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The U.S. Government's Global Hunger & Food Security Initiative

## Diet diversity during pregnancy and infant growth outcomes in Uganda

Isabel Madzorera, Shibani Ghosh, Molin Wang, Wafaie W. Fawzi, Sheila Isanaka, Ellen Hertzmark, Bernard Bashaasha, Edgar Agaba, Florence Turyashemererwa, Grace Namirembe, Patrick Webb, Christopher P. Duggan



**Isabel Madzorera, ScD**  
**Nutrition Innovation Lab, Harvard University**

*Photo credit: FAO*



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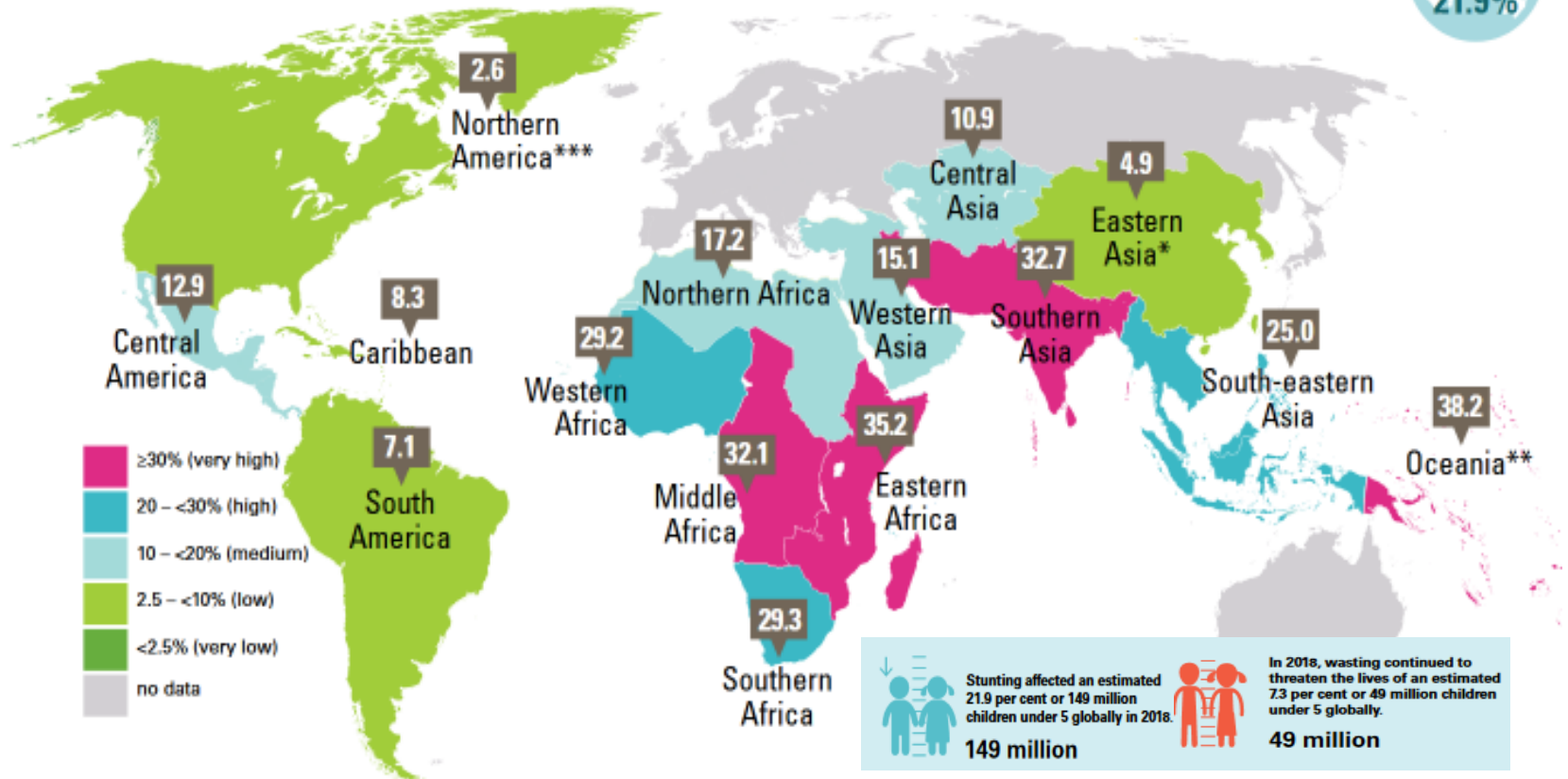


