NICHD Global Health Conference

Session II. Individual/Parent/Family Level: Prevention and Evidence-based Interventions for Children and Adolescents in LMICs

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Food systems and diet quality: Role in the double-burden of malnutrition for children and adolescents

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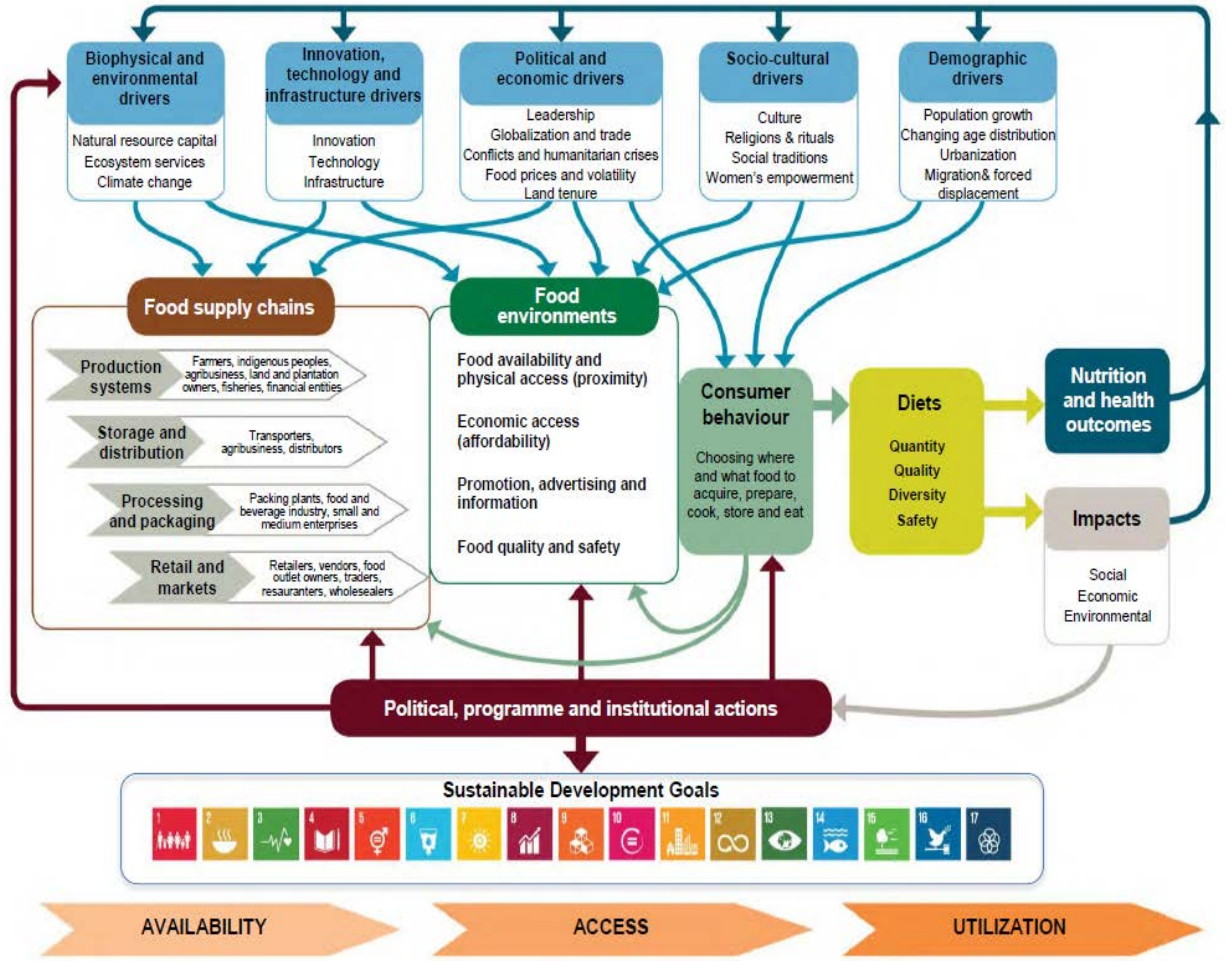
Outline

