

The Role of Diet in Early Child Development: Evidence From Nepal

February 3, 2021

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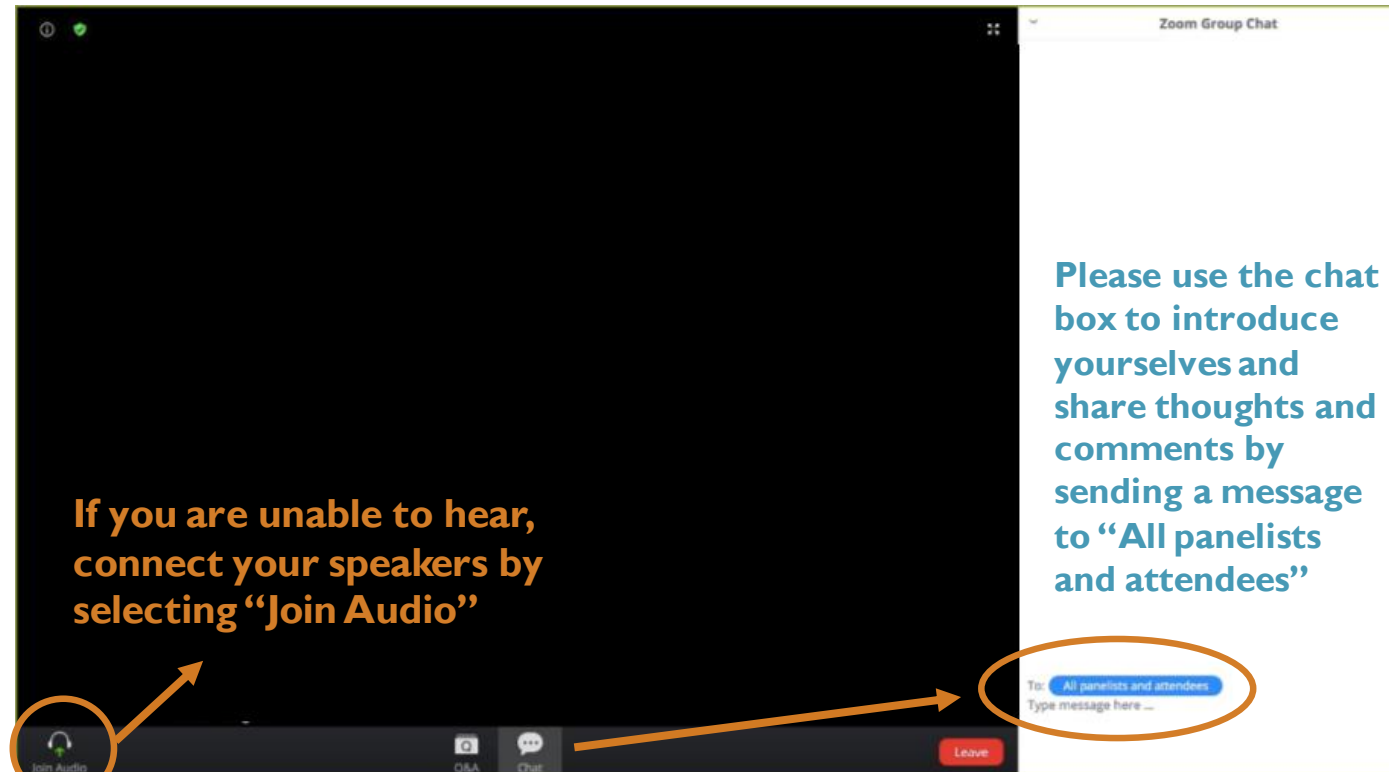
Shibani Ghosh



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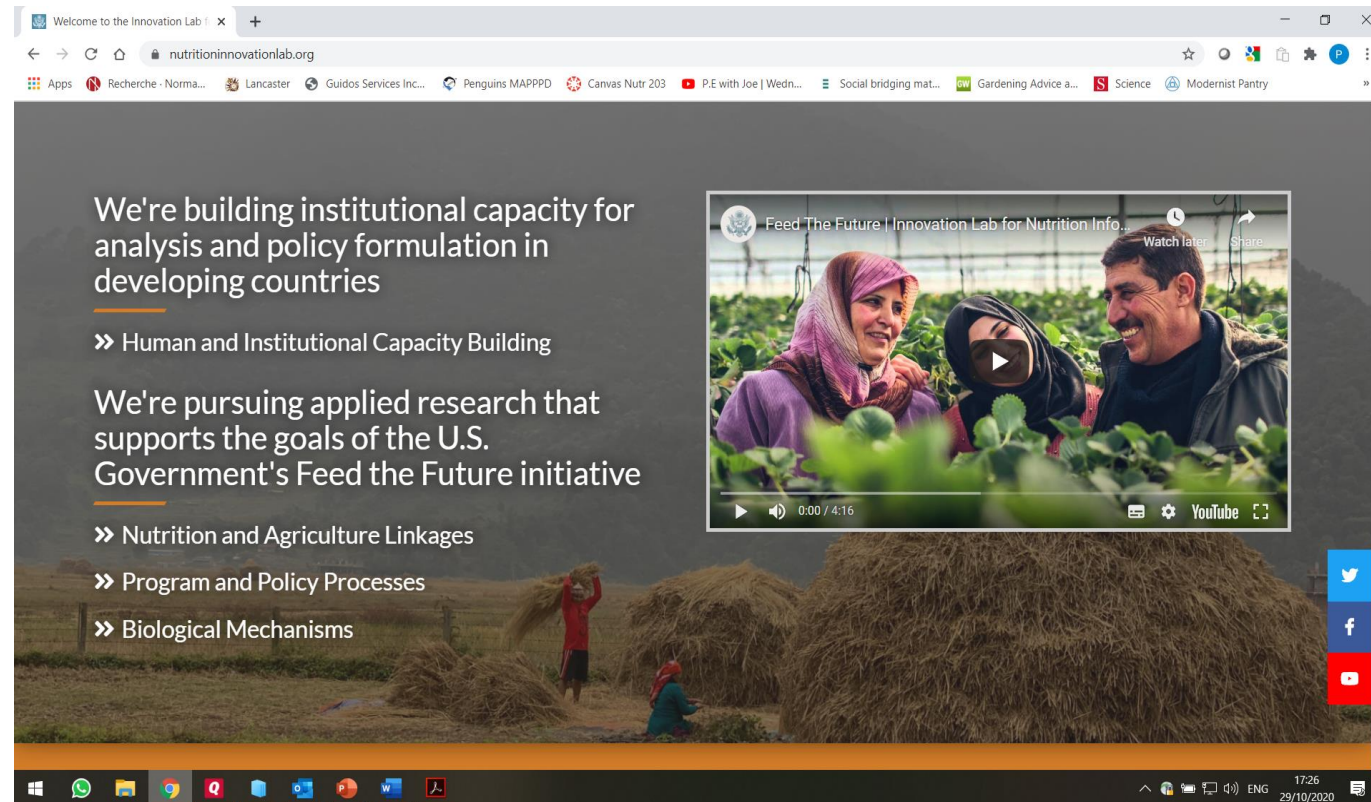
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The screenshot displays a Zoom meeting interface. On the left, a large black area contains the text: **Submit your questions for the panelists in the Q&A box**. An orange arrow points from the 'Q&A' icon in the bottom toolbar to a white 'Q&A' box. This box contains a 'Welcome' message and a text input field labeled 'Type your question here...'. On the right, a 'Zoom Group Chat' window is open, showing a list of recipients: 'All panelists' (selected) and 'All panelists and attendees'. A blue arrow points from the 'All panelists' selection to the chat text area, which contains the instruction: **If you're having any technical difficulties, please send a message to "All panelists" via the chat box and we will do our best to help resolve your issue**. The bottom toolbar includes 'Audio Setting', 'Q&A', 'Chat', and 'Leave' buttons.

FEED THE FUTURE INNOVATION LAB FOR NUTRITION



The screenshot shows a web browser window with the URL nutritioninnovationlab.org. The page features a dark background with white text. On the left, there is a list of bullet points under the heading "We're pursuing applied research that supports the goals of the U.S. Government's Feed the Future initiative". On the right, there is a video player showing a man and a woman in a field. The video player has a play button and a progress bar. Below the video player, there are social media icons for Twitter, Facebook, and YouTube. The bottom of the browser window shows the Windows taskbar with various application icons and the system clock.

Welcome to the Innovation Lab | x

nutritioninnovationlab.org

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- » Human and Institutional Capacity Building

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- » Biological Mechanisms

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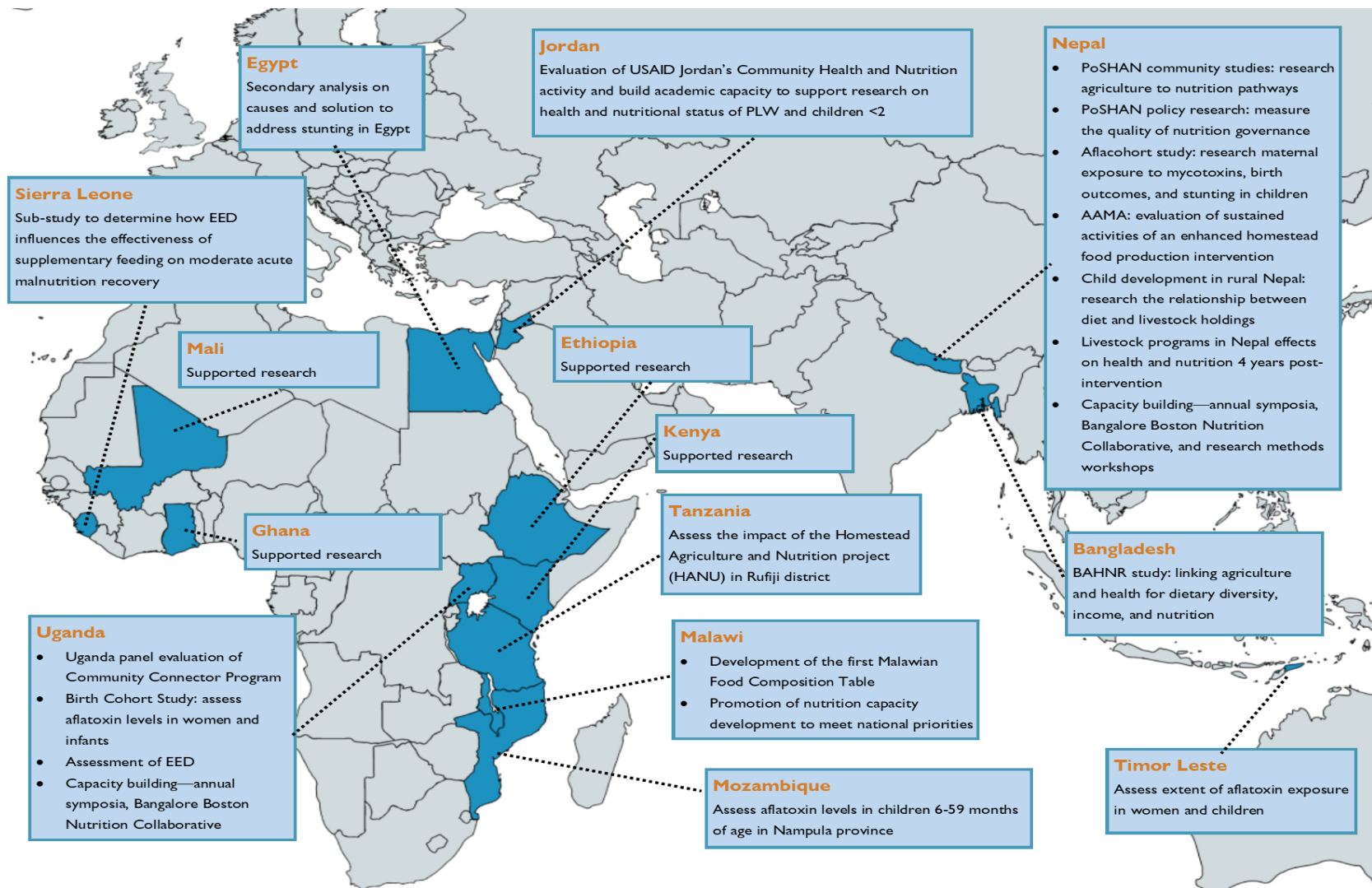
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INNOVATION LAB FOR NUTRITION
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WEDNESDAY, FEBRUARY 3RD
9:00AM - 10:30AM (ET)

The Role of Diet in Early Child Development: Evidence from Nepal



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Friedman School of
Nutrition Science and Policy



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Setting the Stage: Why Child Development within the Nutrition Innovation Lab Research?

Dr. Andrew Thorne-Lyman, ScD, MHS
Associate Scientist, Johns Hopkins University



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WHY CHILD DEVELOPMENT AS AN INDICATOR?

