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Vegetable Intake among Women of Reproductive Age in Northern Tanzania: Baseline Findings from the FRESH End-to-End Evaluation

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Vegetable Intake among Women of Reproductive Age in Northern Tanzania: Baseline Findings from the FRESH End-to-End Evaluation

Introduction

Adequate intake of fruit and vegetables (F&V) is fundamental to meeting micronutrient requirements, reducing the risk of diet-related noncommunicable diseases, and supporting overall health and well-being [1, 2]. The World Health Organization recommends a minimum daily intake of 400 g of F&V [3, 4], whereas the Tanzania Food-Based Dietary Guidelines (FBDGs) advise a daily intake of approximately 280 g each of fruit and vegetables to promote healthy living [5]. Intake of F&V in Tanzania and many other low- and middle-income countries, however, remains substantially below recommended levels [6, 7]. In sub-Saharan Africa, diets are frequently dominated by staple cereals and tubers, with limited dietary diversity and low intake of nutrient-dense foods, including F&V [8]. In Tanzania, women of reproductive age (WRA) are at high risk of micronutrient deficiencies, including iron, folate, vitamins A, C and B12 [9]. These inadequacies impair immune function, increase susceptibility to infection, and contribute to iron-deficiency anaemia, fatigue, and reduced productivity [10]. During pregnancy, poor micronutrient status elevates the risk of maternal morbidity, preterm birth, low birth weight, and impaired fetal growth [11]. During lactation, inadequate status may reduce the micronutrient content of breast milk, potentially compromising infant growth and immune function [12].

The CGIAR Research Initiative on Fruit and Vegetables for Sustainable Healthy Diets (FRESH), now incorporated into the CGIAR Science Program on Better Diets and Nutrition (BDN), is developing and evaluating an end-to-end food systems approach to increase F&V intake in Northern Tanzania. The overall study design has been described previously in [Research Brief 1](#) [13], and baseline dietary patterns among WRA have been reported elsewhere [14]. This brief focuses on vegetable intake, presenting estimates of usual intake, the types of vegetables reported, and the proportion of women reporting any intake of vegetables. The findings are intended to inform program and policy design to support efforts to promote healthier, vegetable-rich diets among women in Tanzania.

Methods

The end-to-end evaluation is being conducted in 33 villages in the Arusha and Kilimanjaro regions. WRA were eligible for inclusion in the study if, at enrollment, they were 15–49 years of age, resided in one of the 33 study villages, had at least one biological child aged 10–14 years, and provided written informed consent. Baseline data collection, including dietary intake assessment, was conducted between October 2023 and January 2024 through in-person interviews using SurveyCTO (Dobility, Inc., Cambridge, MA), an electronic data capture platform deployed on Samsung Galaxy Tab A tablets. Ethical approval for this study was granted by the Institutional Review Boards of the National Institute of Medical Research in Tanzania, the International Food Policy Research Institute, and Wageningen University and Research. Further details on study design and sampling procedures for selecting villages and households are available elsewhere [13].

Dietary intake information was obtained from WRA ($n = 2,599$) using a single 24-hour dietary recall administered through the OpenDRS system. A second, non-consecutive recall was

completed among a random subset of participants (n =520; approximately 20%) to allow adjustment for within-person variation in intake using the National Cancer Institute (NCI) methodology [15]. A single recall adequately estimates group mean intake [16], the primary outcome of this research brief. Hence for this research brief, analyses were restricted to data from the first 24-hour dietary recall (n = 2,547), after excluding suspected under-reporters, defined as those with intakes below the 1st percentile (462 kcal/day) (n = 26) and over-reporters, defined as those with intakes above the 99th percentile (5,965 kcal/day) (n = 25) [14]. The lower cutoff was consistent with that reported by Willett *et al.* [16], whereas the upper cutoff allowed for plausible higher intakes in a population with a high prevalence of overweight and obesity. In addition to the dietary assessment, enumerators administered a structured questionnaire to collect information on women's socio-economic and demographic characteristics. Household food insecurity was evaluated using the FAO Food Insecurity Experience Scale [17]. A household wealth index was generated using principal components analysis, comprised of 12 assets and seven indicators of housing quality. All interviews were conducted in Kiswahili, and data were captured electronically using SurveyCTO on Android devices.