- Background
- Maternal dietary factors and early child growth
- Adolescent diets and nutrition status
- Research questions

Food systems and the double burden of malnutrition

- 768M people are hungry (SOFI, 2021)
- **3 Billion** people cannot afford a healthy diet globally (Herforth et al, 2020, SOFI 2021)
- **Nutrition and dietary transition:** food value chains and diets rapidly shifting in LMICs - processed, refined, fast foods (Popkin et al, 2014)
- **Sub-optimal diets - #1 risk factor for mortality** [Murray et al, 2020]
  - **11M** deaths attributed to dietary risk factors (Afshin et al (GBD), 2019)
  - Diet-related chronic diseases: obesity, diabetes, hypertension, cardiovascular diseases, diet-related cancers



(HPLE, 2017)

Globally accepted measures of diet quality for women, children or adolescents?

1. Dietary diversity as a proxy measure of diet quality in LMICs?

Gap: Does not capture global dietary transition and consumption of unhealthy foods

2. Measurement [Alkerwi et al, 2014; Trijsburg et al, 2019]

a) **nutrient adequacy/food variety or food diversity**

b) **moderation** - saturated fat, sodium, sugar, nutrients associated with excess disease risk

c) **balance** - energy-yielding macronutrients

3. **Gaps:** Varying definitions; Tools and metrics not validated in LMICs – adolescents, children

Source: EAT-Lancet Commission, 2020

Maternal dietary factors and early child growth

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Maternal dietary diversity and dietary quality scores in relation to adverse birth outcomes in Tanzanian women

Isabel Madzorera ✉, Sheila Isanaka, Molin Wang, Gernard I Msamanga, Willy Urassa, Ellen Hertzmark, Christopher Duggan, Wafaie W Fawzi

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https://doi-org.ezp-prod1.hul.harvard.edu/10.1093/ajcn/nqaa172
Published: 11 July 2020 **Article history**

Study in Dar es Salaam, Tanzania among 8,428 pregnant women, 12-27 weeks gestation

Dietary intake: Repeated 24-hour dietary recalls during pregnancy

FAO Minimum Diet Diversity Index - Women (MDD-W)

Composed of 10 food groups

MDD-W
Starchy staple foods
Beans and peas
Nuts and seeds
Dairy
Eggs
Flesh foods
Vitamin A-rich dark green leafy vegetables
Other vitamin A-rich vegetables and Fruits
Other vegetables
Other fruits

Validated for micronutrient adequacy

- Vit A, thiamin, riboflavin, Vit B6, B12, folate, zinc, calcium

  [Martin-Prével et al, 2015 Arimond et al, 2010]

- Gap:
  - MDD-W measures one aspect of diet quality (micronutrient adequacy)
  - Does not capture global dietary transition and consumption of unhealthy foods in LMICs

Women in q5 of MDD-W had 26% lower risk of SGA vs. q1 in Tanzania

Clinical Outcome	Quintile 1 RR (95% CI)	Quintile 2 RR (95% CI)	Quintile 3 RR (95% CI)	Quintile 4 RR (95% CI)	Quintile 5 RR (95% CI)	P trend
DDS Median (IQR)	2.0 (2.0-2.3)	2.5 (2.5-2.7)	3.0 (3.0-3.0)	3.5 (3.3-3.5)	4.0 (4.0-4.5)	
Preterm birth (<37 weeks gestation)						
n/N	252/1550	201/1428	344/1765	149/1362	206/1448	
Univariate	ref	0.87 (0.73,1.03)	1.20 (1.03,1.39)*	0.67 (0.56,0.81)*	0.88 (0.74,1.04)	
Multivariate		0.87 (0.74,1.04)	1.24 (1.06,1.44)*	0.72 (0.60,0.88)*	0.97 (0.82,1.16)	0.24
Small for gestational age (<10th percentile for gest age/sex)						
n/N	245/1400	231/1284	266/1601	207/1221	171/1318	
Univariate		1.03 (0.87,1.21)	0.95 (0.81,1.11)	0.97 (0.82,1.15)	0.74 (0.61,0.89)*	
Multivariate		1.01 (0.86,1.19)	0.95 (0.81,1.11)	0.97 (0.82, 1.15)	0.74 (0.62,0.89)*	<0.01*
Low birth weight (<2,500 grams)						
n/N	114/1458	71/1359	107/1641	71/1287	85/1373	
Univariate		0.67 (0.50,0.89)*	0.83 (0.65,1.08)	0.71 (0.52,0.94)*	0.79 (0.60,1.04)	
Multivariate		0.66 (0.50,0.88)*	0.84 (0.65,1.08)	0.70 (0.53,0.94)*	0.80 (0.61,1.04)	0.11
Fetal loss (Spontaneous abortion, stillbirth)						
n/N	46/1550	34/1428	72/1765	41/1362	45/1448	
Univariate		0.80 (0.51,1.24)	1.37 (0.96,1.98)	1.01 (0.67,1.53)	1.05 (0.70,1.57)	
Multivariate		0.73 (0.46,1.15)	1.37 (0.95,1.98)	0.90 (0.58,1.40)	0.95 (0.62,1.45)	0.96