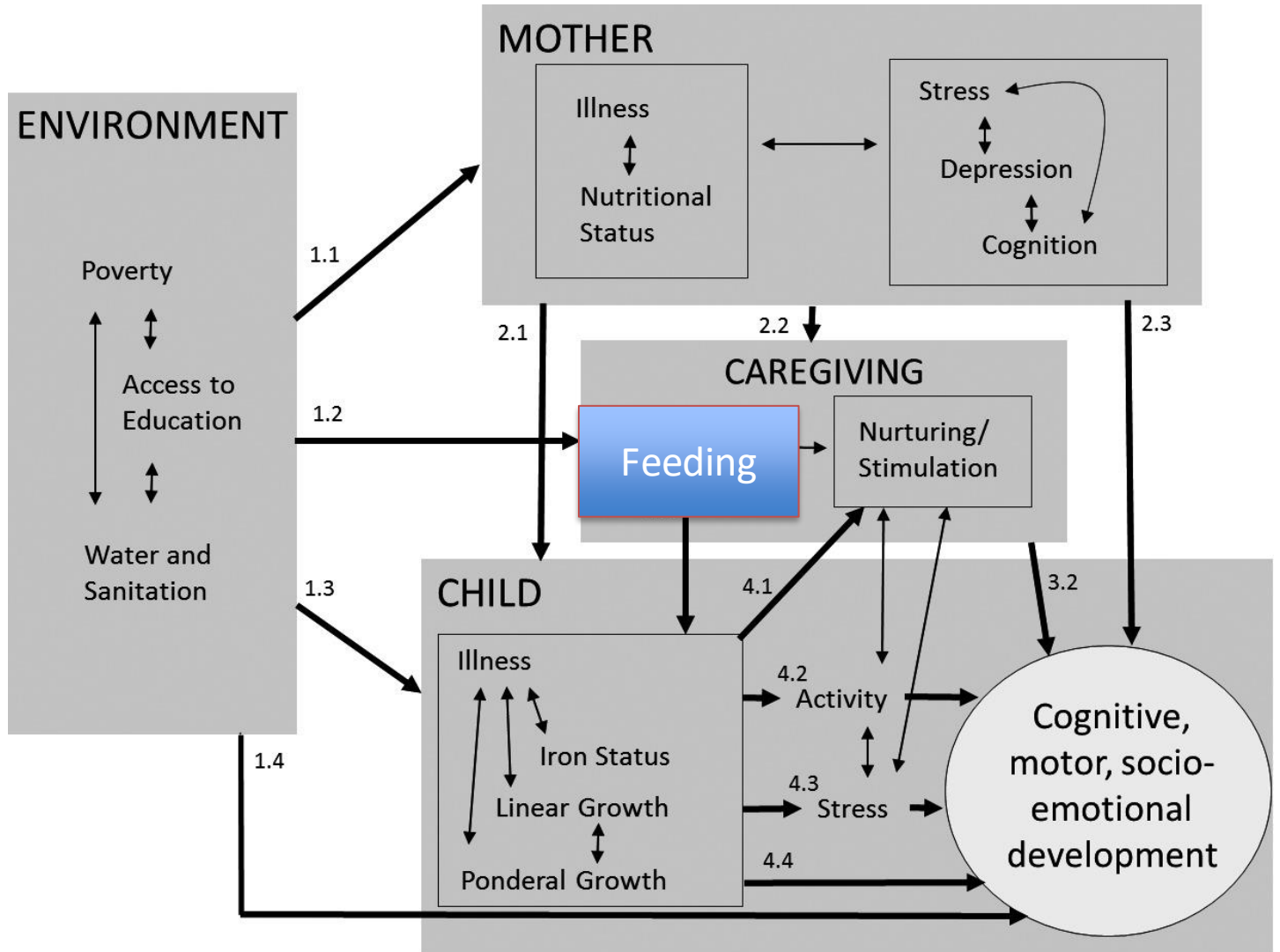
- Stunting has been front and center
 - Strong relationship with poverty
 - Women's height a risk factor for adverse birth outcomes
 - Proxy for 'grey matter infrastructure.' (*but imperfect*)
- What if you could measure child development directly?
 - Until recently has been difficult to do in rural settings



<https://www.saskwellness.com/food-and-mood-how-food-affects-your-brain-health/>



Child development
is adversely
influenced by
multiple facets of
poverty



RATIONALE FOR THE WORK IN NEPAL

- Few studies done in rural South Asia on the relationships between environmental factors and child development
- Access to field friendly tools opened up the possibility of exploring relationships outside of urban/peri-urban areas
 1. Could we integrate child development measures into broader assessments related to nutrition and agriculture in rural settings?
 2. Are the relationships strong enough to be captured even with the tools available?
 3. What relationships are observed with diet, environment, maternal factors and child development?

A MULTI DISCIPLINARY TEAM OF COLLABORATORS

Institute of Medicine at Tribhuvan University

- Dr. Merina Shrestha
- Dr. Prakash Sundar Shrestha
- Dr. Laxman Shrestha
- Dr. Ram Chandyo
- Dr. Manjuswari Ulak

IFPRI

- Sumanta Neupane

Heifer International and Heifer Nepal

- Mahendra Lohani
- Neena Joshi

International colleagues

- Dr. Tor Strand, U. Bergen
- Dr. Mari Hysing, U. Bergen
- Dr. Ingrid Kvested, Regional Center for Child and Youth Mental Health and Child Welfare, NORCE Norwegian Research Centre, Bergen Norway
- Dr. Wafaie Fawzi, Harvard T.H. Chan School of Public Health

Ages and Stages Questionnaire 3rd Edition

Dr Merina Shrestha, Associate Professor
Tribhuvan University Teaching Hospital, Kathmandu, Nepal



CHILD DEVELOPMENT

- Basic science of child health care.
- Biologic, psychological and emotional changes:
 - Birth till adolescence; from individual progresses dependency to autonomy.
- Continuous process with a predictable sequence but rate may vary.
- Health assessment is incomplete without assessment of development.



- Growth: Increase in Size and Number
- Development: Maturation



DEVELOPMENTAL ASSESSMENT TOOLS

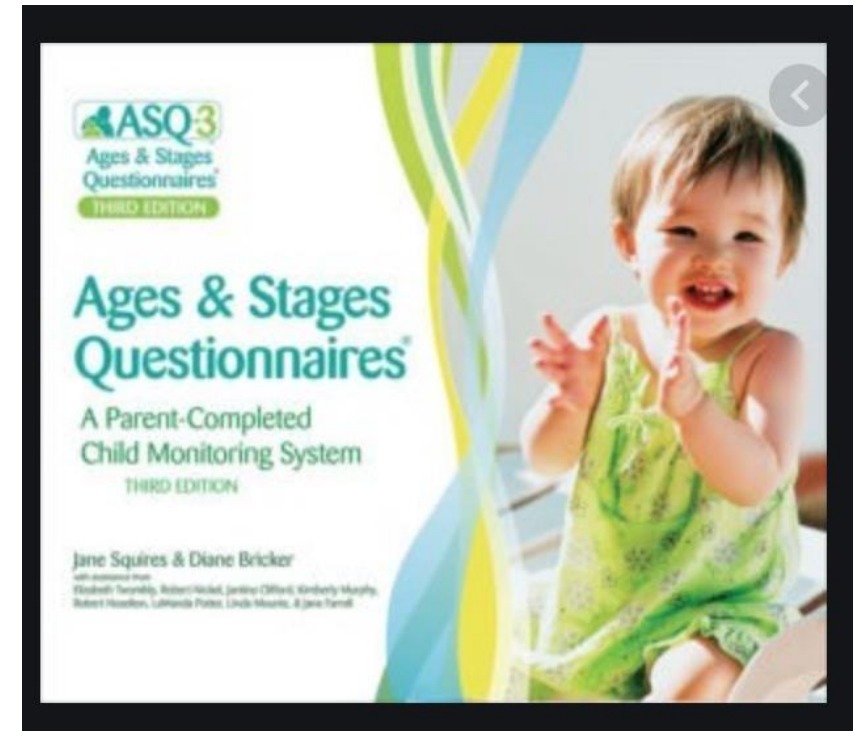
- Parents' evaluation of developmental status (PEDS)
- Modified checklist for autism in toddlers (M-CHAT)
- Denver developmental screening test
- Ages and stages questionnaire (ASQ)
- Bayley Scales of Infant Development



- Child development, which least prioritized in LMCIs, is now getting attention.
- American Academy of Pediatrics recommends developmental screening at 9, 18 or 24/30 months in all well baby visits.

ASQ-3

- ASQ: global developmental screening tool
- Translated in 23 different languages and is being used in diverse cultural settings
- 21 questionnaires
2,4,6,8,9,10,12,14,18,20,22,24,27,30,33,36,
42,48,54 and 60 months
- Can be completed by
 - Parents/ caregivers (4th to 6th standard)
 - Professionals
 - Together in collaboration





WHAT DOES ASQ TEST?

- Communication
- Gross Motor
- Fine Motor
- Problem Solving
- Personal Social

ADAPTATION OF ASQ IN LOCAL CONTEXT

- Translation and Back Translation
- Use of locally available tools for assessment





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SITES



TRAINING OF FIELD WORKERS

- Overview of child development
- Discussion on the ASQ questionnaire
- Hands – on training
- Standardization exercises





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CHALLENGES

- Younger age group
- Wide range of questionnaires across the ages
- Training and quality control (need refresher training)



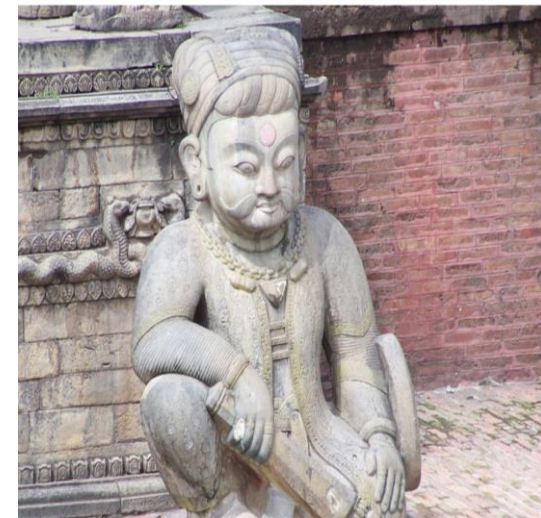
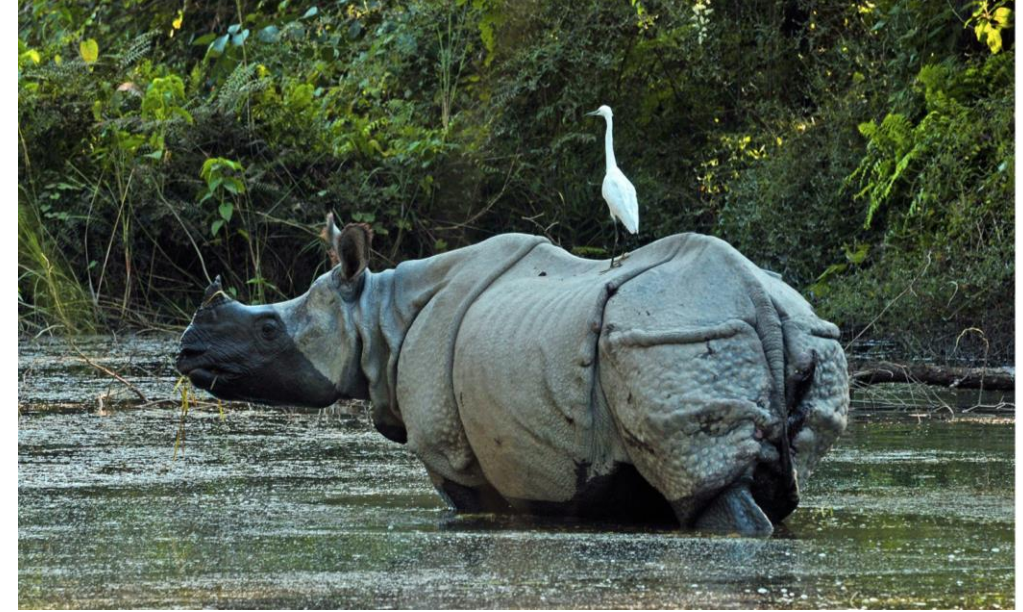
OPPORTUNITIES

- Does not need highly skilled manpower
- Less time consuming
- Local available tools and easy to administer
- Large scale studies



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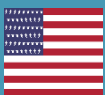


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Dietary Quality over Time is Associated with Better Development in Young Rural Nepali Children

LC Miller, AL Thorne-Lyman, N Joshi, M Shrestha, Su Neupane, Sh Neupane, M Lohani



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BACKGROUND

- The associations between child diet and developmental status in resource-poor settings remain incompletely understood
- These relationships are seldom examined longitudinally



RESEARCH QUESTIONS

- Is dietary quality associated with better child development in young rural Nepali children?
- What is the nature of these relationships in early childhood?
- Which other household factors important?
- Are there age-related differences in these relationships?

METHODS



Longitudinal study nested within a community development intervention trial in Banke (implemented by Heifer Nepal)





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	48 months					
	1	2	3	4	5	6
HH demographics	✓	✓	✓	✓	✓	✓
Anthropometry	✓	✓	✓	✓	✓	✓
Diet recall	✓	✓	✓	✓	✓	✓
Developmental testing*			✓			✓
Home child-rearing quality^						✓

*Ages and Stages
Questionnaire

^Multiple Indicator Cluster Survey,
UNICEF





CHILDREN WITH DEVELOPMENTAL TESTING

- Midline: all children (n=307) age **23-38** months



- Endline: all children (n=629) age **23-66** months

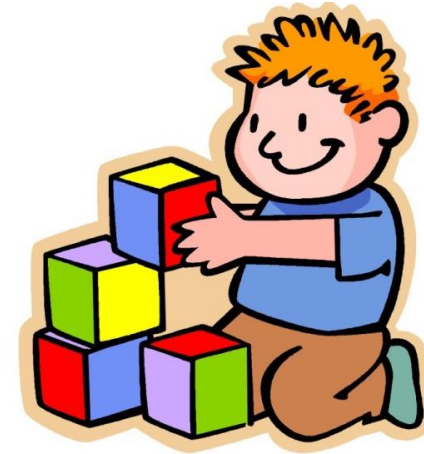




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Does diet relate to child development in young rural Nepali children?