Descriptive statistics were used to summarize participants' socio-economic and demographic characteristics. Descriptive statistics were also used to estimate actual intakes of total vegetables and vegetable subgroups (n=4), defined using the Global Diet Quality Score (GDQS) framework [18]. The GDQS is a validated diet quality metric that reflects micronutrient adequacy and chronic disease risk across populations; we selected this framework because it provides a comprehensive approach to evaluating vegetable intake in relation to overall diet quality and health risks. The vegetable groups examined in this study, as defined by the GDQS, included: (1) dark green leafy vegetables (DGLVs), such as pumpkin leaf and amaranth, which are rich in folate, vitamin A precursors, and iron; (2) cruciferous vegetables, including cabbage, noted for their vitamin C, fiber, and bioactive phytochemicals; (3) deep orange-coloured vegetables, such as carrot, which provide provitamin A carotenoids; and (4) other vegetables, including okra and onion, which contribute additional micronutrients and dietary diversity. These categories were selected because the GDQS framework uses them to capture variation in nutrient density and bioactive compounds across vegetable types. The proportion of women with intake less than 200 g/day of vegetables, half of the WHO recommendation of 400 g/day for F&V [6], and less than 280 g/day, as recommended by the Tanzania FBDGs [5], was estimated using a cut-point approach based on observed intake data. The proportion of women reporting intake of vegetable subgroups and specific vegetables were also estimated. Vegetable intake patterns were examined by vegetable subgroup and stratified according to women's educational attainment (none/incomplete primary, completed primary, secondary or higher), household wealth quintiles, and household food security status (none, mild, moderate, or severe). Differences in vegetable intake across strata were assessed using chi-square or Fisher's exact tests, as appropriate.

Results

We analyzed data from 2,547 women who reported vegetable intake in the first 24-hour recall. Participants were, on average, 38 years old, with nearly half (47.9%) of them 30–39 years of age. Approximately one-fifth (18.8%) had no or incomplete primary education, and about one-third (32%) lived in households experiencing severe food insecurity (**Table 1**).

Overall, the majority of women (93.6%) reported intake of vegetables, with “other vegetables” (93.6%) and orange-coloured vegetables (91.4%) being the most frequently reported subgroups. Intakes of DGLV and cruciferous vegetables were reported by at least half of the women (**Figure 1**). The mean actual vegetable intake was 237.8 ± 4.5 g/day, with 46.3% of women reporting intake of at least 200 g/day. Fewer than one-quarter (22.3%) met the Tanzania FBDGs recommendation of ≥ 280 g/day of vegetable intake. Among the vegetable

subgroups, “other vegetables” had the highest actual usual intake (100.4 ±1.9g/day), while cruciferous vegetables had the lowest intake (23.5 ± 0.8 g/day; **Table 2**).

Table 1. Women’s socio-economic and demographic characteristics (N=2,547)

| Socio-economic and demographic characteristics | Mean ± SD or n (%) |
|--|--------------------|
| Woman’s age (years) | 38.2 ± 6.0 |
| Age category | |
| 20-29 years | 197 (7.7%) |
| 30-39 years | 1223 (48.0%) |
| ≥ 40 years | 1127 (44.3%) |
| Educational status | |
| None/incomplete primary schooling | 479 (18.8%) |
| Complete primary schooling | 1683 (66.1%) |
| Any secondary schooling/ higher education | 385 (15.1%) |
| Household food security | |
| Food secure | 936 (36.7%) |
| Mild food insecurity | 370 (14.5%) |
| Moderate food insecurity | 425 (16.7%) |
| Severe food insecurity | 816 (32.0%) |

¹The analytic sample included only the first 24-hour dietary recalls after excluding suspected under- and over-reporters of energy intake, defined using the 1st and 99th percentiles of the intake distribution.

²Educational attainment was categorized according to the distribution of educational levels within the study population.