*** p <0.05; The median DDS during pregnancy was 3.0 (IQR: 2.5–3.5); Mean BMI (Q1vQ5: 24.4 v 24.8); 16.4% SGA**

Prime diet quality score (PDQS)

21 food groups (score range 0-42)

Healthy (14)	
dark green leafy vegetables	other vit A rich vegetables
cruciferous vegetables	other vegetables
whole citrus fruits	other fruits
fish	poultry
legumes	nuts
low fat dairy	whole grains
eggs	liquid vegetable oils
Unhealthy (7)	
red meat	processed meats
refined grains and baked goods	sugar sweetened beverages
desserts and ice cream	fried foods away from home
potatoes, roots and tubers	

PDQS

Healthy food groups:	Unhealthy food groups:
0–1 serving/week (0 points)	0–1 serving/week (2 points)
2–3 servings/week (1 point)	2–3 servings/week (1 point)
≥4 servings/week (2 points)	≥4 servings/week (0 points)

Evidence for:

- Cardiovascular disease [Fung et al, 2018; Alvarez-Alvarez et al, 2020]
- Gestational diabetes, hypertensive in pregnancy [Gisevic et al, 2018]

Women in q5 of PDQS had 45% lower risk of preterm and 47% lower risk of LBW and fetal loss vs. women in q1 in Tanzania

Clinical Outcome	Quintile 1 RR (95% CI)	Quintile 2 RR (95% CI)	Quintile 3 RR (95% CI)	Quintile 4 RR (95% CI)	Quintile 5 RR (95% CI)	P trend
PDQS Median (IQR)	16.0 (15.0-16.0)	18.0 (17.0-18.0)	19.0 (19.0-19.0)	20.0 (20.0-20.0)	22.0 (21.0-23.0)	
Preterm birth [2] (<37 weeks gestation)						
n/N	338/1732	347/2194	133/1022	192/1215	142/1390	
Univariate	ref	0.81 (0.71,0.93)*	0.67 (0.55,0.80)*	0.81 (0.69,0.95)*	0.52 (0.44,0.63)*	
Multivariate		0.82 (0.71,0.93)*	0.66 (0.55,0.80)*	0.82 (0.70,0.96)*	0.55 (0.46,0.67)*	<0.001**
Small for gestational age [3] (<10th percentile for gest age/sex)						
n/N	264/1605	338/1971	149/906	187/1110	182/1232	
Univariate		1.04 (0.90,1.21)	1.00 (0.83,1.20)	1.02 (0.86,1.22)	0.90 (0.76,1.07)	
Multivariate		1.04 (0.90,1.21)	0.97 (0.81,1.17)	1.01 (0.85,1.19)	0.91 (0.77,1.08)	0.26
Low birth weight [4] (<2,500 grams)						
n/N	145/1606	124/2067	56/962	58/1149	65/1334	
Univariate		0.66 (0.53,0.84)*	0.64 (0.48,0.87)*	0.56 (0.42,0.75)*	0.54 (0.41,0.77)*	
Multivariate		0.67 (0.53,0.84)*	0.63 (0.47,0.84)*	0.55 (0.41,0.74)*	0.53 (0.40,0.71)*	<0.001**
Fetal loss [5] (Spontaneous abortion, stillbirth)						
n/N	68/1732	71/2194	38/1022	30/1215	31/1390	
Univariate		0.82 (0.59,1.14)	0.95 (0.59,1.40)	0.63 (0.41,0.96)*	0.57 (0.37,0.86)*	
Multivariate		0.78 (0.56,1.09)	0.86 (0.57,1.30)	0.62 (0.40,0.95)*	0.53 (0.34,0.82)*	<0.01*