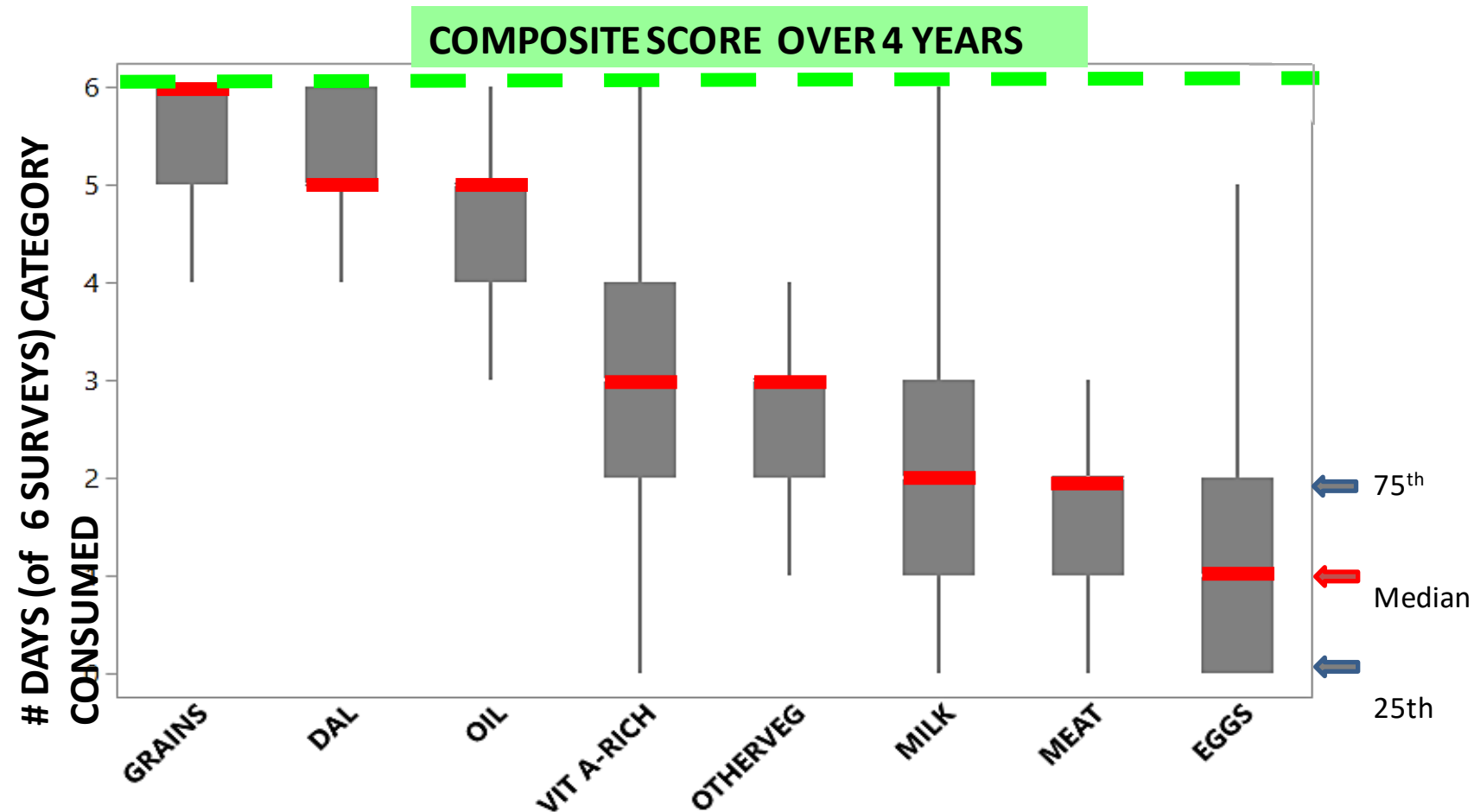
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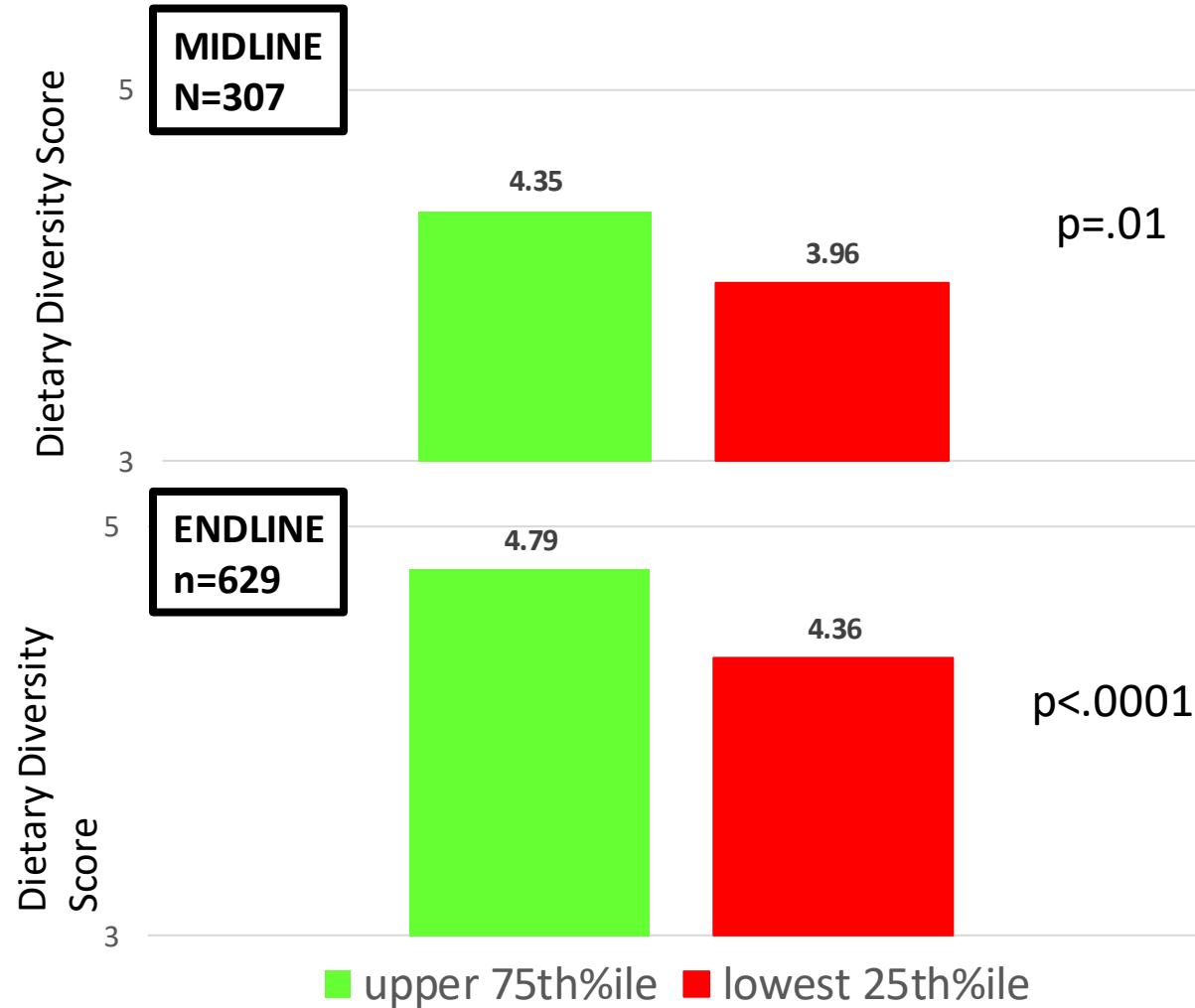
DIET QUALITY WAS POOR OVER 4 YEARS



Children (n=269) evaluated at all 6 household visits and ASQ at endline



DEVELOPMENTAL STATUS & DIETARY DIVERSITY SCORES



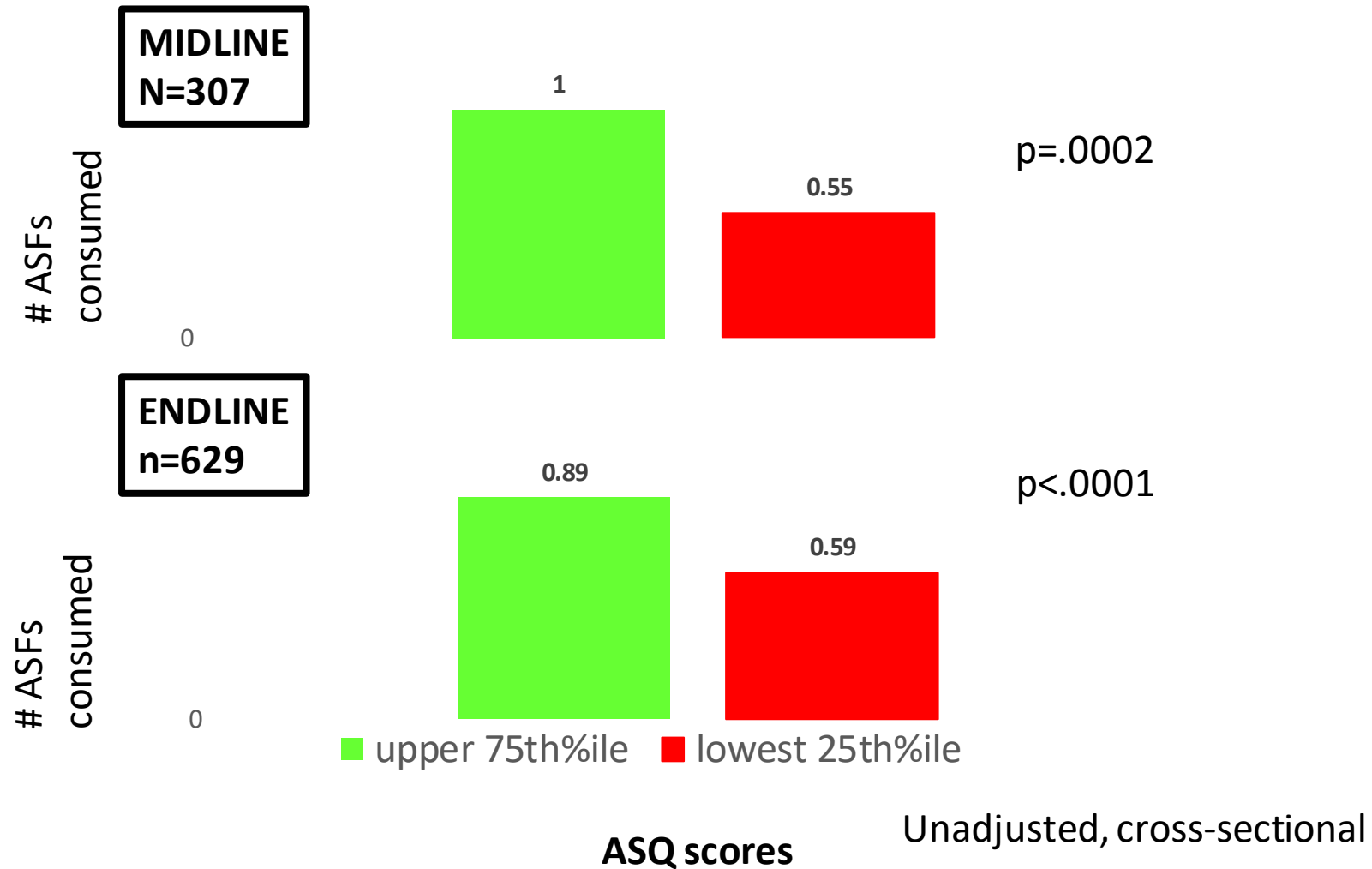
■ upper 75th%ile ■ lowest 25th%ile

ASQ scores

Unadjusted, cross-sectional

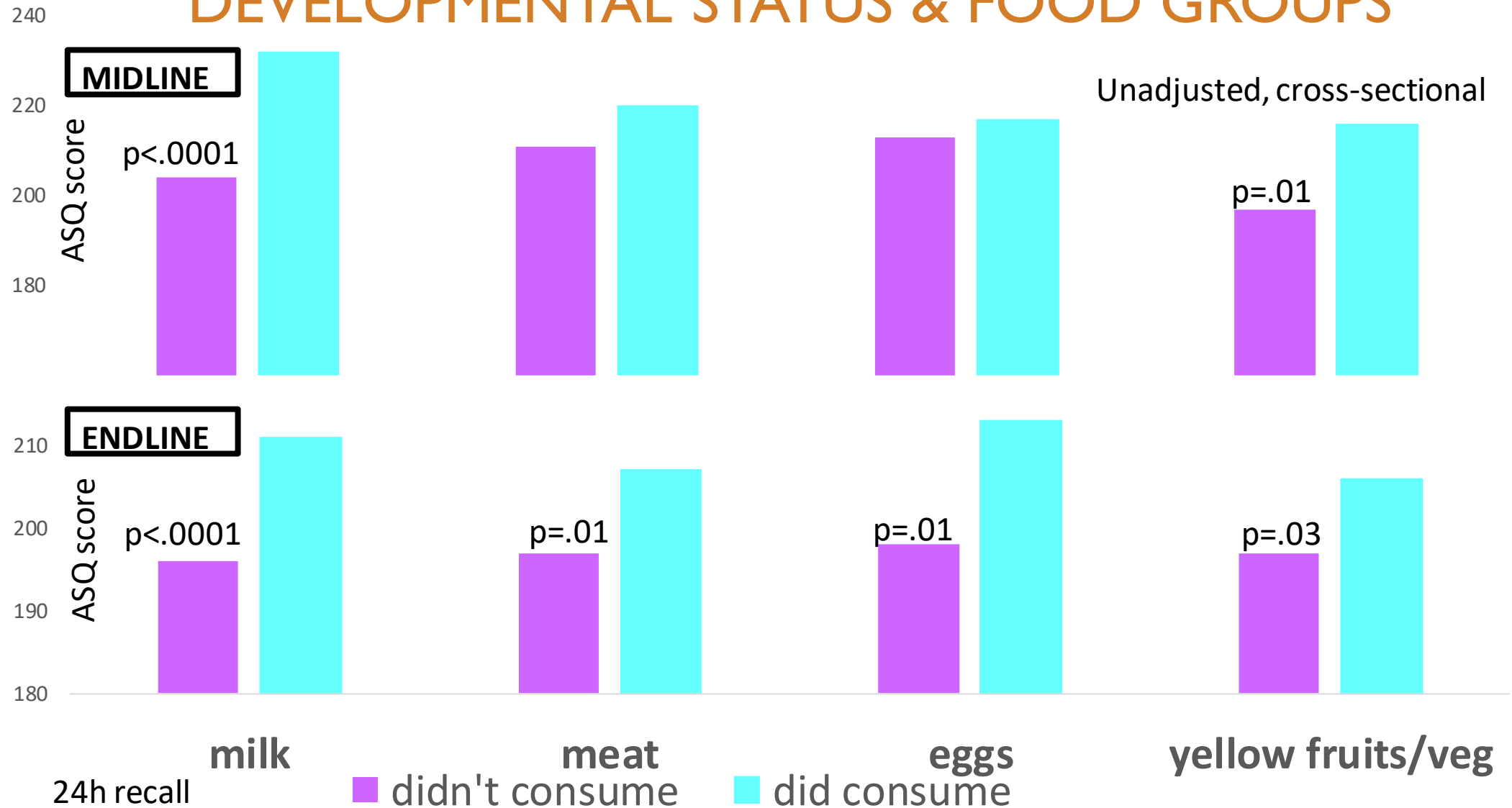


DEVELOPMENTAL STATUS & ASF CONSUMPTION





DEVELOPMENTAL STATUS & FOOD GROUPS



What is the relationship between child diet and development in children (n=307) age **23-38** months...after adjusting for confounders?

