Health facility-based counselling and community outreach are associated with maternal dietary practices in a cross-sectional study from Tanzania

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Abstract

Background: Anemia and underweight among women are major public health challenges. Access to health services can improve dietary behaviors and women’s nutritional status. We examined whether exposure to health services is associated with women’s dietary practices in Tanzania.

Methods: Data come from a cross-sectional baseline survey among 5000 female primary caregivers who were randomly selected via two-stage sampling, prior to implementing a maternal and child nutrition program. We ran frequencies on women’s exposure to existing health facility-based counselling, community health worker visits, and attendance at women’s support groups. We examined associations between exposure to these interventions and maternal diets and adjusted for sociodemographic covariates using ordinary least squares regression and ordered logistic regression.

Results: A third of the sample (34.1%) had received any antenatal care (ANC) during their most recent pregnancy or had been advised by anyone about nutrition (37.0%). 68.0% had never had a community health worker (CHW) speak to them about their children’s health and 9.4% had participated in a women’s group. Only 8.0% of mothers ate more than usual during pregnancy and 7.1% ate more types of foods. After adjusting for mother’s age, education and household assets, women who received nutrition advice were 1.3 times (95% CI: 1.1, 1.7) more likely than mothers who did not to eat more during pregnancy. Receiving antenatal care (ANC) and advice on nutrition before, during, and after pregnancy and delivery were highly associated with the mother eating more types of foods. Hearing from a CHW about children’s health but not support group attendance was often associated with various dietary practices. Almost all measures of access to health services were significantly associated with mothers’ frequency of eating in the previous 24 h. Receiving advice on nutrition during pregnancy and after giving birth and CHW contact were associated with mothers’ dietary diversity in the previous 24 h.

Conclusions: Several program exposure variables—especially being counselled about nutrition—were associated with improved dietary practices. Improving service delivery at scale may contribute to improved dietary behaviors in larger populations, given the associations we describe, along with findings from the existing literature.

Keywords: Maternal, Dietary practices, Tanzania, Counselling, Interpersonal communication, Community health worker, Support groups
**Background**

While the prevalence of anemia among nonpregnant women of reproductive age has decreased from 43% in 1995 to 38% in 2011 [1], only a few countries are on track to meet the World Health Assembly target of a 50% reduction by 2025 [2]. Globally, 39% of all women of reproductive age are anemic, as are 46% of pregnant women in developing countries [3] with about one in 10 (9.7%) being underweight [2]. Anemia and underweight have long-term consequences for women and children, including increased maternal and child morbidity and mortality and impaired mental development [4–6].

Despite improvements in maternal and child health over the past 20 years, malnutrition in Tanzania remains a major challenge with 53% of pregnant women experiencing anemia (hemoglobin concentration < 11 g/dl), 10% of women of reproductive age suffering from underweight (body mass index or BMI < 18.5 kg/m²), 18.4% overweight (BMI 25- < 30 kg/m²), and 10.0% obese (body mass index ≥ 30 kg/m²) [7].

Inadequate dietary intake is a major source of malnutrition; [4, 6], in Tanzania, according to one study, only 46% of women and 26% of children report minimum dietary diversity and a minimum acceptable diet, respectively [8]. A national survey indicates that only 9% of children receive a minimum acceptable diet [7]. Given the large numbers of Tanzanian women less than 15 years of age, malnutrition will likely persist if the nutritional behaviors and practices of women of reproductive age remain sub-optimal.

Evidence suggests that activities such as dietary supplementation, food fortification and the promotion of dietary diversity improve maternal and child health outcomes [9]. Some studies indicate that having access to antenatal care services can positively influence birth outcomes including pre-term birth, birthweight, neonatal health, and the mother’s nutritional status [10–12], though several of these studies lack methodological rigor. Additional evidence suggests that providing nutrition education and counselling before and during pregnancy can improve maternal nutrition and neo-natal and child health [13–15]. As such, there is consensus that health clinics, community health volunteers, and community groups play an important role in the behavior change needed to improve health [14, 16, 17].

Even though the Tanzanian government provides free maternal and child health care services [18], access to services remains a problem [19]. Documenting women’s access to facility-based services and community outreach and understanding whether access to services is associated with women’s improved dietary practices are critical to designing and implementing effective policies and programs.