Table 2. Actual total vegetable intake and intake by Global Diet Quality Score vegetable subgroups among women (N=2,547)

| Variable(s) | Mean | S.E. | P5, P95 |
|-------------------------------------|-------|------|----------|
| Total vegetable intake (g/day) | 237.8 | 4.5 | 0, 630.7 |
| GDQS vegetable subgroup | | | |
| Dark green leafy vegetables (g/day) | 69.8 | 2.1 | 0, 262.5 |
| Cruciferous vegetables (g/day) | 23.5 | 0.8 | 0, 91.9 |
| Deep orange vegetables (g/day) | 44.5 | 0.8 | 0, 118.3 |
| Other vegetables (g/day) | 100.0 | 1.9 | 0, 276.2 |

S.E, standard error; P5, 5th percentile; P95, 95th percentile. The analytic sample included only the first 24-hour dietary recalls after excluding suspected under- and over-reporters of energy intake, defined using the 1st and 99th percentiles of the intake distribution.

Only 11 distinct types of vegetables were reported with any intake by ≥5% of the WRA. Onion, carrot, tomato, and green pepper were the most reported vegetables, with approximately 90% of women reporting intake the previous day. Average actual intakes for these items ranged from 13 g/day for onion to 49 g/day for carrot. At least 50% of the women reported intake of Chinese cabbage, ginger, pumpkin leaves, and other unspecified green leafy vegetables.

Median intakes ranged from 37 g/day for Chinese cabbage to 79 g/day for pumpkin leaves. Eggplant, bitter tomato, and okra were less frequently eaten but still notable, with at least one-quarter of women reporting intake and actual intakes ranging from 18 g/day for okra to 39 g/day for eggplant (**Table 3**).

Table 3. Percentage of women of reproductive age who reported intake of each vegetable on the previous day (N=2,547)

| Vegetable | Percentage ¹ | Actual intake, mean ± SD (g/day) |
|----------------------------------|-------------------------|----------------------------------|
| Onion | 92.8 | 13.2 ± 11.7 |
| Carrots | 91.5 | 48.7 ± 41.2 |
| Tomato | 91.0 | 46.3 ± 45.9 |
| Green pepper (capsicum) | 88.5 | 18.2 ± 16.2 |
| Green medium, leaf ² | 55.2 | 45.5 ± 42.2 |
| Chinese cabbage | 51.3 | 36.8 ± 33.8 |
| Pumpkin leaf | 47.2 | 78.9 ± 74.8 |
| Eggplant | 43.3 | 39.1 ± 29.0 |
| Bitter tomato (African eggplant) | 25.6 | 22.4 ± 34.2 |
| Okra | 24.3 | 17.5 ± 22.9 |
| Salad (green) ³ | 5.5 | 12.1 ± 8.5 |

The analytic sample included only the first 24-hour dietary recalls, after excluding suspected under- and over-reporters of energy intake, defined as those at the 1st and 99th percentiles of the intake distribution.

¹Vegetables reported by ≥5% of participants are presented; ²Includes the average of unspecified dark green leafy vegetables;

³Refers to a leafy green vegetable with curly, crisp leaves, similar in appearance to a mix of cabbage and spinach

No significant differences were observed in overall vegetable intake or in the four vegetable subgroups by woman's age. The proportion of women reporting intake of DGLVs declined significantly with increasing educational attainment ($P = 0.02$), decreasing from 60.1% among women with none/incomplete primary education to 50.7% among those with any secondary or higher education (**Figure 2**). Intake of cruciferous and deep-orange vegetables varied across household food security categories; however, no consistent trend was observed across food insecurity levels (**Figure 3**). Vegetable intake did not differ across household wealth quintiles. No differences in vegetable intake were observed across household wealth quintiles.

Figure 1. Proportion of women reporting intake of any vegetables on the previous day, total and by GDQS fruit group categories