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Percentage of stunted children under 5, by United Nations sub-region, 2018

GLOBAL  
21.9%



UNICEF, 2019



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## Maternal diets are important

- **Women have poor diets (LMICs)**
  - monotonous, plant-based, limited animal foods, seasonal fruits and vegetables, poor bioavailability
  - [Arimond et al, 2012; Ruel et al, 2003; Torheim et al, 2010]
- **Micronutrient deficiencies prevalent - Africa, Asia and Latin America**
  - anemia, Vit A deficiency (women and children)
  - pregnant women – Vit A, C, niacin, thiamine and zinc [Torheim et al, 2010]
- **Demand for simple measures of diet quality**
  - Costs of consumption surveys, national surveillance



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## Study aim

Examine associations between prenatal maternal diet diversity with incidence of stunting, wasting and underweight in infants 3 to 12 months of age.



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## Study setting and population

- Parent study: Uganda Community Connector Program
- Cluster randomized integrated agriculture-nutrition program
- Study population: Nutrition innovation lab birth cohort
- 16 districts: 9 Northern and 6 Southwestern Uganda
- 4,951 pregnant women
- Nov, 2012 - June, 2014



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## Study procedures

### Inclusion:

- Woman aged 15-49 years
- Residence in study area for study duration
- Pregnancy confirmed, urine test

### Exclusion:

- >27 weeks gestation
- Pregnancy surveillance system, Village Health Workers

Prospectively followed from pregnancy until infants 12m

Time point	Description
1	Prenatal 1
2	Prenatal 2
3	0-3 weeks
4	3 mos
5	6 mos
6	9 mos
7	12 mos





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## Primary Exposure

Introducing the Minimum Dietary Diversity – Women (MDD-W)

Global Dietary Diversity Indicator for Women

Washington, DC, July 15–16, 2014



### 10 Food groups

1. Starchy staples
2. Beans and peas
3. Nuts and seeds
4. Dairy
5. Flesh foods
6. Eggs
7. Vit A rich dark green vegetables
8. Other vit A rich fruits & vegetables
9. Other vegetables
10. Other fruits

Food and Agriculture Organization (FAO), 2016



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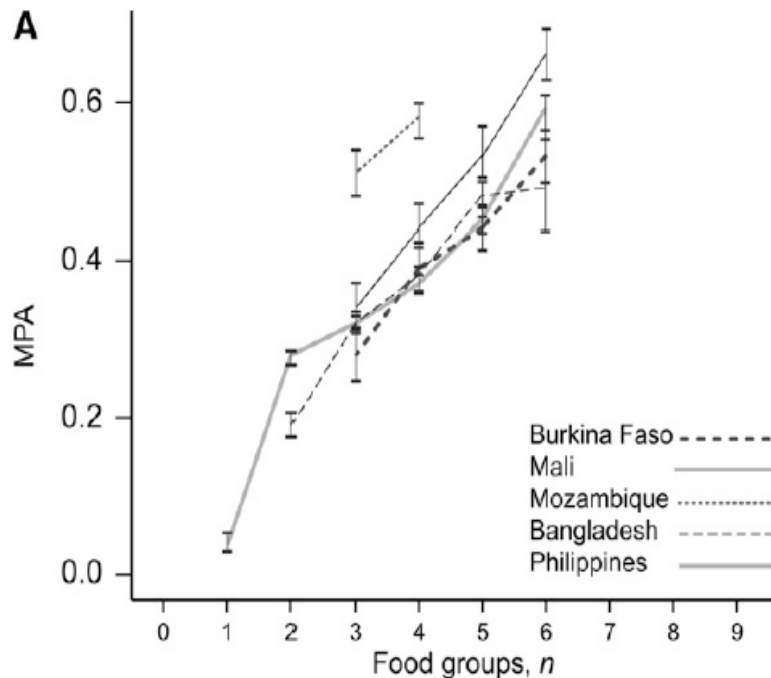
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## Minimum Diet Diversity For Women (MDD-W)