This research assesses whether women’s access to health services (through the government and through other implementing partners such as non-governmental organizations) is associated with dietary practices in pregnancy and post-partum. Specifically, we test the hypothesis that mothers with access to Tanzania’s existing health services are more likely than mothers without access to these services to eat more food, eat more frequently, and consume more diverse foods during pregnancy. We expect that these associations persist after adjusting for sociodemographic covariates.

**Methods**

This study used data from a cross-sectional baseline survey using two-stage cluster sampling to randomly select respondents. The survey was conducted in January and February of 2016, prior to implementing a large, integrated nutrition project (Addressing Stunting in Tanzania Early or ASTUTE). In 2015, IMA (Interchurch Medical Assistance) World Health and its consortium partners launched a five-year projected funded by the United Kingdom Agency for International Development (UKAid). The project targeted women and children in five Northwestern regions of Tanzania, collectively representing a population of 10.2 million and more than 750,000 stunted children. These five regions were selected because they had a high prevalence of stunting and anemia and poor maternal and child feeding practices relative to the rest of the country. The baseline informed program design.

This study’s intent is to 1) document government and other implementing partner program coverage prior to the start of the ASTUTE project, and 2) assess associations between exposure to existing government programs and maternal health practices. After baseline, the ASTUTE project was implemented in five lake zone regions of Tanzania (Geita, Kagera, Kigoma, Mwanza, and Shinyanga) and its primary objective was to reduce stunting among children under 5 years of age with improvements in maternal diets, antenatal care seeking, hand hygiene, sanitation, and other behaviors as secondary objectives. Future research will examine associations between exposure to social and behavior change activities that were implemented as part of the ASTUTE project, antenatal care seeking, and maternal diet.

Study participants include 5000 female primary caregivers of children aged 0 to 23 months. We recruited respondents from five geographic regions, including Geita, Kagera, Kigoma, Mwanza, and Shinyanga. We used two-stage probability proportional to size sampling, first at the district level and then at the village level in rural areas and neighborhoods in urban areas, employing data from Tanzania’s most recent (2012) census as the sampling frame. Once randomly selected villages or...
neighborhoods were identified, we selected 20 households from within each village/neighborhood using a spin-the-bottle approach to choose an axis that interviewers could follow to identify the first household for interview. In rural areas, interviewers were required to identify houses at least 200 m apart. In urban areas, we selected every fifth house for interview (in buildings with more than one eligible household, only one household was interviewed).

We field-tested the survey instrument among mothers and fathers then revised and finalized it prior to administration by IPSOS (Institut de Publique Sondage d’Opinion Secteur) Tanzania, which is part of a global data collection firm. We scripted the questionnaire onto a mobile data collection platform and uploaded it to Android mobile devices used for data collection.

We obtained informed consent from all study participants—written if the respondent was literate and by thumb print if not. The National Institute for Medical Research in Tanzania and relevant local government authorities authorized the research (NIMR/HQ/R.8a/ Vol.IX/2344). Three research teams, trained by IPSOS Tanzania, administered the questionnaire. Interviewers conducted one-hour face-to-face interviews in Kiswahili. Interviews took place at the caretaker’s place of residence. We made three attempts to contact mothers in their residence, after which replacement households were selected. There were 150 refusals total in the five regions (2.9% of all individuals contacted). Upon completion of data collection, IPSOS Tanzania compiled survey results for cleaning and analysis.

Outcomes included whether the mother, at any time during her most recent pregnancy resulting in the birth of the youngest living child, ate more than usual (a single, subjective measure) and consumed more types of foods than usual (also, a single, subjective measure). Additional outcomes included the number of times the mother ate in the previous 24 h and her dietary diversity based on seven food groups (grains, legumes and nuts, dairy, flesh foods, eggs, vitamin A rich foods, and other fruits), also measured for the 24 h prior to interview. Each of these behaviors was self-reported. Our measure of dietary diversity differs somewhat from the current continuous (mother’s dietary diversity and frequency of eating in the previous 24 h).

Wherever possible, we used the same questions as those used in the 2015 Tanzania Demographic and Health Survey (TDHS) [7]. However, the TDHS does not ask about the amount and types of food consumed during pregnancy, exposure to counselling on maternal nutrition, contact with community health workers, nor participation in support groups. Each question not included in the TDHS was pre-tested then modified based on results from pre-testing.