*** p <0.01, ** p<0.001; Mean BMI (Q1vQ5: 24.6 v 24.7); 15.3% PTB; 6.3% LBW; 3.2% fetal loss**

Maternal dietary factors and early child growth

Maternal & Child Nutrition

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PMID: 33595899

Prenatal dietary diversity may influence underweight in infants in a Ugandan birth-cohort

Isabel Madzorera,[1] Shibani Ghosh,[2,3] Molin Wang,[4] Wafaie Fawzi,[1,5] Sheila Isanaka,[1,5] Ellen Hertzmark,[5] Grace Namirembe,[2] Bernard Bashaasha,[6] Edgar Agaba,[3] Florence Turyashemererwa,[6] Patrick Webb,[2,3] and Christopher Duggan[1,7]

Infants of women in quartile 4 of MDD-W had 30% lower risk of developing underweight through age 12 months compared to infants of women in quartile 1

	Minimum Diet Diversity for Women (MDD-W)				
	Quartile 1	**Quartile 2**	**Quartile 3**	**Quartile 4**	**P for trend**
Scores	**(0-2)**	**(3)**	**(4)**	**(5-9)**	
Cases	66/720	61/1128	50/842	34/589	
Univariate model					
HR (95% CI)	1	0.63 (0.56,0.70)**	0.64 (0.57,0.73)**	0.65 (0.56, 0.74)**	
Multivariate model					
HR (95% CI)	1	0.65 (0.58,0.72)**	0.67 (0.59,0.75)**	0.70 (0.62, 0.80)**	<0.001***

**p <0.01, *** p<0.001

Multivariate adjusted for: maternal height, maternal age, marital status, maternal nutrition knowledge, maternal education, paternal education, maternal height, infant gender, household wealth index, breastfeeding, community connector program.

- **Median MDD-W score:** 3.0 (IQR 3.0-4.0); **Minimum diet diversity** (5+ food groups out of 10): 18%

Findings and Implications

- Low maternal dietary diversity and quality may be **modifiable risk factors** for adverse birth outcomes in Tanzanian mothers.
  - PDQS, a measure of maternal diet quality, was inversely associated with PTB, LBW and fetal loss.
  - DDS, a measure of dietary diversity, was inversely associated SGA.

- **LBW and SGA:** important predictors of child anthropometric growth (stunting, wasting and underweight)

- MDD-W index associated with a significantly lower risk of underweight in infants
  - No significant associations between MDD-W index and stunting or wasting in infants

- **Dietary diversity and diet quality should both be considered as important risk factors for poor birth outcomes; may be important for early child growth**

Adolescent diets and nutrition status

Dietary intake and quality for young adolescents in sub-Saharan Africa: Status and Influencing factors

Isabel Madzorera[1], Sabri Bromage[2], Mary Mwanyika-Sando[3], Alain Vandormael[4], Huda Sherfi[5], Amare Worku[6], Sachin Shinde[1], Ramadhani Abdallah Noor[1], Till Baernighausen[4], Deepika Sharma[7], Wafaie W. Fawzi[1, 2, 8]

