133***
	(0.032)
Access to electricity	0.042
	(0.045)
Size of land operated (hectares)	0.005
	(0.006)
Standardized Livestock Units Owned	0.046***
	(0.017)
A household member undertook regular wage work for an employer in last 12 months	0.167***
	(0.060)
A household member undertook casual/irregular wage work in last 12 months	0.083
	(0.053)
Constant	6.561***
	(0.207)
R^2	0.24
N	3,285

*$p < 0.1$;
** $p < 0.05$;
*** $p < 0.01$.

measure of fasting refers to the preceding day and, thus, is not an ideal variable for monthly sales, the follow-up survey overlapped with the 15 day fasting period prior to the Feast of Assumption in August. This overlap likely depressed sales.

The results in Table 6 indicate the net impact of the transfer on sales, while Table 7 indicates sales controlling for the instrumented number of

Appendix Table A2

Balance in characteristics for households assigned to receive the cash grant

	Mean and Standard Deviation		P-Value
	Cash grant reported	Cash grant not reported	Reported vs not reported
Baseline study			
Male reports household owns any poultry	0.363	0.394	0.553
	(0.482)	(0.490)	
Total number of poultry owned by household	1.308	1.018	0.190
	(2.489)	(1.766)	
Index child consumed eggs in the previous day	0.050	0.026	0.466
	(0.219)	(0.159)	
Mother consumed eggs in the previous day	0.014	0.024	0.569
	(0.117)	(0.155)	
Household size	5.729	5.024	0.013
	(2.017)	(1.897)	
Mother has some education	0.183	0.210	0.555
	(0.387)	(0.408)	
Father has some education	0.319	0.259	0.311
	(0.467)	(0.440)	
Age of primary female	30.702	30.315	0.676
	(7.199)	(9.084)	
Age of primary male	38.039	36.761	0.204
	(8.712)	(9.142)	
Log of total food and non-food expenditure last month (adult equivalents)	6.101	6.186	0.434
	(0.697)	(0.763)	
Distance to nearest town (x0.1 km)	1.238	1.354	0.287
	(0.795)	(0.800)	
Follow-up study			
Male reports household owns any poultry	0.617	0.635	0.730
	(0.487)	(0.483)	
Total number of poultry owned by household	2.294	2.645	0.385
	(2.777)	(3.359)	
Woman reports owning any poultry (solely or jointly owned)	0.606	0.633	0.618
	(0.489)	(0.484)	
Total number of poultry owned by female	2.266	2.473	0.599
	(2.758)	(3.255)	
Index child consumed eggs in the previous day	0.073	0.074	0.979
	(0.261)	(0.263)	
Mother consumed eggs in the previous day	0.052	0.054	0.929
	(0.223)	(0.227)	
Household size	5.908	5.176	0.006
	(2.056)	(1.950)	
Primary female has some education	0.276	0.262	0.753
	(0.448)	(0.441)	
Primary male has some education	0.401	0.359	0.498
	(0.491)	(0.482)	
Age of primary female	32.059	31.054	0.282
	(7.286)	(9.466)	
Age of primary male	39.197	37.622	0.144
	(8.629)	(10.716)	

Notes: Estimates from the DFSA SPIR baseline and follow-up survey sample. Standard deviations are in parentheses. P-value is from the test of difference of means between the treatment arms. Standard errors are clustered at the kebele level.

Appendix Table A3
Treatment effects on probability of egg consumption by mother & index child (6–23 months) Extremely poor households.