Demographic data included information on the mother (ethnicity, religion, years of schooling, literacy, and age plus whether she personally owned a mobile phone), household (housing construction and assets ownership, whether the household owned a radio or TV, and the number of other children in the family), and community (travel time to the nearest market and health facility). The asset indicator was created by summing the number of assets respondents indicated they owned out of 13 possible assets, including bicycles, cars, carts, radio, and television, among others. The household construction index was created based on the construction materials used for the floor, roof, and walls of the dwelling ranging from three (if the walls, floor, and roof were made of rudimentary materials) to nine (if the walls, floor, and roof were made of finished materials). Access to services pertains to the availability of safe drinking water sources (e.g., protected wells, a public standpipe) and safe sanitation (e.g., a flush toilet). Pit latrines were not considered to be improved sanitation, per the Joint Monitoring Program of the WHO. The household wealth index was adapted from a previously validated index [21]. The index is comprised of the two sub-indices described above. An average of the two indices was used to calculate an overall wealth score, with possible values ranging between 0 and 1. Higher wealth scores indicate higher socioeconomic status.

Stata 14.2 (College Station, Texas, USA) was used for all statistical analyses. We calculated chi-squares and t-tests to gauge unadjusted associations between exposure to health programs and services and measures of maternal diet. Ordered logistic regression modeling was used to determine whether associations described in bivariate analysis persisted after adjusting for maternal age and education as well as household assets. These covariates were chosen based on conceptual and statistical considerations (including the need to avoid collinearity and overfitting models). Ordinary least squares modeling was conducted for outcomes that were continuous (mother’s dietary diversity and frequency of eating in the previous 24 h).

Results
According to results presented in Table 1, most respondents were Christian, had a primary school education or higher, were literate, and lived a long distance from
| **Table 1** Descriptive statistics for background variables, behavioral determinants, and maternal diet |
|----------------------------------|---|---|
| **Mother**                      |   |   |
| Ethnicity (ref: Wasukuma)        | 5000 | 42.7 |
| Wahaya                           | 12.7 |
| Waha                             | 20.0 |
| Other                            | 24.6 |
| Religion (ref: Christian Protestant) | 5000 | 8.9 |
| Christian, Catholic              | 43.5 |
| Other Christian                  | 41.7 |
| Muslim                           | 5.9 |
| Years of schooling, mother (ref: no education) | 5000 | 19.1 |
| Primary incomplete               | 11.9 |
| Primary complete                 | 56.2 |
| Secondary or more                | 12.9 |
| Maternal literacy (ref: no)      | 5000 | 25.9 |
| Yes                              | 74.1 |
| Maternal age (ref: 15–19 y)      | 4645 | 10.8 |
| 20–29 y                          | 54.8 |
| 30–39 y                          | 27.7 |
| 40–49 y                          | 5.8 |
| 50+ y                            | 0.9 |
| Marital status                   |   |   |
| Married monogamous               | 71.0 |
| Married polygamous               | 5.8 |
| Informal union                   | 8.5 |
| Other                            | 14.7 |
| Main occupation                  |   |   |
| Crop farming                     | 71.5 |
| Self-employed                    | 7.7 |
| Housewife                        | 15.1 |
| Other                            | 5.7 |
| Mother personally owns a mobile phone | 4997 | 40.8 |
| **Household**                    |   |   |
| Household construction (index: 3–9; mean) | 5000 | 5.3 |
| Household asset ownership (index 0–13; mean) | 5000 | 4.2 |
| Household has a radio            | 5000 | 47.5 |
| Household has a TV               | 5000 | 11.7 |
| Number of other children in the family (mean) | 5000 | 1.6 |
| **Community**                    |   |   |
| Access to market (travel time, mean, in minutes) | 5000 | 27.8 |
| Access to health facility (travel time, mean, in minutes) | 5000 | 33.9 |
| **Access to health services**    |   |   |
| Mother received any antenatal care in most recent pregnancy | 4642 | 34.1 |
| Mother received advice on maternal nutrition from any source before her pregnancy | 4966 | 16.9 |
| Mother received advice on maternal nutrition from any source during her pregnancy | 4958 | 37.0 |
Table 1 Descriptive statistics for background variables, behavioral determinants, and maternal diet (Continued)