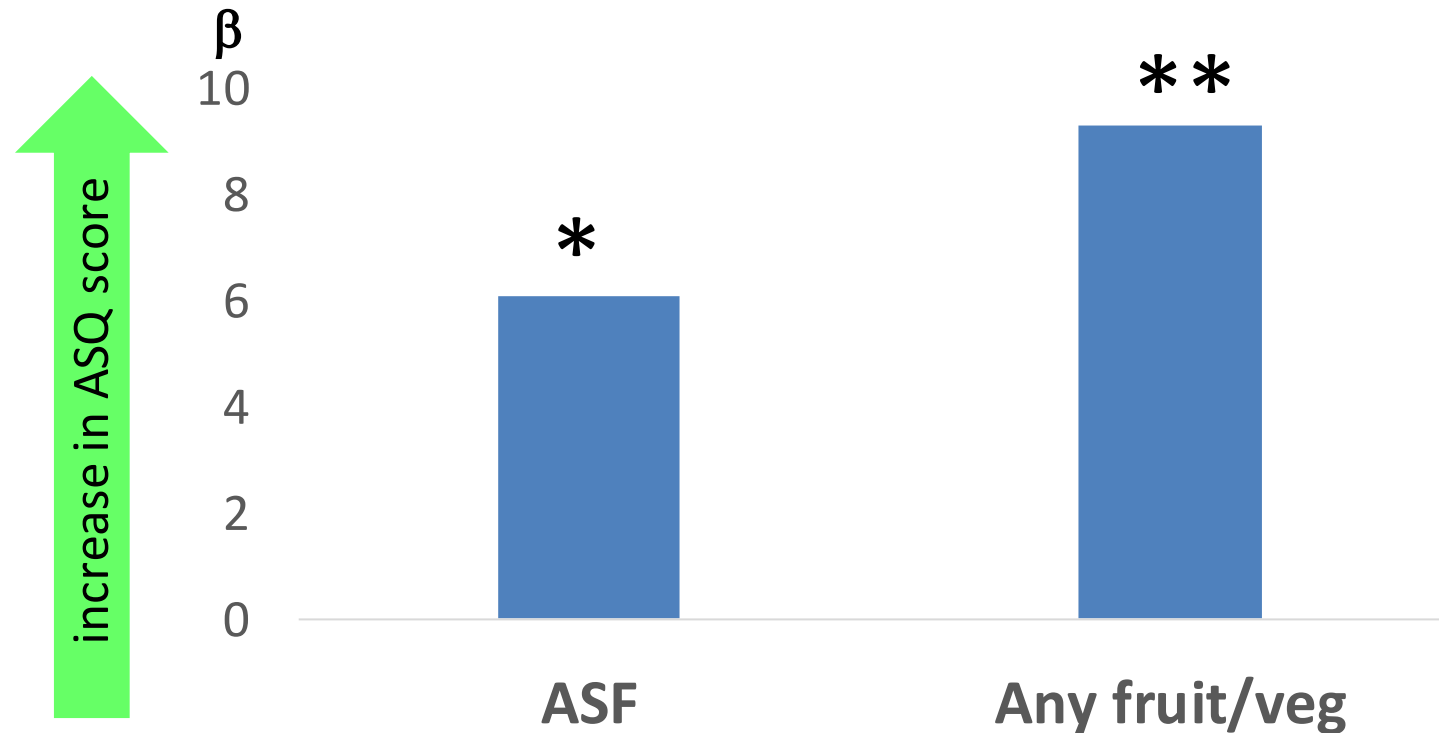


↑
Diet

↑
Diet

↑
Diet
ASQ

SOME DIETARY COMPONENTS ARE POSITIVELY ASSOCIATED WITH BETTER CHILD DEVELOPMENTAL PERFORMANCE



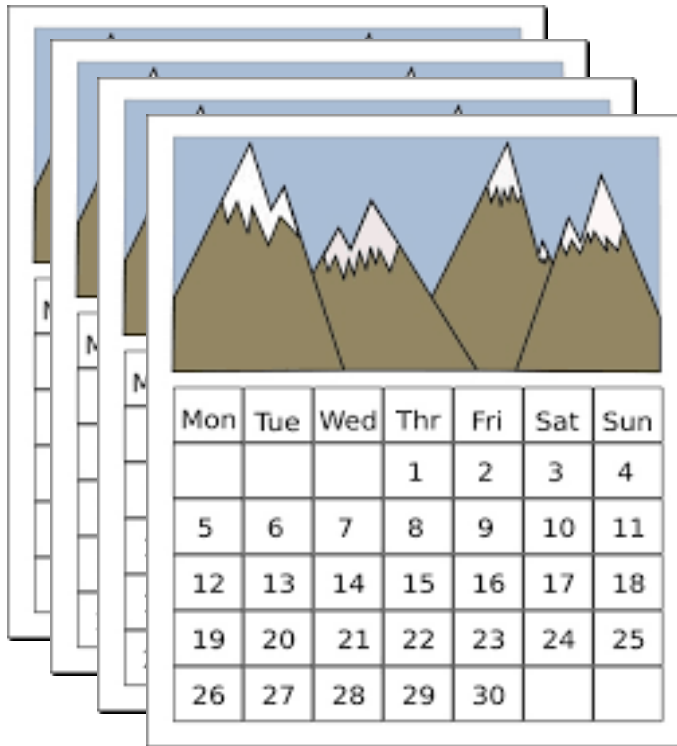
Children (n=282) with ASQ at midline and 3 HH visits. Linear regression, increase in ASQ total score for each day (out of 3) that item was consumed (adjusted for maternal education, wealth, child age, intervention group)





- Can these relationships be confirmed over a longer time span?

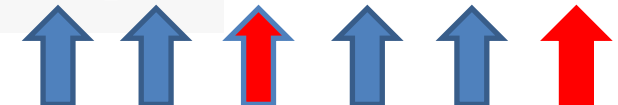
4 years



...and a broader age range?

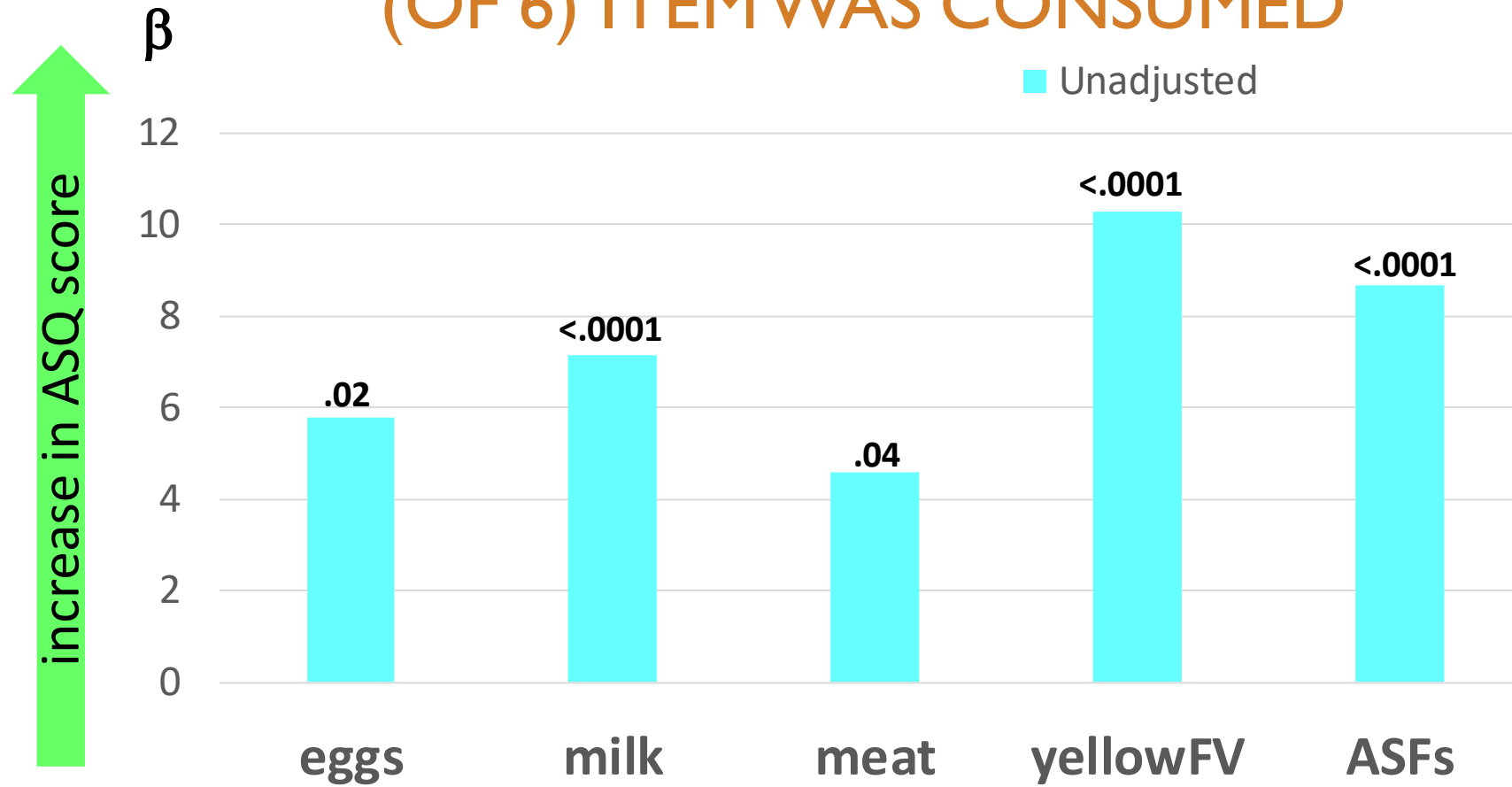


6 HH visits;
complete dietary
information;
N=269





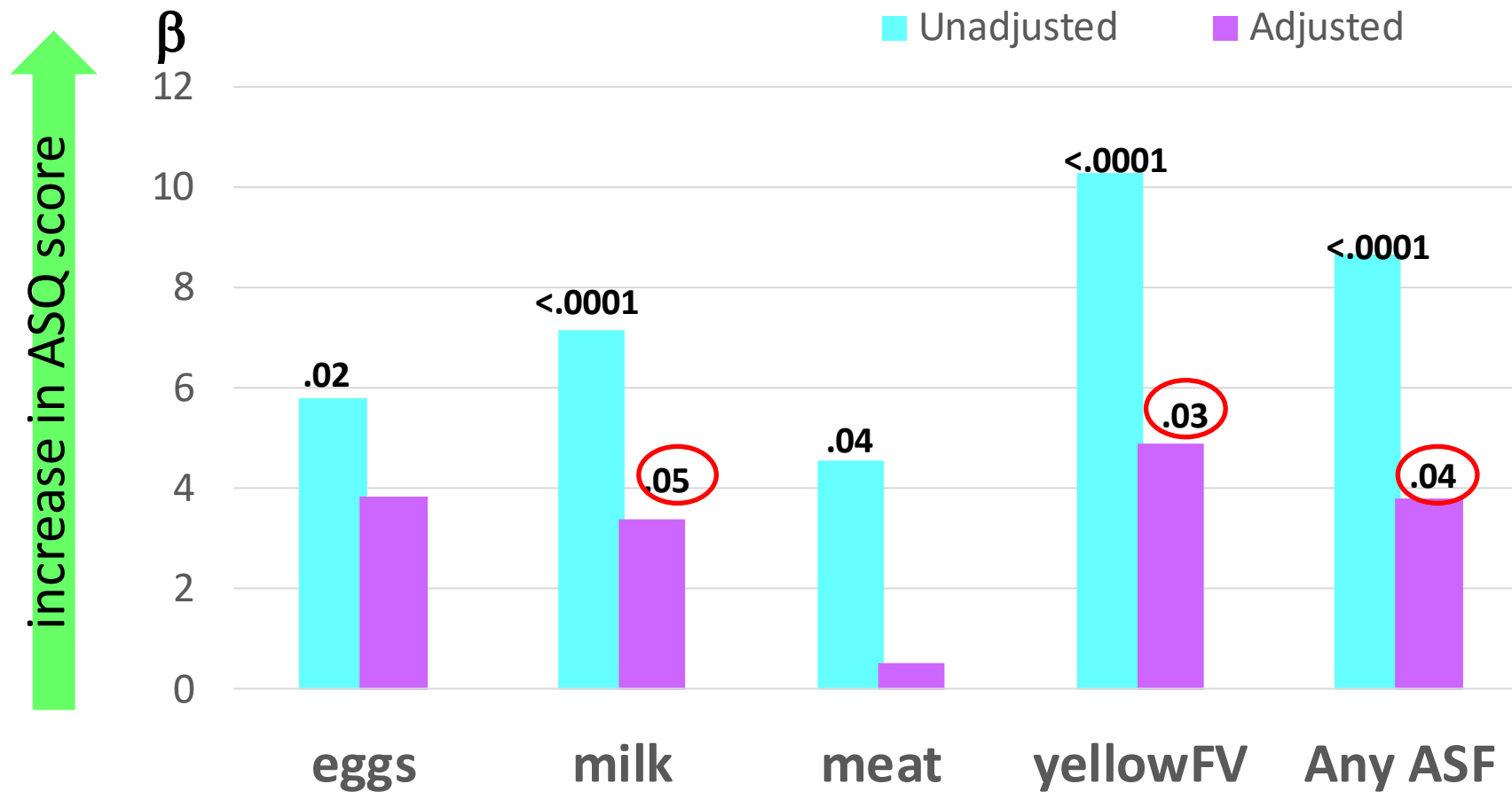
INCREASE IN ASQ SCORE FOR EACH DAY (OF 6) ITEM WAS CONSUMED