Cross-sectional, school-based Adolescent Health and Nutrition Study

4 SSA sites:
Ouagadougou (Burkina Faso)
Addis Ababa (Ethiopia)
Khartoum (Sudan)
Dar es Salaam (Tanzania)

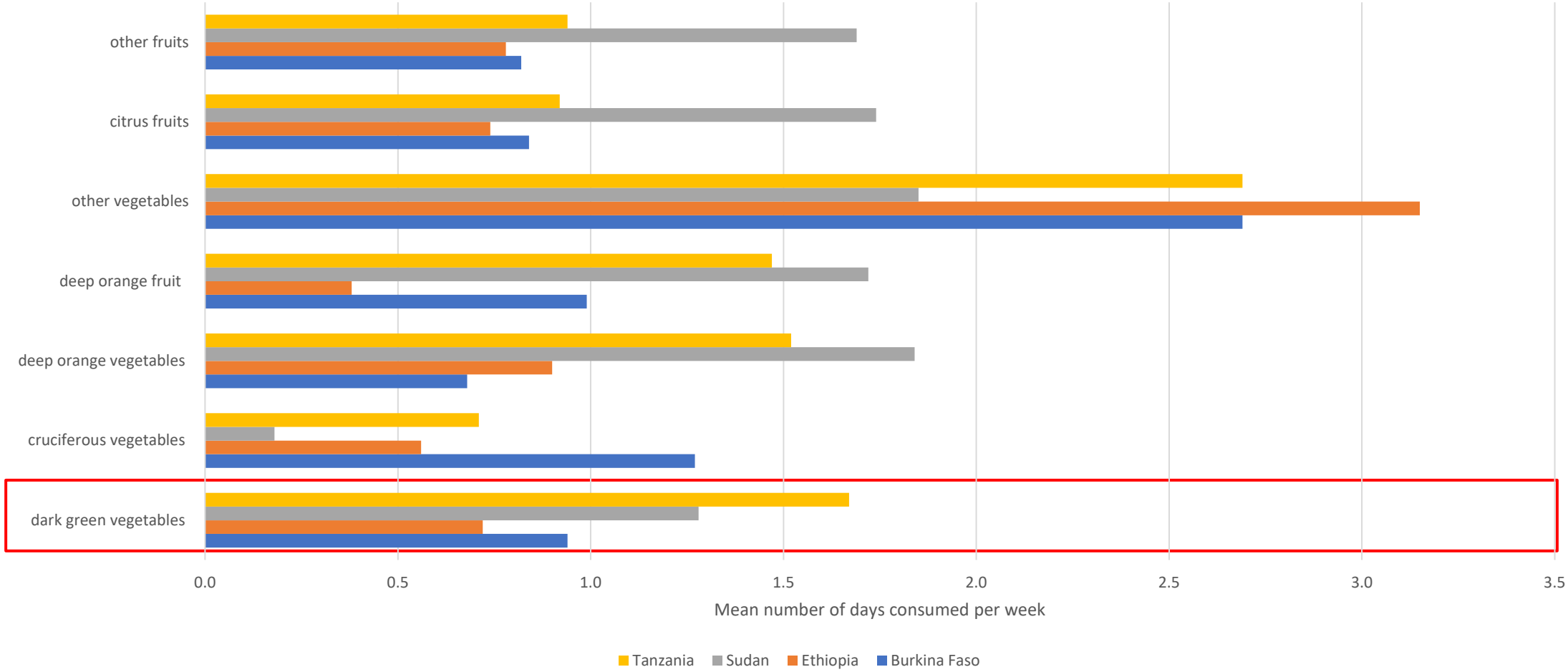
4,609 school-going adolescents aged 10-15 years

Africa Research Implementation Science and Education (ARISE) Network

Adolescent diets: locally adapted 7-day food frequency questionnaire (FFQ)
Diet quality: assessed using ***Global Diet Quality Score (GDQS)***