| Description                                                                 | n     | Mean or % |
|-----------------------------------------------------------------------------|-------|-----------|
| Mother received advice on maternal nutrition from any source after she gave birth to youngest child | 4959  | 26.3      |
| Times mother was exposed to nutrition counselling before and during pregnancy and after giving birth to youngest child |       |           |
| 0                                                                           | 4951  | 56.9      |
| 1                                                                           |       | 16.6      |
| 2                                                                           |       | 16.1      |
| 3                                                                           |       | 10.4      |
| The last time a community health worker spoke with the mother about the child's health generally |       |           |
| Before or during most recent pregnancy                                     | 5000  | 6.0       |
| In the first few weeks and months after delivery                           | 5000  | 12.6      |
| Some other time                                                            | 5000  | 13.4      |
| No community health worker gave advice                                      | 5000  | 68.0      |
| Mother participates in any women's groups                                   | 4995  | 9.4       |
| Access to land and fresh foods                                             |       |           |
| Size of plot household cultivates for home garden and/or other agricultural land (mean, in acres) | 5000  | 1.2 (95% CI 1.1 1.2) |
| Mother buys fresh foods daily or a few times a week                         | 4986  | 67.3      |
| Mother's dietary practices                                                  |       |           |
| Quantity of food mother ate during her most recent pregnancy                | 4645  |           |
| Less than usual                                                            |       | 37.2      |
| Same as usual                                                              |       | 54.8      |
| More than usual                                                             |       | 8.0       |
| Mother's frequency of eating in previous 24 h                               | 4972  |           |
| 0–1 times                                                                  |       | 1.7       |
| 2 times                                                                    |       | 21.3      |
| 3 times                                                                    |       | 35.3      |
| 4 times                                                                    |       | 22.2      |
| 5 or more times                                                            |       | 19.6      |
| Mean                                                                       |       | 3.4 (95% CI 3.4, 3.5) |
| During her most recent pregnancy, mother ate                               | 4648  |           |
| Fewer types of foods                                                       |       | 31.9      |
| Same types of foods                                                        |       | 61.0      |
| More types of foods                                                        |       | 7.1       |
| Type of food mother consumed in previous 24 h                               |       |           |
| Cereal                                                                     | 5000  | 95.0      |
| Legumes and nuts                                                           | 5000  | 36.0      |
| Dairy                                                                      | 5000  | 2.5       |
| Flesh foods                                                                | 5000  | 24.1      |
| Eggs                                                                       | 5000  | 1.2       |
| Vitamin A-rich fruits                                                      | 5000  | 4.8       |
| Other fruits                                                               | 5000  | 5.1       |
| Mother's dietary diversity in previous 24 h (7-item scale)                 | 5000  |           |
| 0 types of food                                                            |       | 3.0       |
| 1 type of food                                                             |       | 40.2      |
| 2 types of food                                                            |       | 44.7      |
| 3 types of food                                                            |       | 10.2      |
markets (27.8 min on average to reach the closest market) and health facilities (on average, a 33.9-min trip). About a third of the sample (34.1%) had received any antenatal care during their most recent pregnancy or had been advised from any source about nutrition when most recently pregnant (37.0%). During their most recent pregnancy, less than half (43.1%) of women received any advice whatsoever—regardless of source—about maternal nutrition. Of those receiving any advice, 93.5% were counselled by health facility or hospital staff, 0.9% by feeding center staff, 6.1% by CHWs, and 0.3% by pharmacists, and 68.0% had never had a CHW speak to them about their children’s health. Only one in ten (9.4%) of mothers had participated in a women’s group of any kind. Per self-reports, only 8.0% of mothers ate more than usual during their most recent pregnancy and 7.1% ate more types of foods. About a quarter of women (24.1%) consumed flesh foods in the previous 24 h while 1.2% had eaten eggs and 4.8% consumed vitamin A-rich foods (Table 1). A large percentage of mothers had not

Table 1 Descriptive statistics for background variables, behavioral determinants, and maternal diet (Continued)

| 4 types of food       | 1.6 |
| 5 types of food       | 0.3 |
| 6 types of food       | 0.1 |
| 7 types of food       | 0.1 |
| Mean                  | 1.7 (95% CI 1.7, 1.7) |

*Mothers rarely indicated another source of advice except for the health facility and CHW. 3.3% received information on maternal nutrition from their mother-in-law, 3.0% from a friend or neighbour, 1.3% from their husbands, and less than 1% from feeding centre staff, traditional healer, traditional birth attendant, pharmacist, religious leader, community leader, mother/mother-in-law, TV, radio, mobile phone, and print material.