Our study:

- Single 24-hour dietary recall
- Foods classified into food groups
- MDD-W: sum of food groups
- Quartiles of diet diversity scores

**Mean Probability of Adequacy (MPA):** probability of adequacy for 11 micronutrients (Arimond, 2010)





## Outcomes

### 1. Stunting

- Length for age Z-score (LAZ)

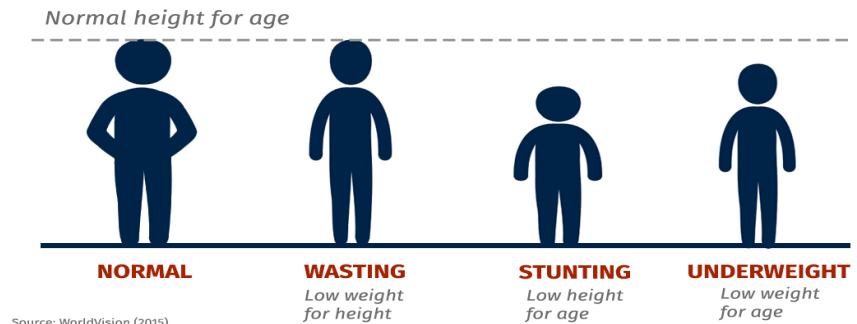
### 2. Wasting

- Weight for length Z-score (WLZ)

### 3. Underweight

- Weight for age Z-score (WAZ)

- WHO growth standards (2006)
  - < -2 Standard Deviations





## Statistical Approach

Associations between prenatal maternal diet diversity with incidence of stunting, wasting, and underweight in infants 3 to 12 months

- Cox regression models, exact method for ties
- Did not exclude infants with the outcome at baseline (3 months)
- **Exposures:** MDD-W
- **Estimate:** Hazard ratios (HR) of stunting, wasting and underweight
- **Other:** Proportional hazards ratio test, Trend test
- **Potential confounders:** maternal age, marital status, maternal nutrition knowledge, maternal education, paternal education, maternal height, infant gender, household wealth index, breastfeeding
- **Selection of confounders:** Univariate significance at  $P < 0.20$
- A priori factors suggested by the literature (e.g. maternal height)
- **Adjusted:** clustering by sub-county, community connector program