Children (n=269) evaluated at all 6 household visits and ASQ at endline. Linear regression, increase in ASQ total score for each day (out of 6) that item was consumed



INCREASE IN ASQ SCORE FOR EACH DAY (OF 6) ITEM WAS CONSUMED



Children (n=269) evaluated at all 6 household visits and ASQ at endline. Linear regression, increase in ASQ total score for each day (out of 6) that item was consumed (adjusted for maternal education, wealth, intervention group, home quality)



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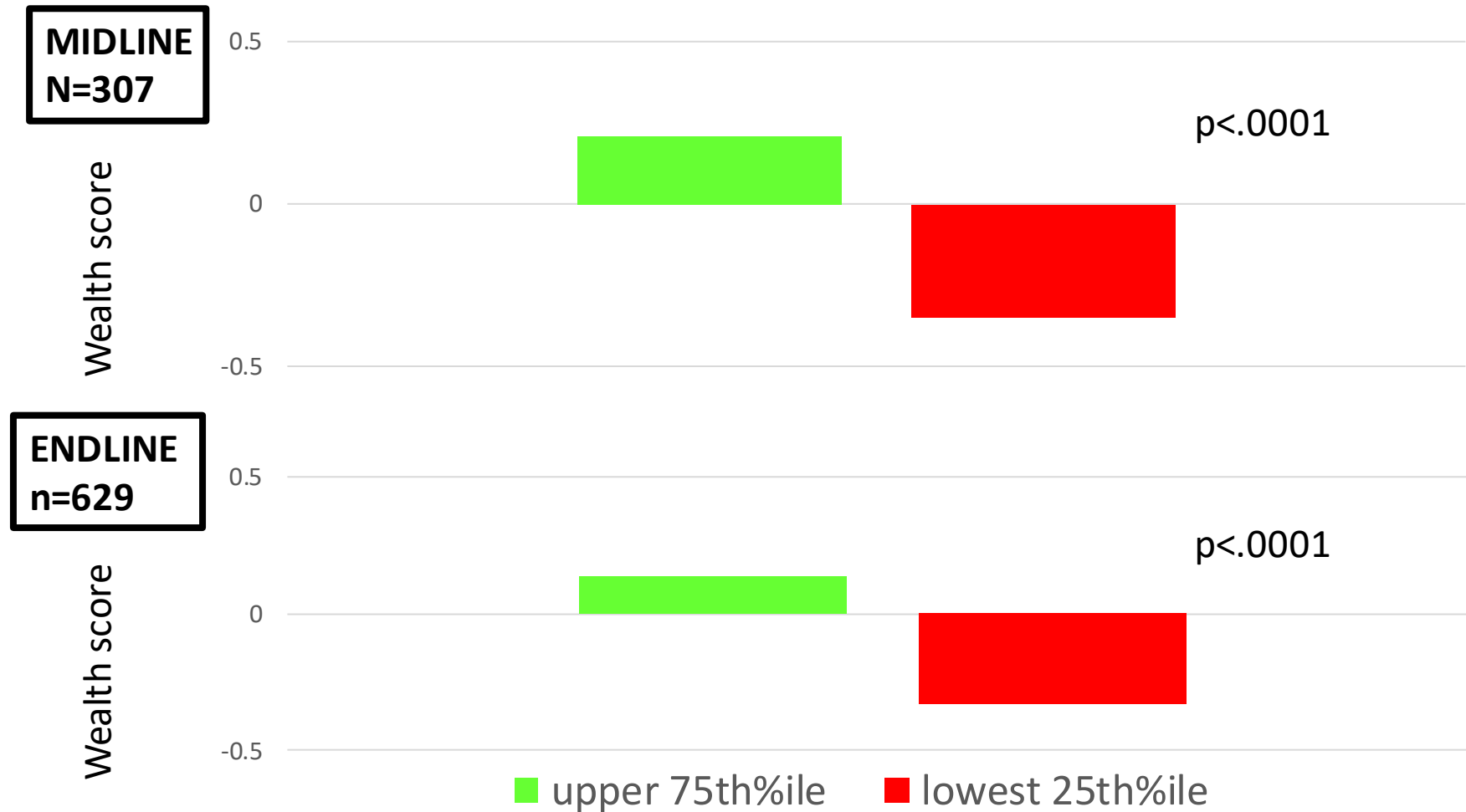
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- What other household factors are important?





DEVELOPMENTAL STATUS AND HOUSEHOLD WEALTH

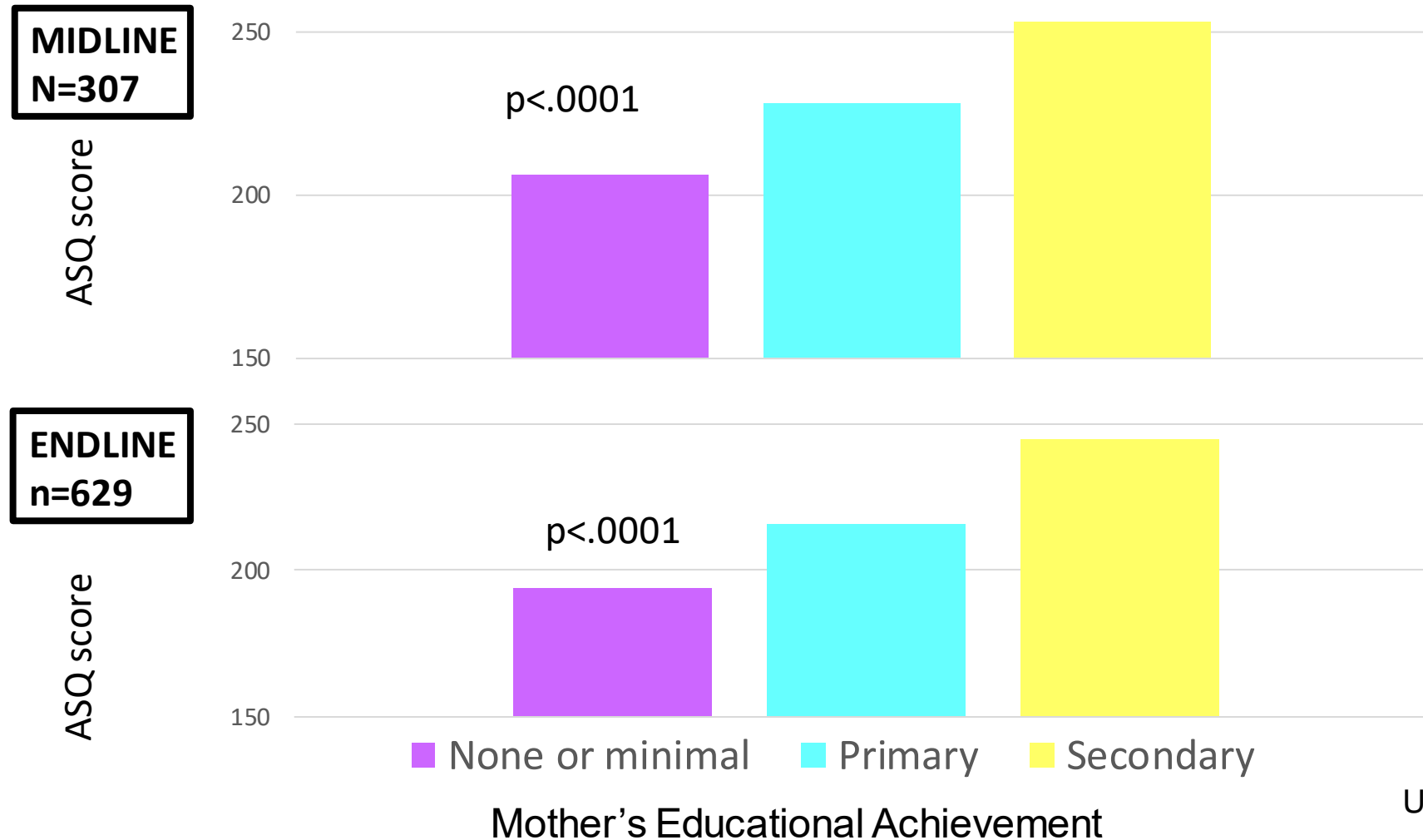


ASQ scores

Unadjusted, cross-sectional



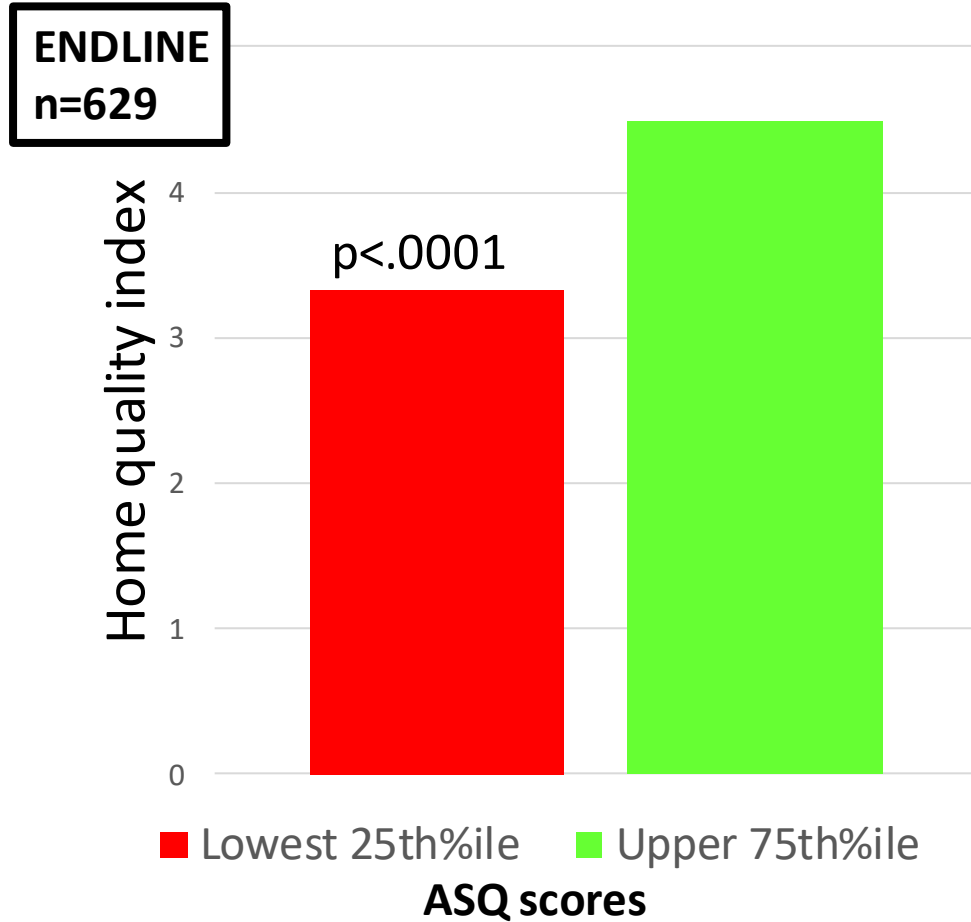
DEVELOPMENTAL STATUS AND MOTHER'S EDUCATION