*Includes 0.9% who indicated receiving advice before pregnancy.

*Less than 5% of women indicated they had participated in an agricultural group, a child health group, or a religious group.

Table 2 Associations between health services and food consumption during pregnancy and in the previous 24 h

| Recall period: | Most recent pregnancy | Last 24 h |
|----------------|-----------------------|----------|
| Variable       | Mother ate more than usual during pregnancy | Mother ate more types of foods | Mother’s frequency of eating | Dietary diversity |
|                | % | % | % | Mean | % | % | Mean |
| Mother received any ANC in the most recent pregnancy | | | | | | | |
| Yes            | 9.2 | 0.019 | 9.9 | <0.001 | 3.7 | <0.001 | 1.7 | 0.004 |
| No             | 7.3 | 5.7 | 3.3 | 1.7 |
| Mother received advice on maternal nutrition from any source before her pregnancy | | | | | | | |
| Yes            | 8.7 | 0.424 | 11.2 | <0.001 | 3.8 | <0.001 | 1.7 | 0.226 |
| No             | 7.8 | 6.3 | 3.4 | 1.7 |
| Mother received advice on maternal nutrition from any source during her pregnancy | | | | | | | |
| Yes            | 9.7 | 0.001 | 9.6 | <0.001 | 3.6 | <0.001 | 1.8 | <0.001 |
| No             | 6.9 | 5.7 | 3.4 | 1.6 |
| Mother received advice on maternal nutrition from any source after she gave birth to youngest child | | | | | | | |
| Yes            | 9.4 | 0.038 | 9.3 | 0.001 | 3.6 | <0.001 | 1.8 | <0.001 |
| No             | 7.5 | 6.4 | 3.4 | 1.6 |
| Mother was advised at least once about nutrition before and during pregnancy and after giving birth to youngest child | | | | | | | |
| Yes            | 9.5 | 0.001 | 9.1 | <0.001 | 3.5 | <0.001 | 1.8 | <0.001 |
| No             | 6.8 | 5.6 | 3.3 | 1.6 |
| CHW spoke with mother about child health generally | | | | | | | |
| Yes, advice at any time | 9.7 | 0.004 | 8.3 | 0.016 | 3.6 | <0.001 | 1.8 | <0.001 |
| No             | 7.2 | 6.4 | 3.3 | 1.6 |
| Mother participates in any women’s groups | | | | | | | |
| Yes            | 7.6 | 0.789 | 7.6 | 0.674 | 3.6 | <0.001 | 1.7 | 0.127 |
| No             | 8.0 | 7.1 | 3.4 | 1.7 |
consumed meat (61.2%), fish (41.0%), eggs (89.5%), nor fruit (69.4%) in the previous week (results not shown in table form).

Factors associated with eating more than usual during pregnancy included receiving any antenatal care, receiving advice about maternal nutrition during and after pregnancy (but not before), and speaking with a CHW about child health (Table 2). However, in many instances, these differences were small. For example, 9.2% of women who received any ANC during their most recent pregnancy and 7.3% of women who did not, ate more than usual during pregnancy. Receiving any ANC; being counselled about nutrition before, during and after pregnancy; being advised at least once about nutrition; and speaking with a CHW about their child’s health generally were associated with eating more types of foods. All program exposure variables were significantly associated with mothers’ frequency of eating in the previous 24 h ($p < 0.001$ for all comparisons). Mothers’ dietary diversity over the same time period was associated with receiving any ANC, receiving advice about maternal nutrition during and after pregnancy (but not before), and speaking with a CHW about their child’s health.