## Baseline characteristics of pregnant women in Uganda birth cohort (N=3,291)

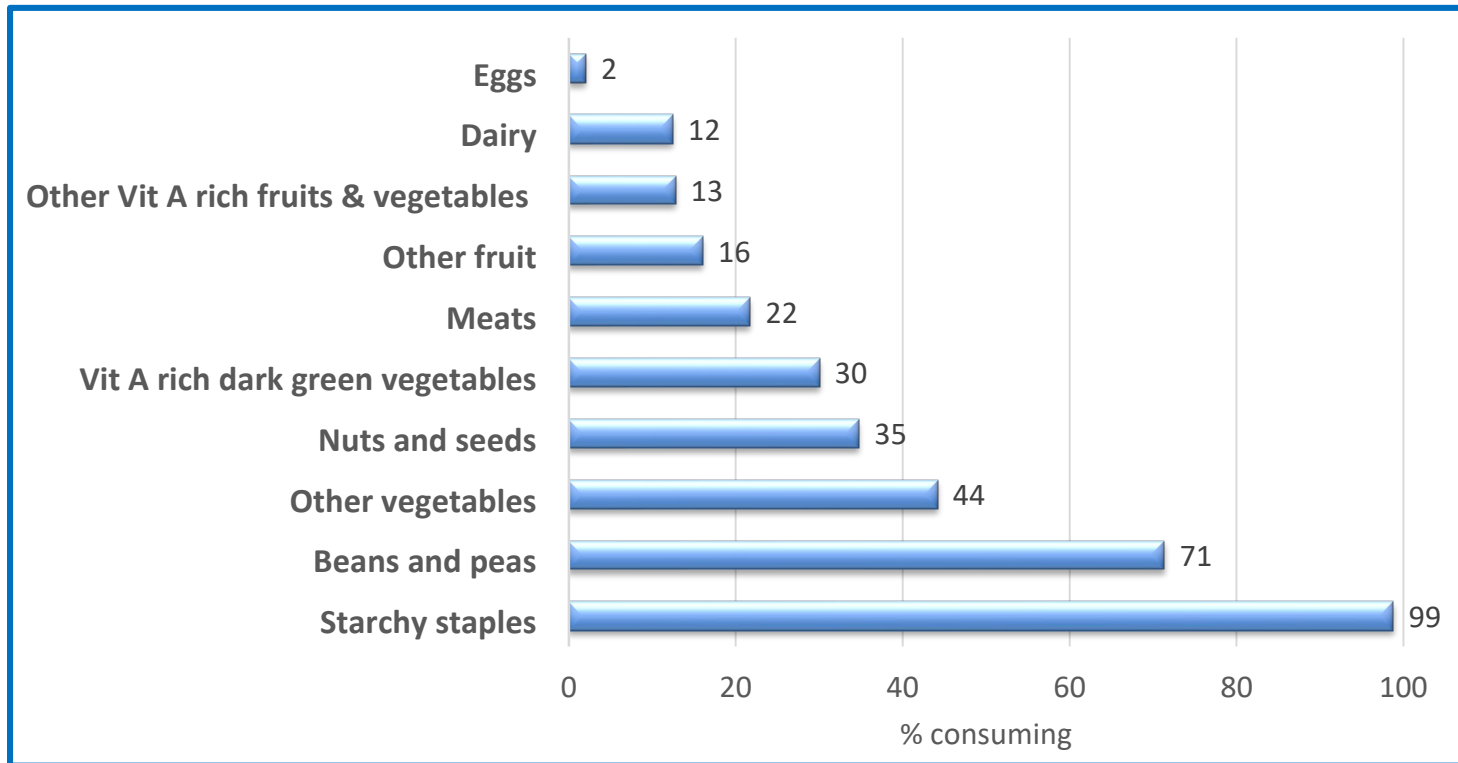
Characteristics	Minimum diet diversity for women (MDD-W) score			
	Quartile 1	Quartile 2	Quartile 3	Quartile 4
	N=725	N=1130	N=843	N=593
	(0-2)	(3)	(4)	(5-9)
	N(%)	N(%)	N(%)	N(%)
Woman is head of household	72 (9.9)	71 (6.3)	47 (5.6)	26 (4.4)**
Age, years (mean, SD)	25.4±6.3	25.6±6.2	25.6±6.2	25.4±5.9
Maternal education - None or primary	509 (70.2)	779 (68.9)	582 (69.0)	324 (54.6)**
Paternal education - None or primary	363 (50.0)	574 (50.4)	401 (47.6)	279 (40.5)*
<b>Household characteristics</b>				
Community connector participation	443 (61.1)	563 (49.8)	376 (44.6)	273 (46.0)**
Wealth index				
Tertile 1	315 (43.5)	479 (42.4)	381 (45.2)	183 (30.9)**
Tertile 2	246 (33.9)	377 (33.4)	250 (29.7)	187 (31.5)**
Tertile 3	164 (22.6)	274 (24.3)	212 (25.2)	223 (37.6)**
Household fuel is wood	692 (95.5)	1062 (94.0)	790 (93.7)	523 (88.2)**
Household has electricity	7(1.0)	10(0.9)	15 (1.8)	21 (3.5)**
Improved pit latrine or flush toilet	14 (1.9)	36 (3.2)	36 (4.3)	43 (7.3)**



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## Consumption of food groups in the previous 24 hours by pregnant women



Median MDD-W score: 3.0 (IQR 3.0-4.0)