Unadjusted, cross-sectional

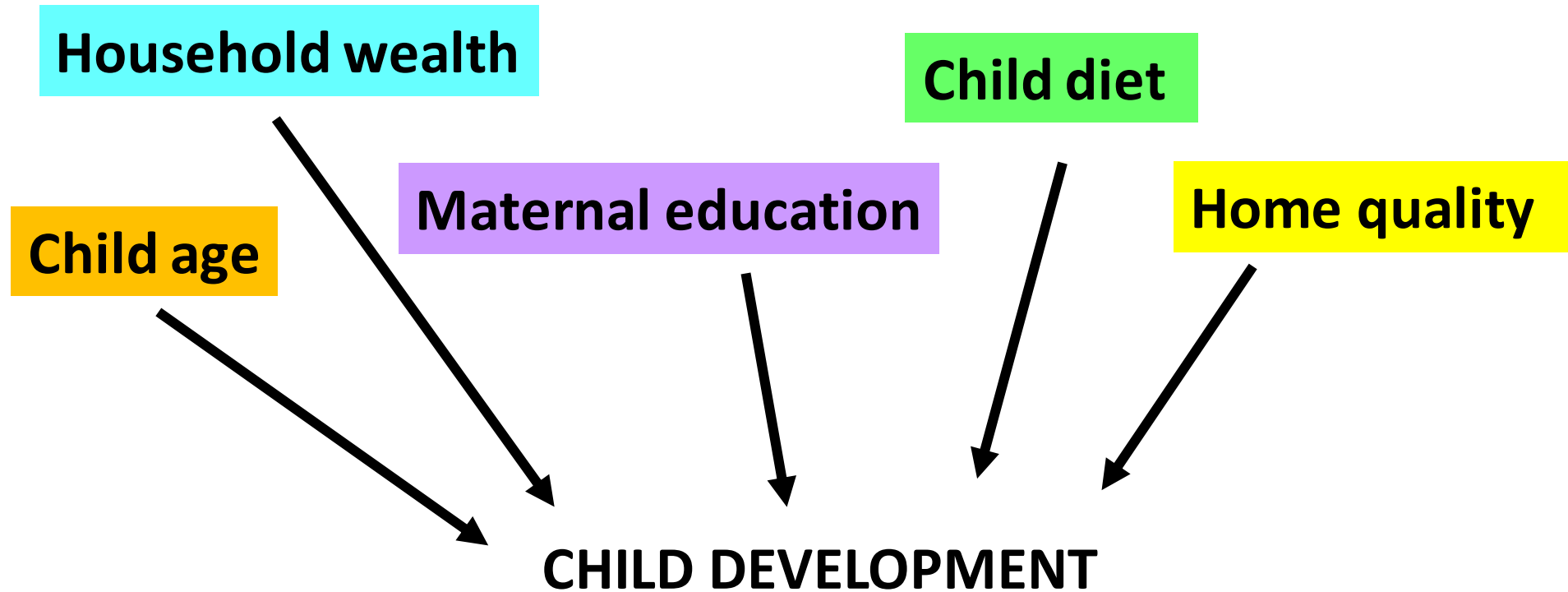


DEVELOPMENTAL STATUS AND HOME QUALITY





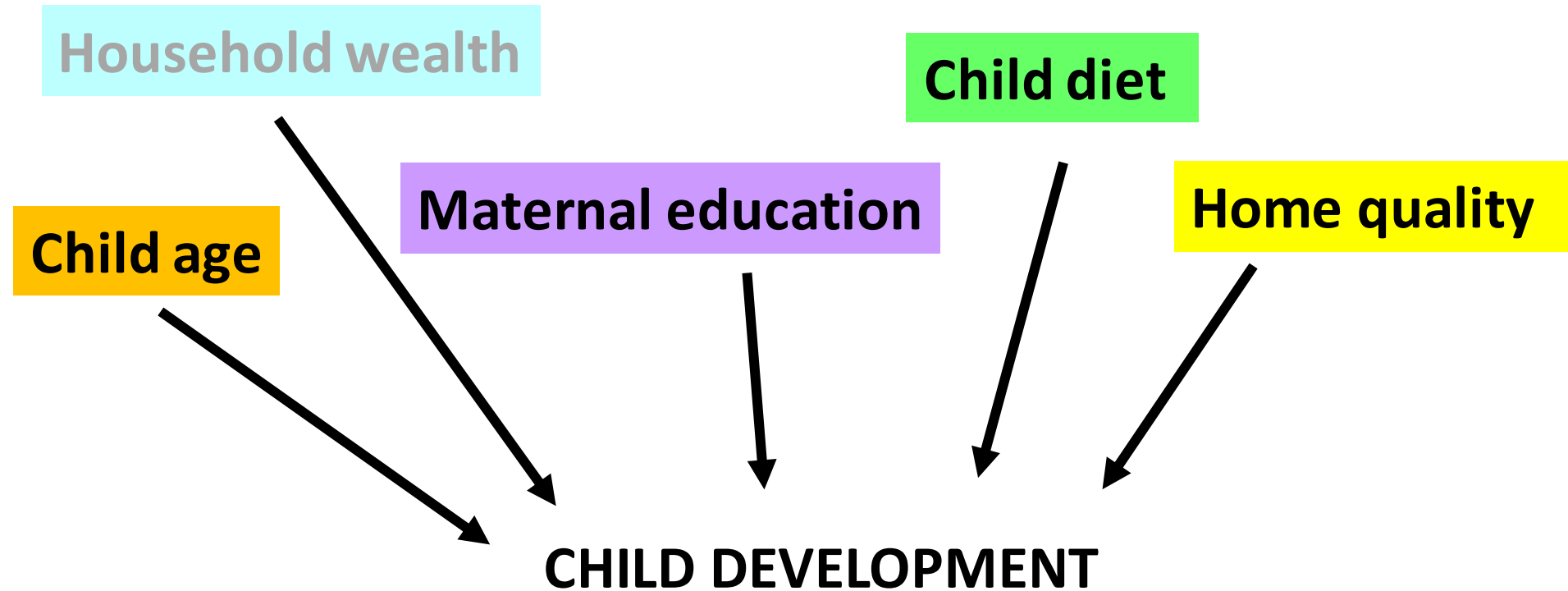
FULL MODEL



cumulative dietary measures over 6 rounds; ASQ continuous scores; linear regression;
adjusted for intervention group



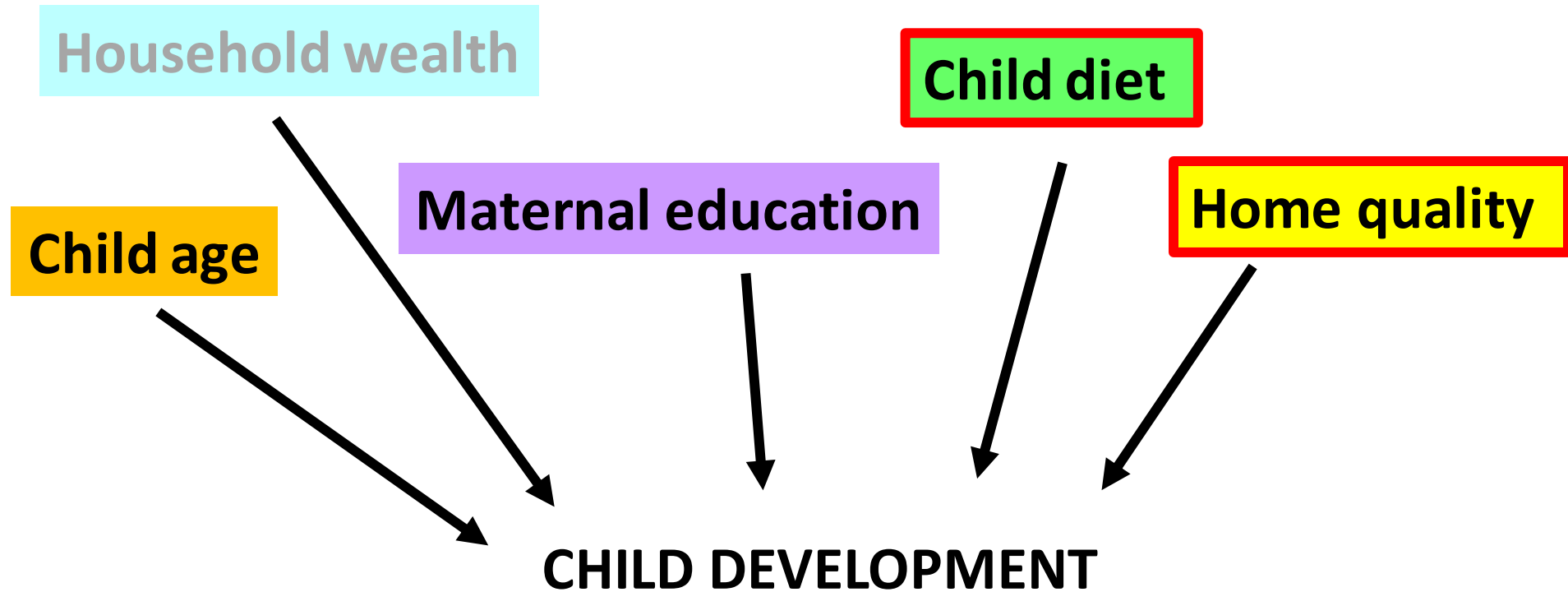
FULL MODEL



cumulative dietary measures over 6 rounds; ASQ continuous scores; linear regression;
adjusted for intervention group



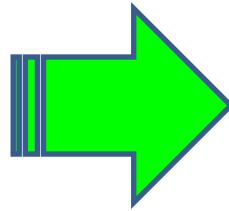
FULL MODEL



cumulative dietary measures over 6 rounds; ASQ continuous scores; linear regression;
adjusted for intervention group

● Are there age-related differences in these associations?

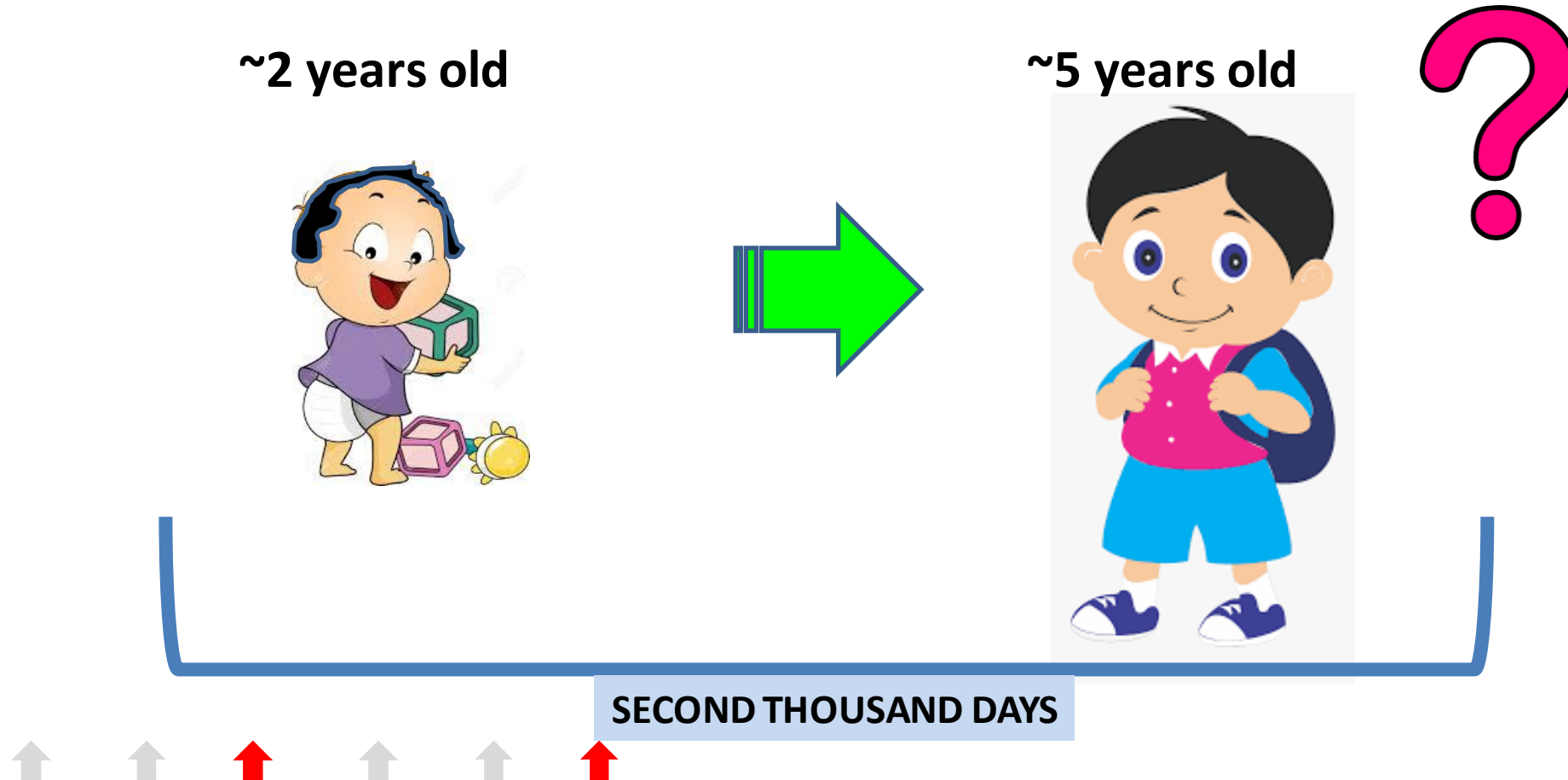
~2 years old



~5 years old



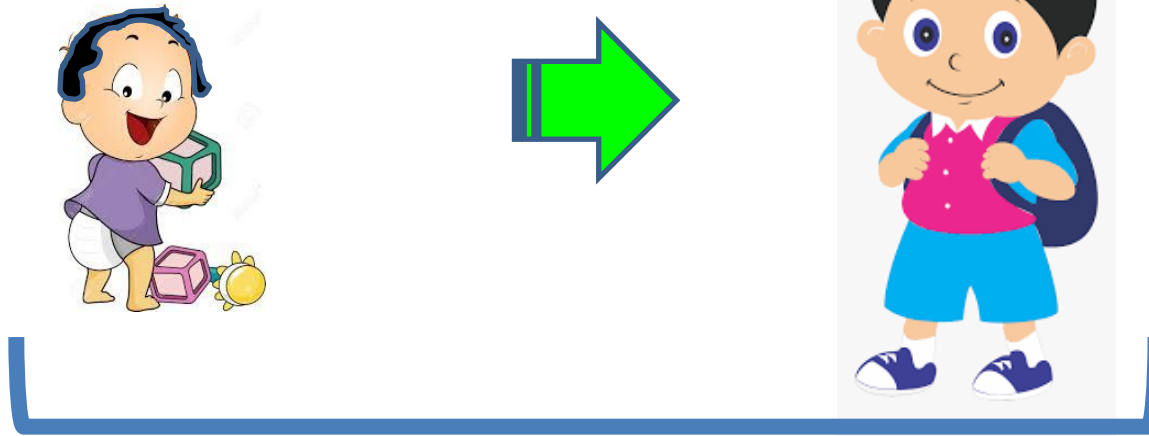
● Are there age-related differences in these associations?



Cohort of all children (n=207) with ASQ at midline and endline



Are there age-related differences in these associations?



Do these relate to specific developmental domains?





RELATIONSHIP OF ASQ SCORES TO HOUSEHOLD & CHILD FACTORS

SPECIFIC DOMAINS

	Total ASQ	Communication	Gross Motor	Fine Motor	Personal-social	Problem-solving
Mother's education						
HH wealth						
Child ASF						

Cohort of all children (n=207) with developmental testing at age 2 and age 5 years
Linear regression, adjusted for group assignment

RELATIONSHIP OF ASQ SCORES TO HOUSEHOLD & CHILD FACTORS

 Positive and significant association

SPECIFIC DOMAINS

Age 2 years	Total ASQ	Communi- cation	Gross Motor	Fine Motor	Personal- social	Problem- solving
Mother's education						
HH wealth						
Child ASF						

Cohort of children (n=207) with developmental testing at age 2 and age 5 years
Linear regression, adjusted for group assignment

RELATIONSHIP OF ASQ SCORES TO HOUSEHOLD & CHILD FACTORS

 Positive and significant association

Age 2 years	Total ASQ	Communication	Gross Motor	Fine Motor	Personal-social	Problem-solving
Mother's education						
HH wealth						
Child ASF						

Age 5 years	Total ASQ	Communication	Gross Motor	Fine Motor	Personal-social	Problem-solving
Mother's education						
HH wealth						
Child ASF						
Child in school						

Cohort of children (n=207) with developmental testing at age 2 and age 5 years

Linear regression, adjusted for group assignment



- Both cross-sectional and longitudinal results
- Dietary information 6 times over 4 years provides detailed picture of child diet
- Small sample size
- Food quantities not measured
- ASQ not “gold standard” test (but informative and practical for use in HH under field conditions)
- Home quality measures by self-report
- Unmeasured variables likely affect outcome



CONCLUSIONS

- Dietary quality over time is associated with child developmental performance
 - Strength of association between diet and ASQ attenuated by adjusting for confounders
- Multiple aspects of diet and not just ASFs are important
 - Yellow fruits/veg (?marker of diet diversity, ?other HH factors?)
- Many household factors also are associated with child development; these relationships differ with child age



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“Early child development is a cornerstone of human development and should be central to how we judge the success of societies”.