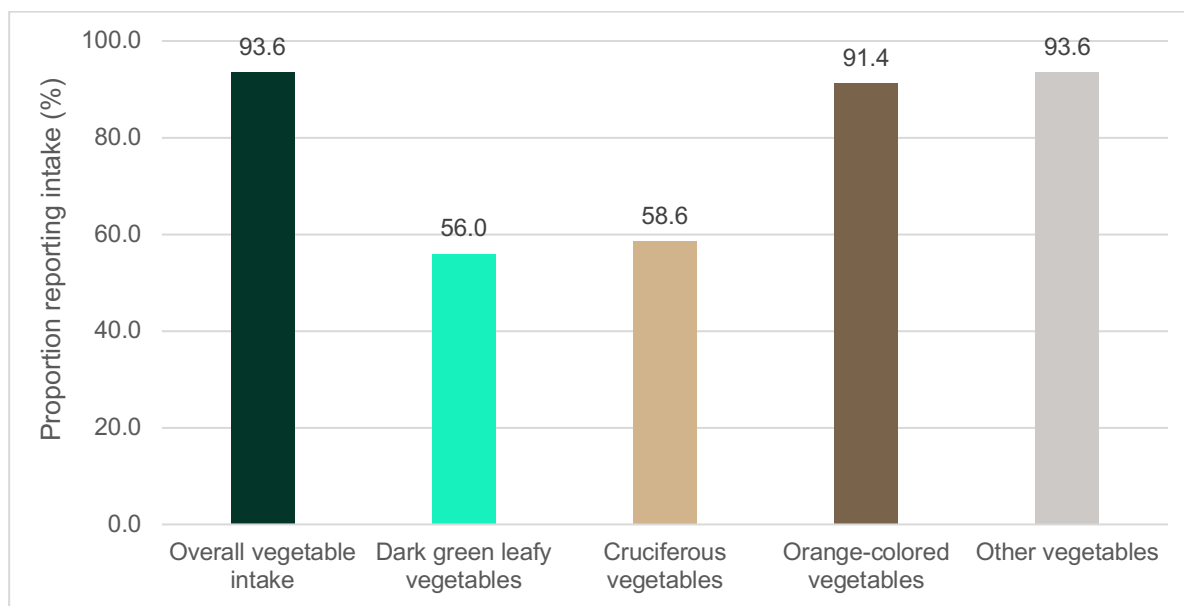


Figure 2. Proportion of women reporting intake of any vegetables and GDQS-classified vegetable subgroups on the previous day, by educational status