Results from ordered logistic regression models that adjusted for mother’s age, education and household assets (Table 3) suggest that only one variable (receiving advice on nutrition during pregnancy) was associated with the mother eating more food during her most recent pregnancy. Women who received advice were 1.3 times (95% CI: 1.1, 1.7) more likely than mothers who did not receive advice to eat more during pregnancy. Women who received ANC and advice on nutrition before, during, and after pregnancy and birth were all significantly more likely than women who did not to eat more types of foods. Additionally, mothers who received ANC care; those who received advice about maternal nutrition from any source before, during, and after pregnancy; and mothers hearing from CHWs during and after delivery about the child’s health were generally more likely than those who did not receive care nor counselling to consume a more diverse diet in the previous 24 h, after adjusting for mother’s age and education and household assets ($p < 0.01$ for all comparisons found to be significant).

### Discussion

This paper examined potential associations between existing access to health services and other sources of advice about nutrition and women’s dietary practices during pregnancy and post-partum. We found that only 34% of women received any ANC, a sharp contrast to

| Access to health services | Mother ate more food during her most recent pregnancy | Mother ate more types of foods during her most recent pregnancy |
|---------------------------|------------------------------------------------------|---------------------------------------------------------------|
|                           | AOR 95% CI | P     | AOR 95% CI | P     |
| Mother received any antenatal care in most recent pregnancy | 1.2 1.0, 1.5 | 0.111 1.7 | 1.3 1.2, 1.7 | < 0.001 |
| Mother received advice on maternal nutrition from any source before her pregnancy | 1.1 0.8, 1.4 | 0.730 1.8 | 1.4 1.2, 1.7 | < 0.001 |
| Mother received advice on maternal nutrition from any source during her pregnancy | 1.3 1.1, 1.7 | 0.010 1.7 | 1.3 1.2, 1.7 | < 0.001 |
| Mother received advice on maternal nutrition from any source after she gave birth to youngest child | 1.2 1.0, 1.5 | 0.102 1.4 | 1.1 1.1, 1.8 | 0.003 |
| The last time a community health worker spoke with the mother about the child’s health generally |                        |                                      |                        |               |
| No community health worker gave advice (ref) |                          |                                      |                          |               |
| Before most recent pregnancy | 2.2 0.9, 5.4 | 0.078 0.7 | 0.2 0.2, 0.9 | 0.631 |
| During most recent pregnancy | 1.1 0.7, 1.9 | 0.585 1.1 | 0.6 0.6, 1.8 | 0.778 |
| In the first few weeks and months after delivery | 1.2 0.9, 1.7 | 0.260 1.5 | 1.1 1.2, 2.0 | 0.015 |
| Some other time | 1.3 1.0, 1.8 | 0.066 2.0 | 0.9 0.9, 1.7 | 0.293 |
| Mother participates in any women’s groups | 1.0 0.7, 1.4 | 0.904 1.0 | 0.7 0.7, 1.5 | 0.810 |

Note: Adjusted for mother’s age and education and household assets
national figures which indicate that 98% of all pregnant
women receive at least some antenatal care [7]. Consis-
tent with study hypotheses, we found that mothers who
had made at least one ANC visit, had heard advice about
their own nutrition and the health of their child, and to
a lesser extent, had benefited from visits by CHWs, were
more likely to consume a diverse diet. These findings
are largely consistent with the existing literature. Glu-
deirard and Olude [22] note that nutrition education
and counselling have mostly been associated with im-
proved maternal dietary practices. In India, Ghosh-
Jerath and colleagues [23] found that ANC visits were
associated with protein uptake. In Nepal, Sunuwar and
collaborators [24] documented significantly higher in-
take of red meat, fish and liver, vitamin C-rich fruits,
dairy products, eggs, and green leafy vegetables among
women making ANC visits. In Egypt and in Senegal, ex-
posure to positive deviance programs was associated
with consuming more meat and vegetables [25] and iron
supplements [26]. In a large study from Bangladesh, rela-
tive to a standard maternal, neonatal, and child health
package, women who received intensive nutrition coun-
selling via salaried health workers and incentivized com-
munity health volunteers, monthly home visits, one-on-
one ANC sessions with individually-tailored diet plans,
and nutrition promotion activities among family
members were more likely to consume a greater number
of food groups, specific foods, and iron and calcium sup-
plements [27]. In contrast, some studies, including one
from Nepal [28], report that women participating in
support groups did not have significantly more diverse
diets nor protein and energy adequacy than non-
participants.