	(1) Index child consumed eggs in the previous day	(2) Mother consumed eggs in the previous day	(3) Index child consumed eggs in the previous day	(4) Mother nsumed eggs in the previous day	(5) Index child consumed eggs in the previous day	(6) Mother consumed eggs in the previous day	(7) Index child consumed eggs in the previous day	(8) Mother consumed eggs in the previous day
Randomized to poultry sub-arm	0.100**	0.057***	0.105***	0.054***	0.101**	0.069***	0.094**	0.053***
	(0.040)	(0.018)	(0.037)	(0.016)	(0.050)	(0.023)	(0.038)	(0.015)
Randomized to cash sub-arm	0.013	0.001	0.017	0.003	0.005	−0.010	0.013	0.002
	(0.029)	(0.014)	(0.027)	(0.013)	(0.038)	(0.015)	(0.027)	(0.014)
Enhanced Nutrition arms	0.026	0.011	0.031	0.011	0.022	0.012	−0.048	−0.001
	(0.027)	(0.013)	(0.025)	(0.011)	(0.032)	(0.016)	(0.047)	(0.023)
Interaction of Enhanced Nutrition and poultry					0.009	−0.030		
					(0.075)	(0.030)		
Interaction of Enhanced Nutrition and cash					0.025	0.025		
					(0.054)	(0.027)		
Distance to nearest town (x0.1 km)							−0.072**	−0.010
							(0.029)	(0.011)
Interaction of Enhanced Nutrition and distance to nearest town							0.064**	0.010
							(0.029)	(0.014)
Predicted baseline expenditure			0.195	0.089*	0.196	0.087	0.169	0.085
			(0.119)	(0.054)	(0.119)	(0.053)	(0.121)	(0.052)
Interview was on a day after fast			−0.025	−0.080***	−0.024	−0.078***	−0.026	−0.080***
			(0.042)	(0.018)	(0.041)	(0.018)	(0.042)	(0.018)
Mother has some education			0.035	0.014	0.035	0.014	0.033	0.014
			(0.041)	(0.017)	(0.041)	(0.017)	(0.040)	(0.017)
Father has some education			0.012	0.008	0.012	0.008	0.012	0.007
			(0.030)	(0.016)	(0.030)	(0.016)	(0.030)	(0.016)
Household size			0.026*	0.014*	0.026*	0.014*	0.024	0.013*
			(0.015)	(0.007)	(0.015)	(0.007)	(0.015)	(0.007)
Child age in months			0.002		0.002		0.002	
			(0.002)		(0.002)		(0.002)	
Male child			0.009		0.009		0.008	
			(0.026)		(0.026)		(0.027)	
Baseline value of outcome	0.039	−0.006	0.046	−0.010	0.053	−0.012	0.062	−0.009
	(0.099)	(0.051)	(0.106)	(0.059)	(0.109)	(0.059)	(0.101)	(0.058)
Constant	0.057**	0.046***	−1.353*	−0.644*	−1.356*	−0.621*	−1.085	−0.605*
	(0.025)	(0.011)	(0.756)	(0.368)	(0.754)	(0.363)	(0.776)	(0.359)
R^2	0.02	0.01	0.09	0.05	0.09	0.05	0.10	0.05
N	542	1,793	542	1,793	542	1,793	542	1,793
Wald test: Poultry = Enhanced Nutrition	0.104	0.054	0.078	0.04	0.108	0.018	0.005	0.062
Mean of control	0.061	0.044	0.061	0.044	0.061	0.044	0.061	0.044

Notes: Estimates from the SPIR second-round survey sample. Standard errors are in parentheses and adjusted for kebele and treatment. Baseline value is the baseline mean of the outcome within the respective kebele and sub-treatment group. Where mother's/father's education is missing, it is replaced with 0 and respectively controlled for.

* $p < 0.1$.
** $p < 0.05$.
*** $p < 0.01$.

birds owned and allows inference on the role of market orientation relative to ownership *per se.* Sales of birds increase with ownership in a manner fully consistent with the product of Tables 4 and 6. That is, the bird ownership accounts for the net program effect implying that the recipients of the poultry package are no more likely to sell birds or eggs conditional on the size of their flock. Again, being in the enhanced nutrition program influences sales of eggs but not birds. Table 7 again indicates that the distance to a town or market does not significantly influence sales in contrast to the results on consumption.