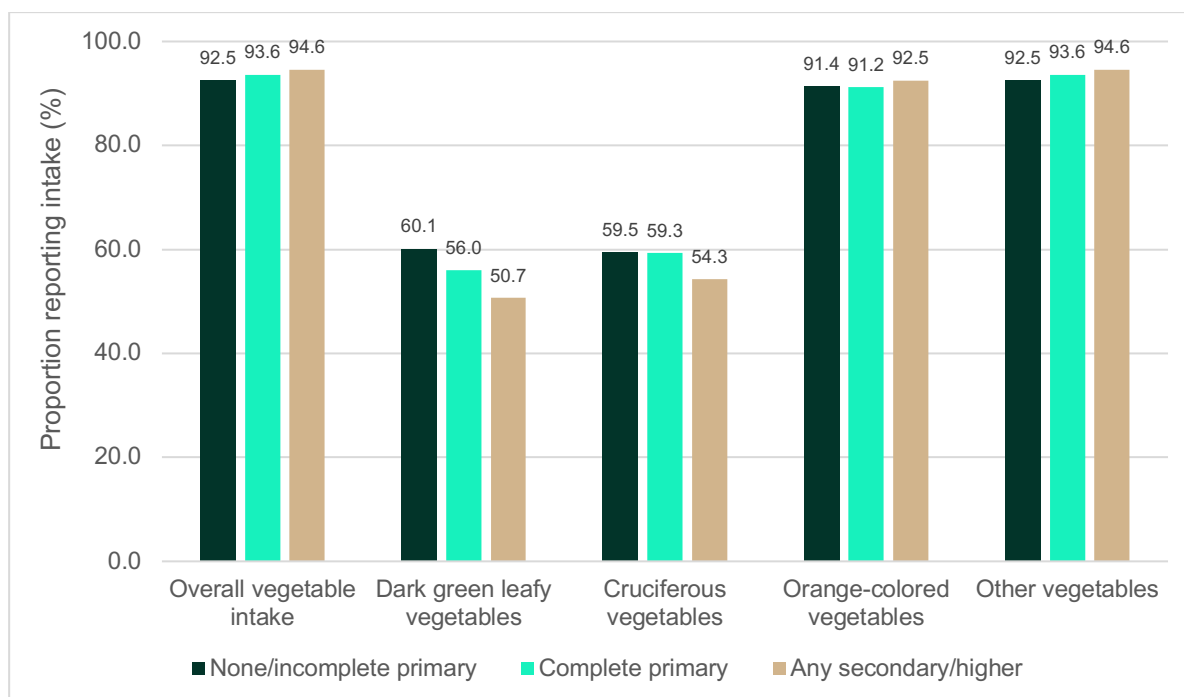
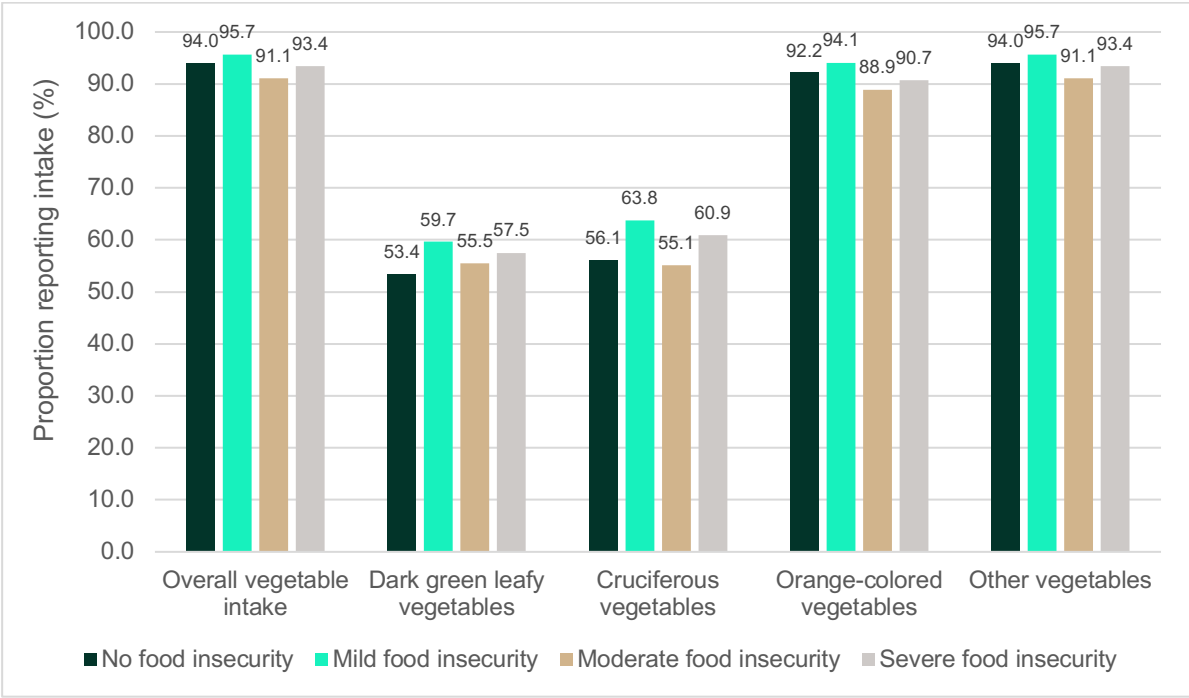


Figure 3. Proportion of women reporting intake of any vegetables and GDQS-classified vegetable subgroups on the previous day, by household food security status



Key messages

- The mean actual total vegetable intake among women of reproductive age was 237.8 ± 4.5 g/day. However, fewer than half reported intake ≥200 g/day, and less than one-quarter met the Tanzania Food Based Dietary Guideline (FBDG) recommendation of ≥280 g/day.
- Other vegetables (100.0 g/day) and DGLVs (69.8 g/day) had the highest quantities of intake among vegetable subgroups, whereas cruciferous vegetables had the lowest quantity of intake (23.5 g/day).
- Onion, carrot, tomato, and green pepper were the vegetables most frequently reported with any intake (>0 g/day) in the 24-hour dietary recall.
- No meaningful differences in total vegetable intake or vegetable subgroup intakes were found by women’s age, household wealth, or food security status. Intake of DGLVs, however, declined with increasing educational attainment.

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Cover photo: Vegetables for sale at a market in Moshi, Tanzania; IFPRI/S. Honeycutt.



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The CGIAR Science Program on Better Diets and Nutrition (BDN) identifies, co-designs and tests consumer-oriented solutions to ensure sustainable healthy diets for all while enhancing livelihoods, social equity, and environmental sustainability. Through evidence-based research and collaboration, BDN supports country-led food system transformation in low- and middle-income countries. To learn more about BDN, please visit <https://www.cgiar.org/cgiar-research-portfolio-2025-2030/better-diets-and-nutrition/>.

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