We also found that mothers who received any ANC
during pregnancy ate more frequently, compared to
women who did not receive such services. There is con-
siderably less literature on nutrition promotion and feed-
ning frequency but Demilew and colleagues [29] and
Diddana [30] report from their observational study in
Ethiopia that knowledge about diet during pregnancy
was associated with consuming foods more frequently.
Our findings indicate that mothers who received advice
on maternal nutrition from any source during pregnancy
self-reported eating more food compared to mothers
who did not receive such advice, a finding noted by
Ahrari and colleagues [25] in Egypt and Nguyen and col-
leagues [27] in Bangladesh.

In addition to program exposure, other factors are
known to influence nutrition behaviors. These include
women's knowledge of nutrition, perceived severity of
malnutrition, poor perceived benefits of adopting healthy
nutrition practices, and low self-efficacy [29–31].

| Table 4 Ordinary least squares: Associations between access to development assistance, health services, and mother’s dietary diversity |
|-------------------------------------------------|-------------------------------------------------|
| Access to health services                        |                                             |
| Mother received any antenatal care in most recent pregnancy | 0.2350 | 0.1697, 0.3003 | < 0.001 | 0.0179 | −0.0321, 0.0679 | 0.484 |
| Mother received advice on maternal nutrition from any source before her pregnancy | 0.3426 | 0.2633, 0.4220 | < 0.001 | −0.0258 | −0.0866, 0.0351 | 0.406 |
| Mother received advice on maternal nutrition from any source during her pregnancy | 0.0959 | 0.0330, 0.1588 | 0.003 | 0.0722 | 0.0243, 0.1201 | 0.003 |
| Mother received advice on maternal nutrition from any source after she gave birth to youngest child | 0.1888 | 0.1205, 0.2571 | < 0.001 | 0.1094 | 0.0573, 0.1615 | < 0.001 |
| The last time a community health worker spoke with the mother about the child’s health generally |                                             |
| No community health worker gave advice (ref) |                                             |
| Before most recent pregnancy | 0.2232 | −0.0837, 0.5301 | 0.154 | −0.0238 | −0.2563, 0.0207 | 0.841 |
| During most recent pregnancy | 0.4812 | 0.3450, 0.6173 | < 0.001 | 0.3133 | 0.2090, 0.4175 | < 0.001 |
| In the first few weeks and months after delivery | 0.2536 | 0.1627, 0.3445 | < 0.001 | 0.0421 | −0.0273, 0.1112 | 0.235 |
| Some other time | 0.0534 | −0.0365, 0.1432 | 0.244 | 0.0856 | 0.0169, 0.1543 | 0.015 |
| Mother participates in any women’s groups | 0.1594 | 0.0566, 0.2623 | 0.002 | 0.0256 | −0.0528, 0.1041 | 0.522 |

Note: Adjusted for mother’s age and education and household assets
Findings reported here demonstrate at least modest associations between access to health facility and community-based services and a range of nutrition-related behaviors. However, only a third of our sample received any ANC during their most recent pregnancy and a similarly low percent received nutrition advice from any source. Less than half of women received any advice on maternal nutrition—professional or otherwise—during their most recent pregnancy and for those who had been advised, the majority of that advice occurred in hospitals or health facilities, with only about 5% coming from CHWs. Similarly, just one in ten mothers had participated in a women’s group of any kind—a potential forum for discussing women’s nutrition. Other studies in Tanzania also report low exposure to facility-based counselling and frontline health worker activities [7, 32]. While our results regarding the potential impact of ANC and CHW counselling are encouraging, population-level changes in nutrition behaviors are unlikely to occur at the scale reported in Bangladesh and elsewhere [28], barring major efforts to scale up current interventions. Nguyen and colleagues note that in Bangladesh, among seven program elements, differences in intervention coverage were one of two factors that best explained the lack of program impact [27].

Achieving scale is only one potential challenge to improving nutrition behaviors. Others include health worker shortages such as a lack of dieticians [33], low salaries [34], health workers’ shortage of time [28], inadequate information and training to counsel women [13, 33–35], and uncertainty about how to translate general nutrition requirements to individual needs [13].