-World Health Organization, 2018



https://www.who.int/maternal_child_adolescent/topics/child/development/10facts/en/

ACKNOWLEDGMENTS

Shibani Ghosh
Neena Joshi
Mahendra Lohani
Liz Marino-Costello
Sumanta Neupane
Merina Shrestha
Robin Shrestha
Andrew Thorne-Lyman
Patrick Webb



Heifer Nepal
Heifer International
Valley Research Group
Nutrition Innovation Lab
Participating families

REFERENCES

- Nutrients 11(8):1799, 2019
- Public Health Nutrition 23 (1): 146-161, 2020
- Maternal Child Nutrition, DOI: 10.1111/mcn.12964, 2020
- Journal of Dairy Science, 103 (11), p.9700-9714, 2020
- Food Nutrition Bulletin, in press, 2021



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The Association Between Animal Sourced Food Consumption and Metrics of Child Growth and Development

Shibani Ghosh, PhD
(on behalf of the Alfacohort Study research team)



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RESEARCH TEAM

Study team (in Alphabetical Order)

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Krishna Paudel

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Patrick Webb

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Institutions

Family Welfare Division, Department of Health Services, MOHP, Nepal

Patan Academy of Health Sciences

Helen Keller International (HKI)

Banke District Public Health Office, VDC and Ward Health Posts, FCHVs

Nepalgunj Medical College

Tufts University

Support from USAID Bureau for Resilience and Food Security and USAID Nepal

ANIMAL SOURCED FOODS

- Provide high quality protein, iron, vitamin A, zinc and iodine and when in eaten in small quantities can provide these vital nutrients to infants and young children
- Past ASF consumption was found to be correlated with a 10% decline in stunting in Nepali children under two years of age (Zaharia et al, forthcoming)
- Past consumption of two or more ASFs demonstrated a 16% decline in Nepal children under two years of age (Zaharia et al forthcoming)
- The role of ASFs (types, numbers and frequency) in supporting both cognitive and physical development has been indicated



RESEARCH QUESTIONS

- Is there an association between ASF consumption at different age time points in early life (starting at 6 months of age through 18-22 months of age) and metrics of child growth and development at 24-26 months of age?
- Is there an association of consistent and cumulative consumption of ASFs and metrics of child growth and development at 24-26 months of age?
- Outcomes
 - Ages and Stages Questionnaire (ASQ) scores
 - Length for Age Z-score
 - Head Circumference for age Z-score

HEAD CIRCUMFERENCE FOR AGE Z-SCORE

- Brain development in early life is linked to later cognitive and social development and educational success
- Head circumference measures have been found to be a good proxy of brain size and in some studies correlates with some brain function
- Head circumference for age Z-score is a simple metric to assess brain growth



AFLACOHORT STUDY

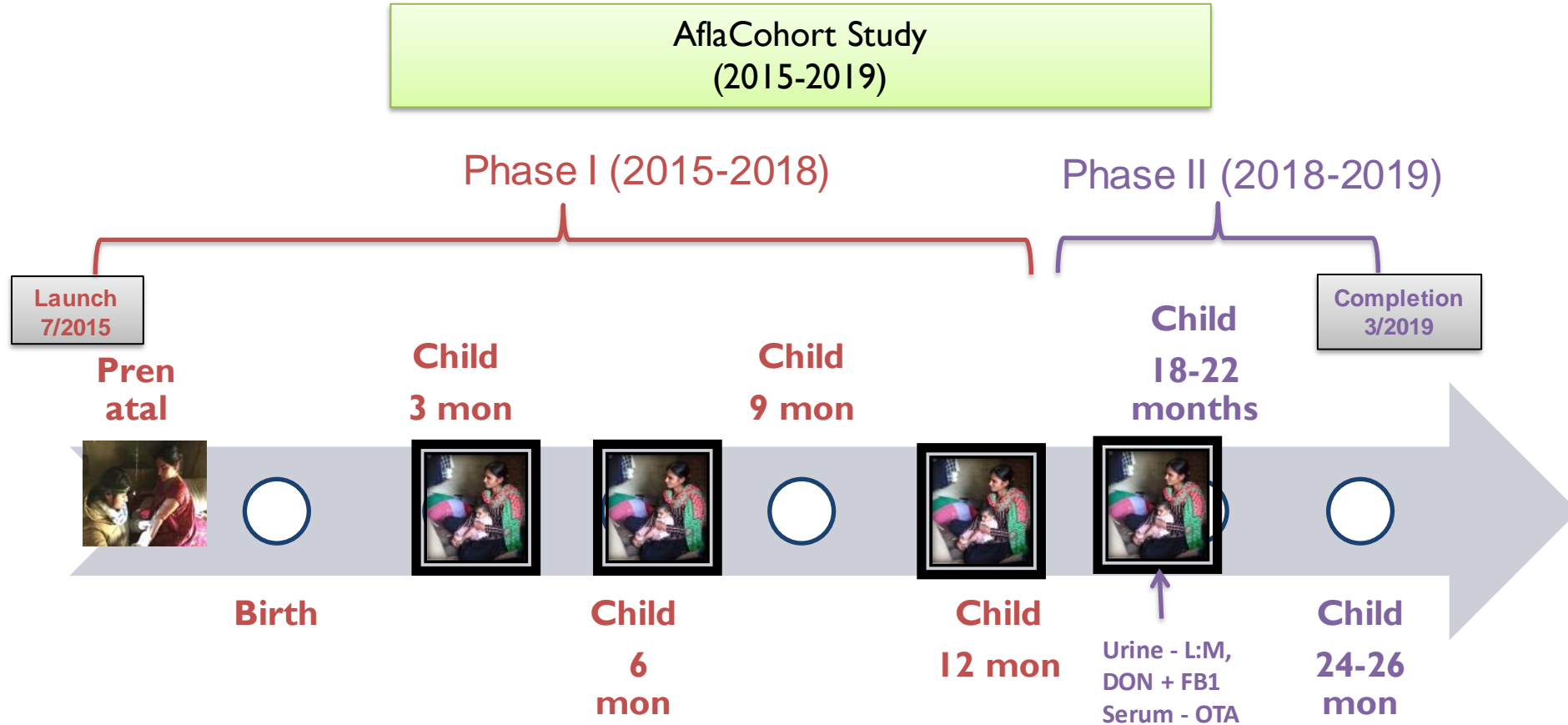
- Observational Birth Cohort Study
- Location: Banke District of Nepal
- $n=1,675$ mother-infant dyads





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n=1675 mother-infant dyads through 12 months
n=736 mother-infant dyads through 24-26 months



METHODS

- Longitudinal data (6 months, 9 months, 12 months, 18-22 months)
 - Consumption of animal source foods and all other food groups (24 hours and past 7 days)
 - Length and weight
 - Breastfeeding status
- ASQ questionnaires, length, weight and head circumference measurements at 24-26 months of age
- Children with data on both ASF consumption at 18 months and a complete ASQ survey at 24-26 months were included in the analysis
- ASFs reported include milk, yogurt, eggs, chicken, goat meat, buffalo meat, pork, large fish, small fish and dried fish



METHODS

- Cumulative ASQ scores, Length for age Z-scores (LAZ) and Head Circumference for Age Z-scores (HCZ) were computed
- ASF consumption by time point (24 hours and 7 days)
 - Any ASF consumed (Y/N) (if any ASF was reported)
 - Number of ASFs consumed (total number of ASF food items consumed).
 - Frequency of ASF consumed (number of times) (total number of times any ASF food item was consumed by the child)
- Cumulative ASF consumption (24 hours and 7 days) (all time points)
 - Number of ASFs consumed
 - Frequency of ASF consumed (number of times)



METHODS

- Descriptive statistics (Means, medians, SD and frequencies), Bi-variate statistics (Pearson Correlations, Cross tabulations, Students T-test)
- Multivariable Ordinary Least Square regression analyses with location/clustering adjustments
- Outcomes at 24-26 months: ASQ score, HCZ, LAZ
- Co-variates and confounders: Wealth, education of the mother, age and gender of the child
- Assessed breastfeeding status for inclusion in models (73% were exclusive breastfed at 3 months, over 95% continued breastfeeding from 6 months onwards)

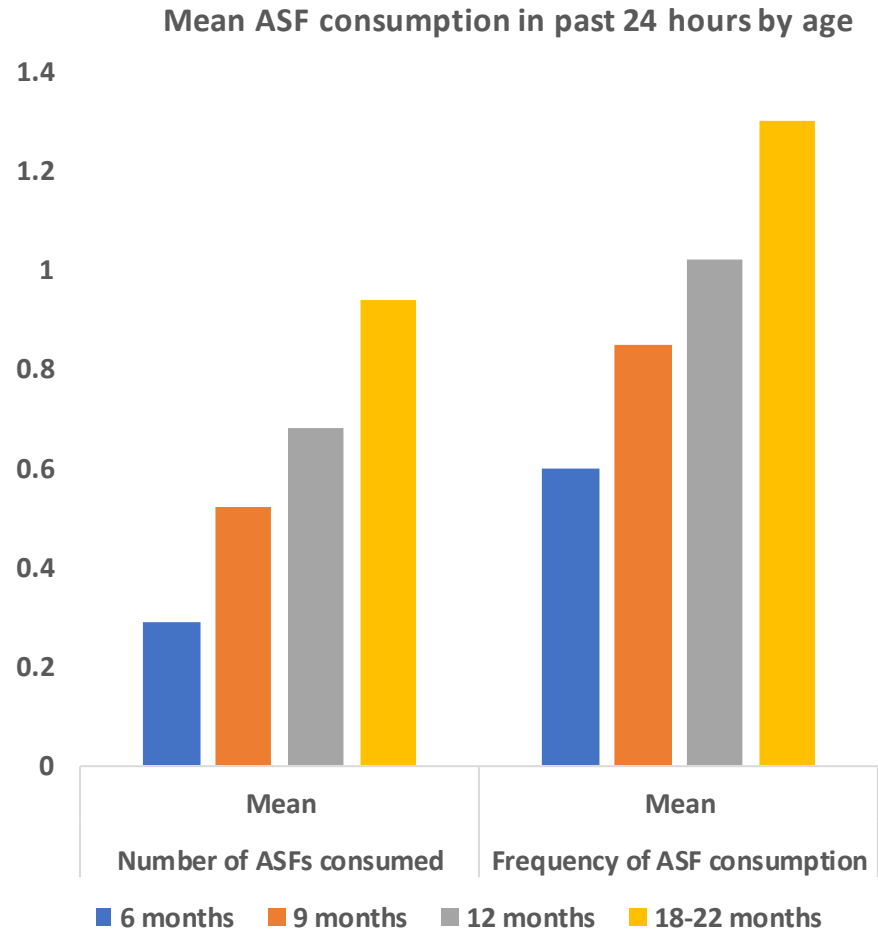
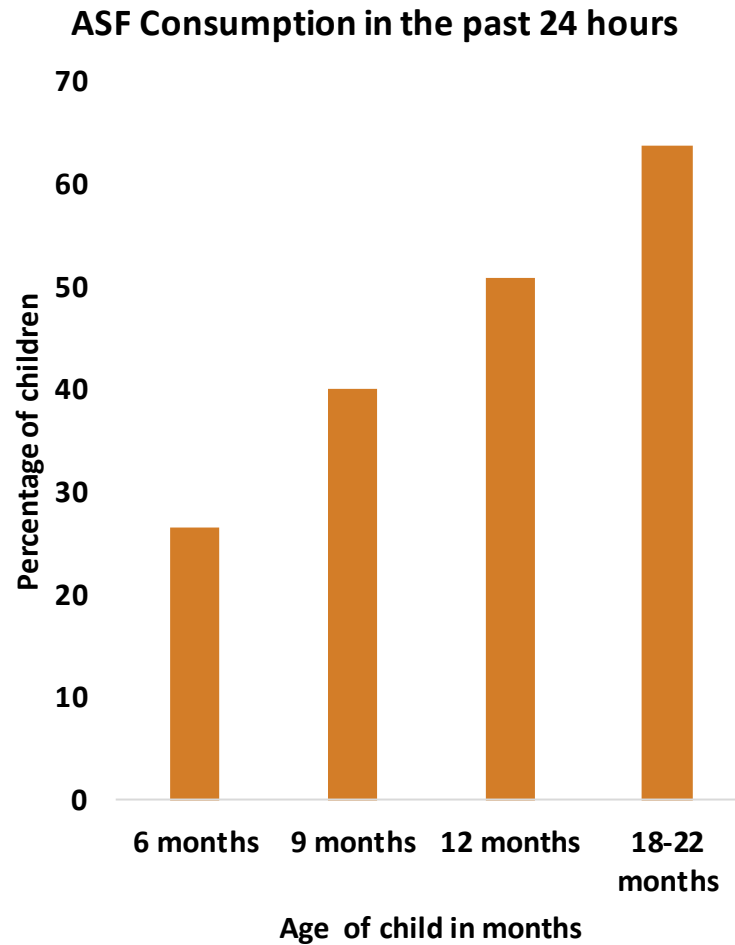


DESCRIPTIVE STATISTICS

	n	% or Mean (SD)
ASQ score at 24-26 months	702	244.4(49)
HCZ score at 24-26 months	702	-1.65 (0.92)
LAZ score at 24-26 months	702	-1.81 (1.13)
Child Sex (%)		
Male	346	48.2
Female	372	51.2
Mother's schooling (%)		
No schooling	259	36.9
Primary (1-5 years)	149	21.2
Secondary (6-10 years)	235	33.5
More than Secondary (>10 years)	59	8.4
Household Wealth Quintile (%)		
Poorest	127	18.1
Poor	150	21.4
Middle	143	20.4
Rich	128	18.2
Richest	154	21.9