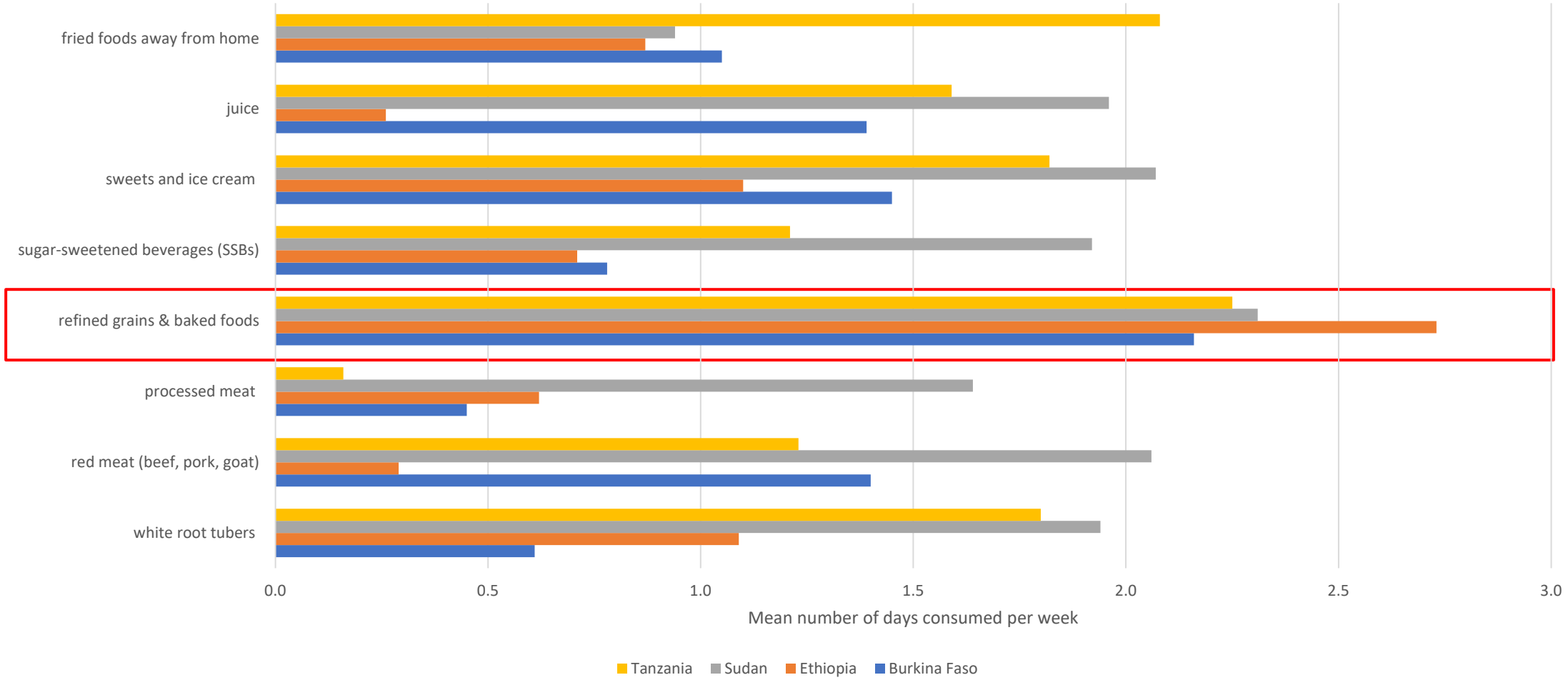
Madzorera et al., in preparation 2022

Low weekly consumption of fruits and vegetables overall by adolescents (10-15 years) in Burkina Faso, Ethiopia, Sudan and Tanzania