We used project baseline data from a large survey to explore the relationship between exposure to existing government programs and dietary practices among women in a specific geographic region of Tanzania. Our findings provide useful information to policy makers and program planners who are tasked with improving women’s nutrition. However, our study has limitations. These include single, subjective measures to gauge two variables “ate more than usual” and “consumed more types of foods than usual,” given that it was not possible to quantify the actual amount of food women consumed before giving birth. Twenty-four-hour dietary recall provided a more objective measure of dietary diversity but was measured in the 24 h prior to interview, not during women’s pregnancy. Other limitations included lack of more detailed measures of the quality, timing, and nature of programs and source of nutrition information (for example, clinicians versus CHWs versus family members or friends). Additionally, data are cross-sectional, thus restricting our ability to infer causality, and only include information on exposure to existing government services, thus limiting our ability to document changes in program exposure and nutritional practices over time. Further analyses based on the ASTUTE project’s midline and endline will shed light on apparent anomalies in our findings, for example, that counseling after pregnancy was associated with eating more foods and more types of foods during pregnancy.

A number of factors influence women’s diets, including production of nutritious, diverse foods; women’s position within the household, including control over resources and decision-making power; how foods that the household uses are produced; what crops are designated for home consumption; cultural beliefs about what foods women should eat during pregnancy and lactation; and the emotional and instrumental support other family members offer to promote dietary behaviors known to improve women’s nutrition [8, 36]. Programs designed to improve women’s dietary behaviors can benefit from efforts to bolster both the number and preparedness of health workers (including training to standardize innovative counselling and community-based behavior change strategies), a re-structuring of salaries and incentives for health workers, greater time allocation for nutrition education and counselling, and more supportive supervision. Standardization of roles and responsibilities, job aids, and frequent monitoring of nutrition education and counselling are critical to implementing high-quality interventions.

Future research would benefit from elucidating how the timing, content, and source of counselling and community mobilization impact upon women’s dietary behaviors [16, 37]. Intervention research that more fully characterizes programs [35] and elucidates how and why interventions achieve impact will benefit policy and program design and implementation. Rigorous program fidelity assessments can pinpoint which of various program elements might explain the impact of a given intervention.

**Conclusions**

Consistent with much of the existing literature, our research reinforces the importance of receiving advice about nutrition and health from health facility workers and frontline health workers/volunteers before and during pregnancy as well as post-partum. Given the impact of nutrition education and counselling on women’s diets, it is essential that future attempts to improve women’s dietary behaviors consider the complex environment within which women operate. Improving mothers’ diets should include training and supportive supervisory systems, the introduction of proven counselling and behavior change strategies, community social mobilization and greater political will to extend health facility and community-based outreach.
Availability of data and materials
The datasets generated and analyzed during the current study are not publicly available due to concerns about the confidentiality of individual respondents. The ASTUTE program (contract number PO 6803) was funded by UKAid of the United Kingdom. UKAid had no role in the design of the study, data collection, data analysis, and interpretation of data or in writing the manuscript. The authors’ views expressed in this publication do not necessarily reflect the views of IMA World Health, Brigham Young University, nor UKAid.

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Authors’ contributions
KAD, BTM, BTC, and GIM conceived and designed the work. KAD and BTM acquired the data. KAD conducted data analysis. All authors interpreted the data. All authors drafted the work or substantively revised it. All authors approved the submitted version. All authors have agreed both to be personally accountable for their own contributions and to ensure that questions related to the accuracy or integrity of any part of the work are appropriately investigated, resolved, and the resolution documented in the literature.

Authors’ information
Not applicable.

Availability of data and materials
The datasets generated and analyzed during the current study are not publicly available due to concerns about the confidentiality of individual respondents but are available from the corresponding author on reasonable request.

Declarations
Ethics approval and consent to participate
The National Institute for Medical Research in Tanzania (NIMR/HQ/R8a/VolIX/2344) and relevant local government authorities authorized the research. NIMR has an institutional committee to approve the study on humans. Written informed consent from all study participants—written if the respondent was literate and by thumb print if not. The National Institute for Medical Research in Tanzania (NIMR/HQ/R8a/VolIX/2344) and relevant local government authorities approved the procedure for thumbprint consent from illiterate participants. All methods were performed in accordance with the relevant guidelines and regulations.

Consent for publication
Not applicable.

Competing interests
The authors declare that they have no competing interests.

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