4. Discussion and policy implications

The results confirm that including a poultry transfer in a livelihood enhancement program in rural Ethiopia led to increased consumption of eggs and improved diet diversity for the target groups of young children and their mothers, irrespective of any explicit efforts to link the transfer to child nutrition. This is in partial contrast with the general pattern of nutrition sensitive agricultural projects which often required synergistic behavioral change communication to reach desired improvements in diet diversity (Ruel, Quisumbing, and Balagamwala, 2018). Nevertheless, the enhanced nutrition program component did have a small additive impact on egg consumption by young children whether or not the household received the poultry transfer package. At the same time an equal value cash grant had no discernable impact on poultry ownership or egg consumption. .

The main results pertain to the probability of egg consumption by young children and their mothers; the number of eggs or the size of the portion consumed by the child is not available in the data. The data do, however, indicate the production and consumption of eggs at the household level in the previous month. There is no difference in the share of eggs consumed as a ratio of those produced between the poultry grant recipients and other households who own chickens; the mean ratio of eggs consumed to that produced for poultry transfer recipients is 0.55 [SE 0.51] compared to 0.60 [SE 0.42] for other poultry owners. Thus, the impact on child diet diversity comes from the increase in egg production rather than any shift in marketing shares. This is consistent with the results in Tables 6 and 7.

That increased supply of a food at the household level increases consumption is hardly surprising; this has been shown in the case of both milk (Alderman 1994: Rawlins et al. 2014) and eggs (Broaddus-Shea et al. 2020). The randomization of poultry provision assures that this causality runs from ownership to consumption rather than from dietary preference to purchase of birds and, to a degree, runs counter to a strict separability of production and consumption decisions. Market access is a small part of the story. Demand is mediated by physical access; the distance to a market or town slightly reduces the probability of egg consumption, although it has no measured impact on sales. The former association has been observed in other studies of marketing and diet diversity in Ethiopia (Hirvonen and Hoddinott, 2017), albeit without a randomized design. The pattern of lower consumption when markets are not local is also consistent with observations on milk consumption in Ethiopia (Hoddinott, Headey, and Dereje, 2015). Unlike that study, however, we note that the transfer also increased sales of both eggs and birds. A caveat, however, is in order; distance to towns or markets does not cover the frequency or scale of these markets.

Other issues besides distance may contribute to inadequate markets for eggs in Ethiopia. At the time of this study, routine vaccination for Newcastle disease was not common. As discussed in Morris, Beesabathuni, and Headey (2018), egg production is seldom at large scale in Africa due to the risk of diseases. The additional 40 egg per kebele total monthly sales implicit in Table 7 is not yet at a scale likely to influence a regular market. The absence of scale production influences the absence of a market and vice versa; a literal chicken and egg first move conundrum. If a household is unable to regularly obtain the quantity desired at its level of income and notional price from the irregular market, then increased household production would be expected to go towards consumption more than it would in the case of reliable markets.

Hoddinott, Headey, and Dereje (2015) also ascertained that cow ownership improved nutritional status of children. While a positive impact on child nutrition is plausible with egg consumption as well, the short duration from the time of the transfer to the data collection places that question outside of the scope of the current study. Nevertheless, the poultry transfer, which was designed as a livelihood project for women, exhibits the potential to be nutrition sensitive in these communities where diet diversity is extremely low. On average, children 6–23 months at baseline outside the poultry transfer recipient households and enhanced nutrition treatment kebeles consumed 2.6 out of 8 food groups daily, well below the WHO recommended level of 5 groups including breast milk (WHO and UNICEF, 2017). The increase attributed to increased poultry ownership does not come at a measured decrease in the number of any other food groups consumed. Thus, while still a small increment – although of a particularly nutritious food – it is a step in the direction towards a healthy diet.

While the PSNP has been recognized as a model for safety nets in Sub-Saharan Africa, complementary activities can strengthen livelihoods and build assets. Targeted provision of improved poultry breeds can play a significant role in this strategy. At the same time, these in-kind grants can address a second goal of the PSNP, that of improving the nutritional status of women and children. These livelihood-oriented grants can improve diet diversity even in the absence of specific behavioral change communication paired with the introduction of new poultry breeds, in contrast to many nutrition sensitive agricultural programs. Nevertheless, overall nutrition behavior communication can have an additive impact on consumption of animal sourced foods that are important for child nutrition.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix

See Appendix Tables A1-A3.

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