Minimum diet diversity (5+ food groups out of 10): 18%



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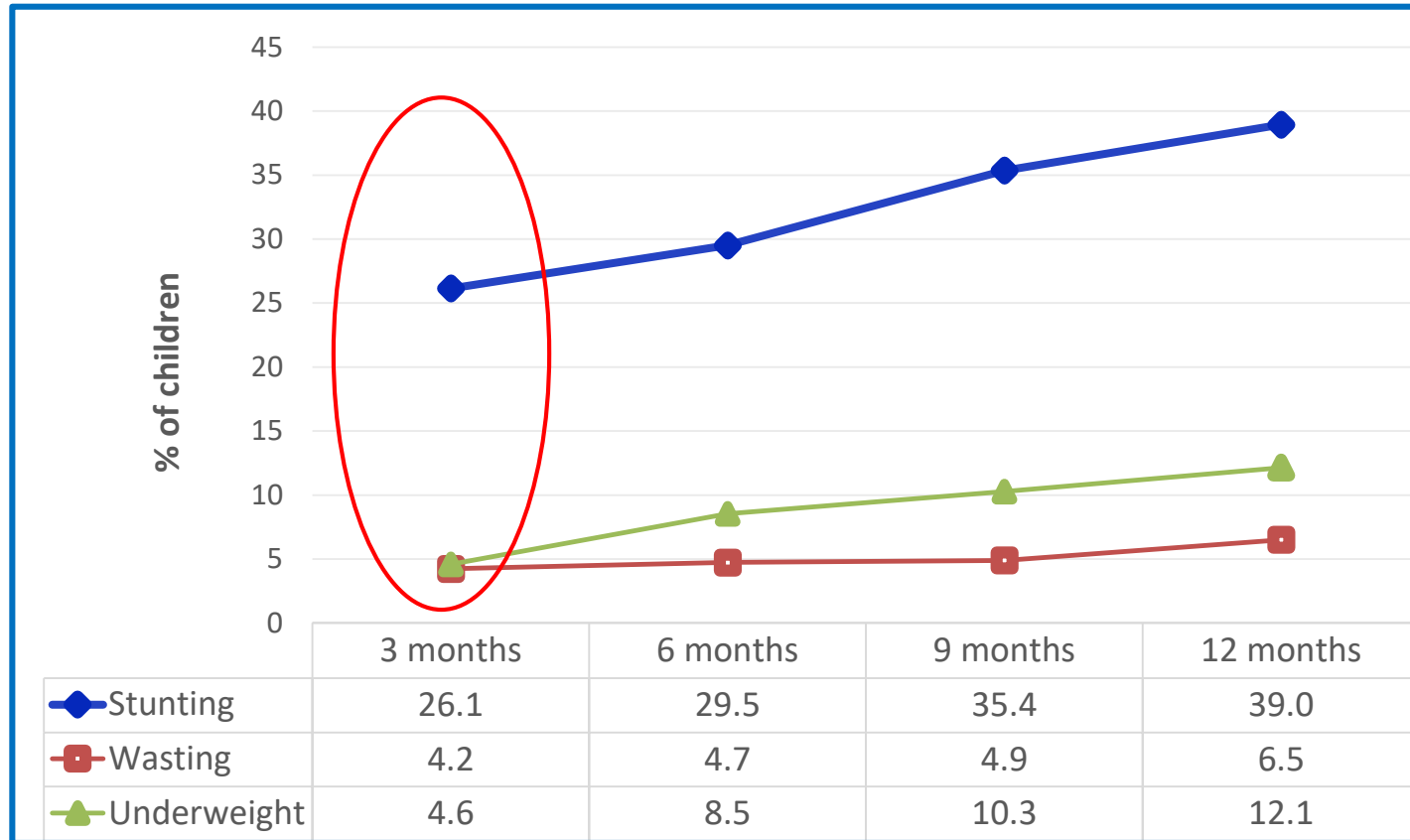
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## Prevalence of undernutrition in infants born to women in Uganda birth cohort