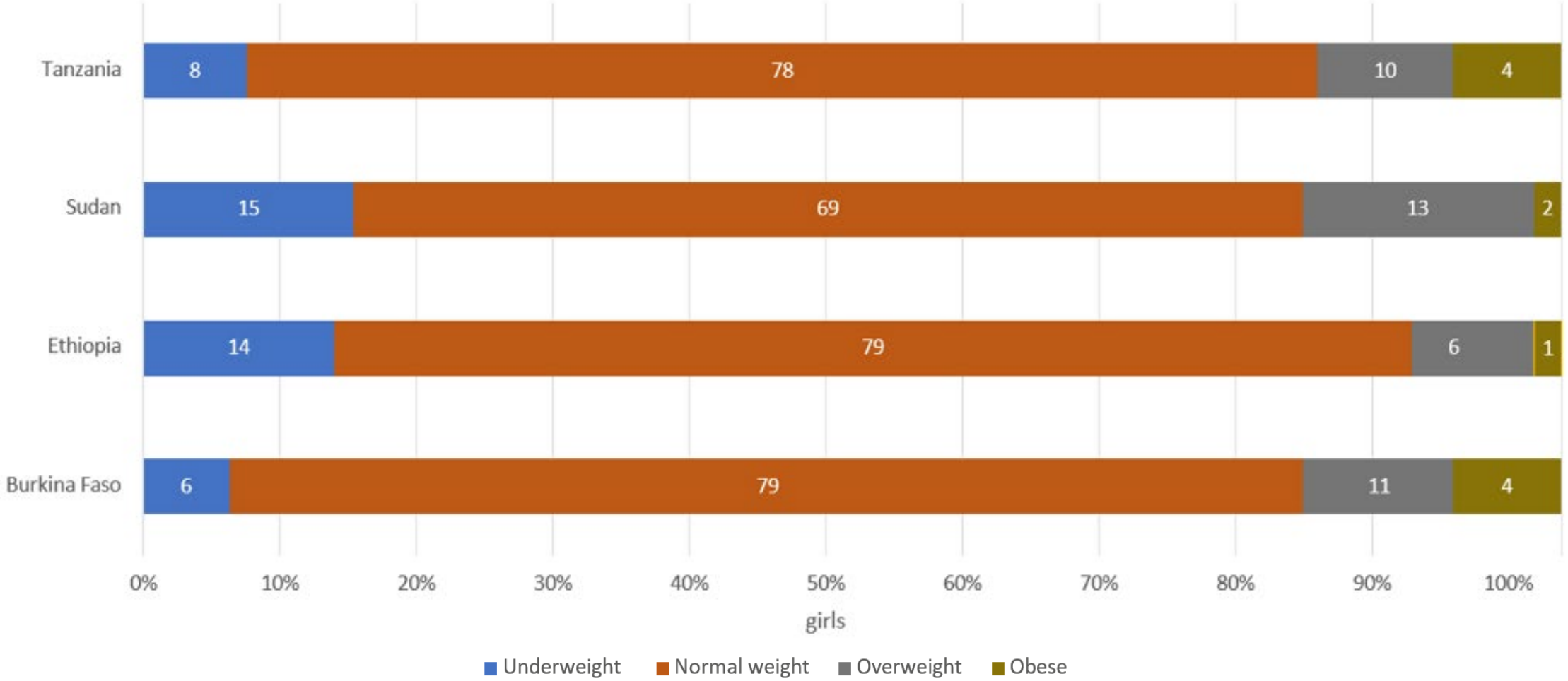
Madzorera et al., in preparation 2022

Mean weekly frequency of consumption of unhealthy foods by adolescents (10-15 years) in Burkina Faso, Ethiopia, Sudan and Tanzania