**Infants of women in Q4 of MDD-W had 30% lower risk of developing underweight through age 12 months compared to infants of women in Q1**

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					<0.001**
HR (95% CI)	1	0.65 (0.58,0.72)**	0.67 (0.59,0.75)**	0.70 (0.62, 0.80)**	

**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.



## Cox hazards models for incidence of **stunting** in infants 3-12 months by prenatal MDD-W

Outcomes	Maternal diet diversity score (MDD-W )				P for trend
	Quartile 1 (0-2)	Quartile 2 (3)	Quartile 3 (4)	Quartile 4 (5-9)	
Cases	188/707	301/1106	240/824	144/583	
<b>Univariate HR (95% CI)</b>					
3 months	1	0.95 (0.87,1.04)	1.02 (0.93,1.12)	0.99 (0.89,1.10)	
6 months	1	0.90 (0.85,0.97)*	0.93 (0.86,1.00)	0.95 (0.88,1.04)	
9 months	1	0.86 (0.79,0.95)*	0.84 (0.76,0.94)*	0.92 (0.82,1.03)	
12 months	1	0.82 (0.71,0.95)*	0.77 (0.66,0.91)*	0.89 (0.75,1.06)	
<b>Multivariate HR (95% CI)</b>					<b>0.14</b>
3 months	1	0.94 (0.86,1.03)	1.00 (0.91,1.11)	0.98 (0.88,1.09)	
6 months	1	0.91 (0.85,0.98)*	0.94 (0.87,1.01)	0.97 (0.89,1.05)	
9 months	1	0.89 (0.81,0.98)*	0.88 (0.79,0.98)*	0.95 (0.85,1.07)	
12 months	1	0.86 (0.74,1.00)*	0.82 (0.70,0.96)*	0.94 (0.79,1.11)	

## Cox hazards models for incidence of wasting in infants 3-12 months by prenatal MDD-W

Outcomes	Maternal diet diversity score (MDD-W )				P for trend
	Quartile 1 (0-2)	Quartile 2 (3)	Quartile 3 (4)	Quartile 4 (5-9)	
Cases	39/676	43/1061	30/805	18/556	
<b>Univariate HR (95% CI)</b>					
3 months	1	0.63 (0.50,0.80)*	0.60 (0.46,0.77)*	0.86(0.66, 1.12)	
6 months	1	0.70 (0.60,0.81)*	0.77 (0.70,0.88)*	0.35 (0.77,1.12)	
9 months	1	0.76 (0.63,0.92)*	0.91 (0.74, 1.12)	1.00 (0.80, 1.25)	
12 months	1	0.83 (0.61,1.12)	1.12 (0.83,1.53)	1.08 (0.78,1.50)	
<b>Multivariate HR (95% CI)</b>					0.68
3 months	1	0.62 (0.50, 0.78)*	0.61 (0.47, 0.79)*	0.91 (0.69,1.19)	
6 months	1	0.69 (0.59, 0.81)*	0.74 (0.63, 0.89)*	0.97 (0.80,1.17)	
9 months	1	0.76 (0.63, 0.92)*	0.91 (0.74,1.12)	1.04 (0.83,1.29)	
12 months	1	0.84 (0.63,1.13)	1.12 (0.82,1.52)	1.11 (0.80,1.54)	



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## Limitations

- Dietary intake was measured once (2<sup>nd</sup> and 3<sup>rd</sup> trimesters)
- Loss to follow up 12-month
- Exclude birth measures of weight and length
- Possible residual, unmeasured confounding
  - pregnancy weight gain
  - gestational age (no ultrasound)

## Strengths

- Large sample size
- Detailed anthropometric data at several time points during infancy
- First time MDD-W has been linked with infant growth outcomes



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## Discussion

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

Differences in associations:

- stunting - long term exposures; wasting - acute response; underweight - composite
- differences in aetiology

## Conclusion

Infants whose mothers were in the higher dietary diversity group had 30-35% lower risk of developing underweight through age 12 months

Further research is required on role of maternal diets during pregnancy on other infant growth outcomes in diverse locations



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