Madzorera et al., in preparation 2022

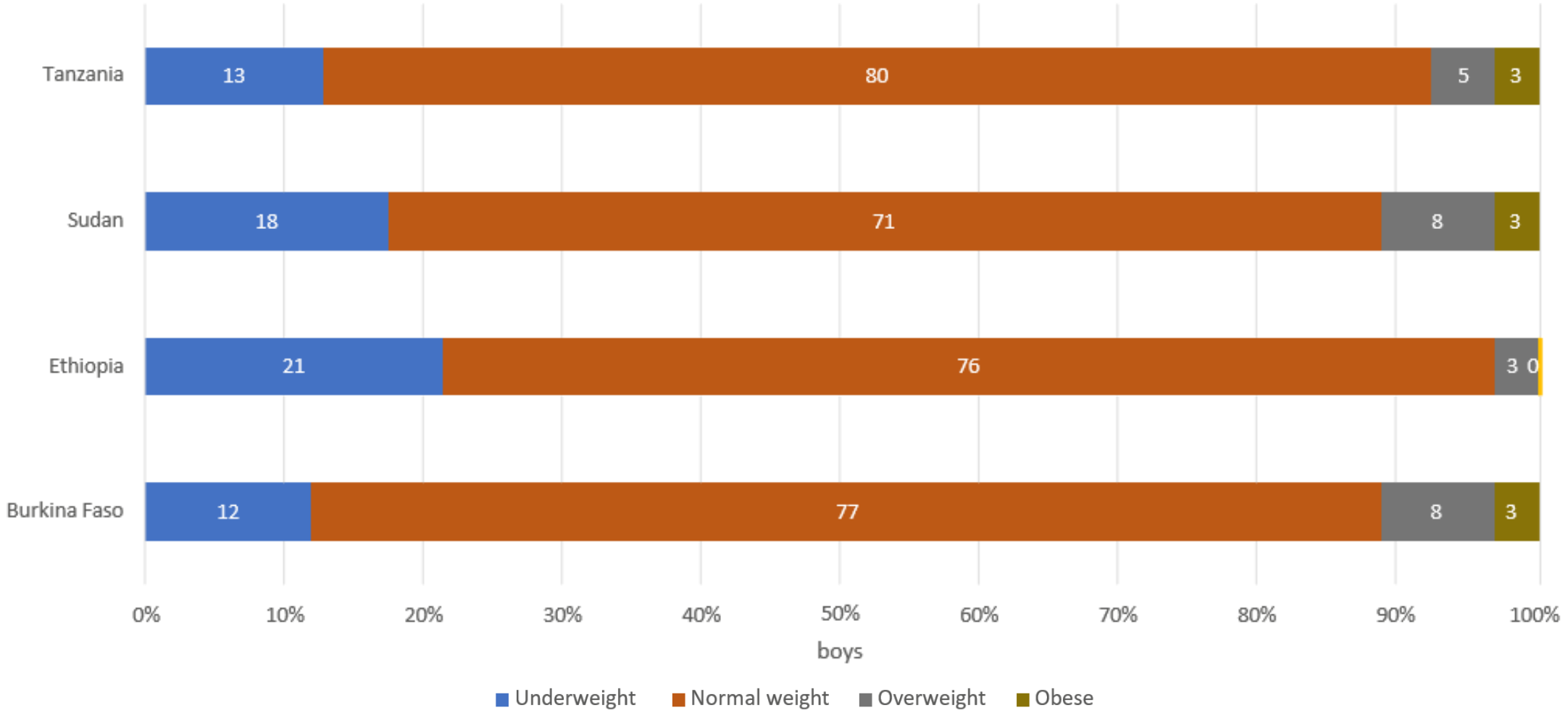
Nutritional profile of adolescent girls in Burkina Faso, Ethiopia, Sudan and Tanzania



Overweight and obesity> 13% in 3 countries and underweight >13% in 2 countries

Madzorera et al., in preparation 2022

Nutritional profile of adolescent boys in Burkina Faso, Ethiopia, Sudan and Tanzania



Overweight and obesity> 10% in 2 countries and underweight> 18% in 2 countries

Madzorera et al., in preparation 2022

Findings and Implications

- Evidence of poor-quality adolescent diets, gender and age differences in the consumption of healthy diets.
  - **Low:** Consumption of vegetables, fruit, nuts and seeds, eggs, fish and poultry
  - **Higher:** Consumption of refined grains
  - Adolescent boys consumed unhealthy foods less frequently but consumed fewer cruciferous vegetables and deep orange tubers.

- Factors associated with adolescent diet quality (GDQS)
  - maternal unemployment ↓
  - physical activity ↑
    - adolescents reported physical activity on 2 (±2) days/week.

- Poor quality diets providing insufficient fruits, vegetables and animal source foods (ASFs) and increasing consumption of unhealthy foods may be exposing African adolescents to the double burden of malnutrition.

Next questions

- What are the metrics and tools available to assess diet quality in children and adolescents?
- Validation of tools: How is diet quality associated with the triple burden of malnutrition in children and adolescents?
- What interventions in food systems can improve diet quality and address the triple burden of malnutrition for children and adolescents
  - Concurrently addressing micronutrient deficiencies, undernutrition and overweight/obesity and future risk of diet-related chronic diseases

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