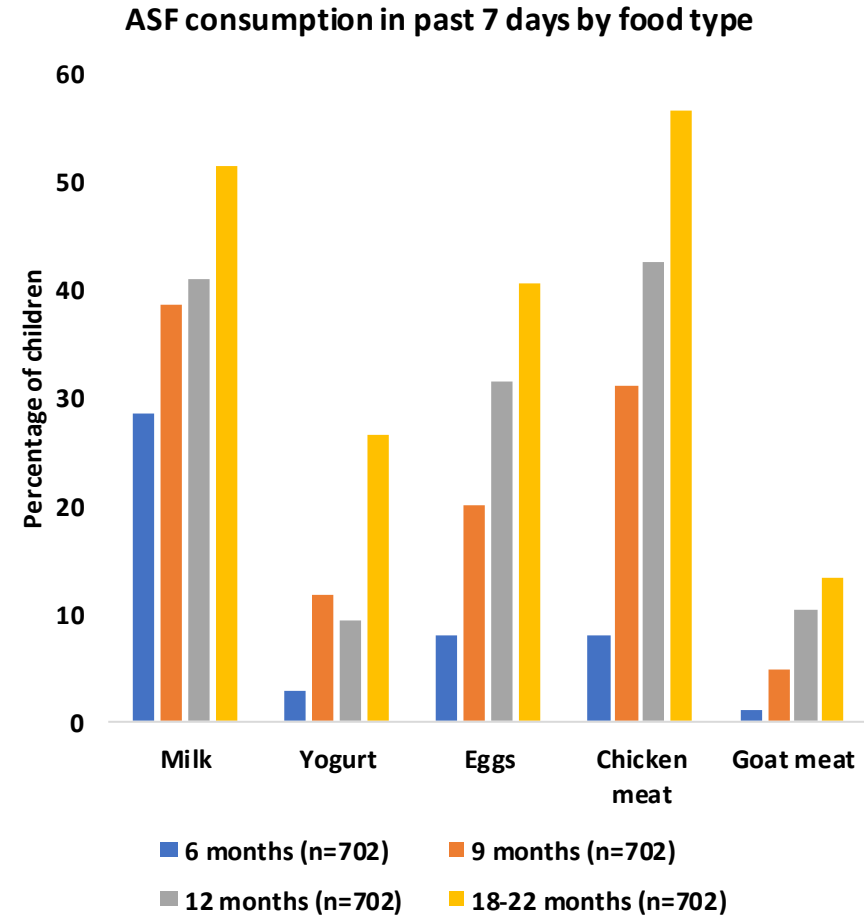
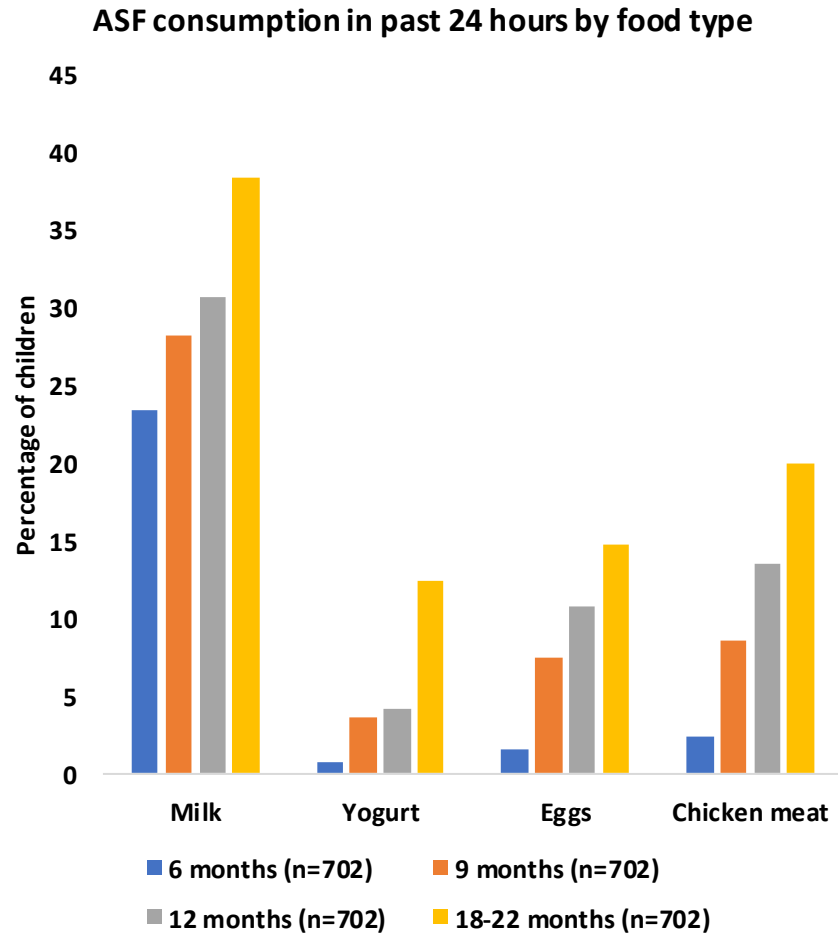


ASF CONSUMPTION BY AGE





TYPE OF ASF CONSUMED





ASF CONSUMPTION AND ASQ SCORES

Dependent:ASQ Score at 24- 26 months of age	Number of ASF (SE)		Frequency of ASF (SE)	
ASF consumption in the past 24 hours				
At 6 months of age	0.446	(3.207)	-0.146	(1.448)
At 9 months of age	4.091	(2.178)	3.018	(1.876)
At 12 months of age	1.924	(1.917)	-1.014	(1.685)
At 18-22 months of age	5.562***	(1.294)	3.035*	(1.212)
ASF consumption in the past 7 days				
At 6 months of age	1.616	(2.179)	-0.116	(0.218)
At 9 months of age	2.533	(1.660)	0.569	(0.352)
At 12 months of age	3.538*	(1.252)	-0.108	(0.288)
At 18-22 months of age	0.231	(1.434)	0.243	(0.216)
Cumulative ASF Consumption (6-22 months)				
Past 24 hours	3.457***	(0.701)	1.148*	(0.434)
Past 7 days	1.939***	(0.335)	0.142*	(0.0577)

Robust standard errors in parentheses

Models adjusted for clustering, wealth, education of the mother, age and gender of the child

*** p<0.001, ** p<0.01, * p<0.05



ASF CONSUMPTION AND HCZ

Dependent: HCZ at 24-26 months of age	Number of ASF (SE)		Frequency of ASF (SE)	
HCZ and Consumption in the past 24 hours				
At 6 months	0.108	(0.0687)	0.00976	(0.0318)
At 9 months	0.0444	(0.0606)	0.0378	(0.0306)
At 12 months	-0.0430	(0.0481)	-0.0493	(0.0282)
At 18-22 months	0.154***	(0.0332)	0.0950**	(0.0290)
HCZ and Consumption in the past 7 days				
At 6 months	0.119*	(0.0501)	-0.000562	(0.00550)
At 9 months	-0.0197	(0.0334)	0.00717	(0.00464)
At 12 months	0.0146	(0.0247)	-0.00744	(0.00439)
At 18-22 months	0.0637**	(0.0179)	0.0134*	(0.00461)
HCZ and Cumulative Consumption (6-22 months)				
Past 24 hours	0.0626***	(0.0152)	0.0186*	(0.00767)
Past 7 days	0.0335**	(0.00965)	0.00235	(0.00132)

Robust standard errors in parentheses

Models adjusted for clustering, wealth, education of the mother, age and gender of the child

*** p<0.001, ** p<0.01, * p<0.05



ASF CONSUMPTION AND LAZ

Dependent: LAZ at 24- 26 months of age	Number of ASF (SE)		Frequency of ASF (SE)	
ASF consumption in 24 hours				
At 6 months	0.08	(0.08)	0.03	(0.04)
At 9 months	0.12	(0.06)	0.06	(0.04)
At 12 months	0.07	(0.04)	0.04	(0.03)
At 18-22 months	0.10	(0.06)	0.04	(0.04)
ASF consumption in the past 7 days				
At 6 months	0.04	(0.06)	0.00	(0.01)
At 9 months	0.00	(0.04)	0.01	(0.01)
At 12 months	0.10**	(0.03)	0.01	(0.00)
At 18-22 months	0.05*	(0.02)	0.01	(0.00)
Cumulative ASF consumption (6-22 months)				
Past 24 hours	0.09**	(0.02)	0.05***	(0.01)
Past 7 days	0.05***	(0.01)	0.01***	(0.00)

Robust standard errors in parentheses

Models adjusted for clustering, wealth, education of the mother, age and gender of the child *** p<0.001, ** p<0.01, * p<0.05



CONCLUSION

- Cumulative ASF Consumption measured from 6 month to 22 months of age is associated with improved ASQ scores, HCZ and LAZ at 24-26 months of age
- In age-disaggregated analyses, the significance of the association varies by age and by outcome but in general, the association is significant at an older age
- Does early life consumption then matter?
 - This is not straight forward
 - The measure of ASF matters
 - Age of the child and age of ASF introduction



STRENGTHS AND LIMITATIONS

- Close detailed look at a critical period in child development (6 months to 24 months)
- Longitudinal data on the same child provides robustness to the findings and allows us to assess lagged relationships
- Few children were given ASFs at 6 months of age and thus we may not be able to accurately assess early life exposure to ASF
- Diet information collected through 18-22 months of age while ASQ surveys were conducted 24-26 months, thus we may not capture any dietary effects after 18-22 months
- Ongoing:
 - Using cumulative indicators at different ages to assess the inflection time point (or age) when introduction of ASF might matter the most
 - Assessing the relationship of other food groups and ASQ, HCZ and LAZ scores over time.



FEED THE FUTURE

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

Summary

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Associate Scientist, Johns Hopkins University



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FROM THE AMERICAN PEOPLE



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SCHOOL OF PUBLIC HEALTH



Tufts
UNIVERSITY

GERALD J. AND DOROTHY R.
Friedman School of
Nutrition Science and Policy

WHAT HAVE WE LEARNED

- Applying the ASQ tools in a rural setting worked well.
 - Was feasible and not overly burdensome
 - We observed many associations that we expected to see
- Dietary diversity and certain food group components are positively associated with total development, some subscales, head circumference and height-for-age z scores
 - Animal source foods are dense in many nutrients involved with brain and neural development.
- Vegetables also important!
- Greater diversity in ASFs consumed may be associated with greater development scores.

REFLECTION ON METHODS

- Key limitation: possibility of unmeasured confounding
- Dietary assessment measures varied
 - 24hr vs. 7-day recall
 - Longitudinal vs. cross sectional
 - Number of different ASF consumed
- Outcomes:
 - Continuous vs. dichotomous
 - Detecting at 5y rather than 2y
 - Lack of variation in some scale components

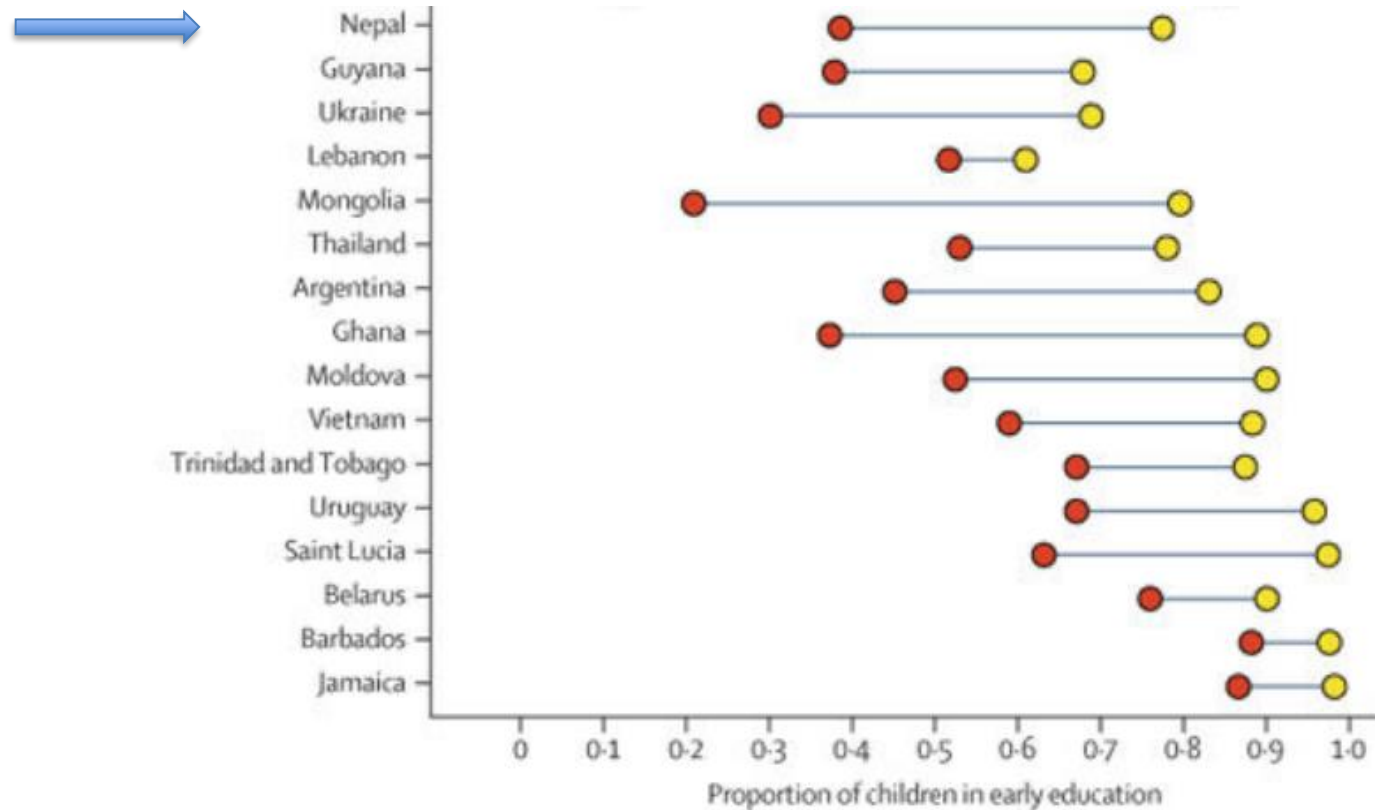
Longer recall and cumulative over time better able to demonstrate associations

QUESTIONS FOR FUTURE EXPLORATION

- Further adaptation to local context would be useful
- How the ASQ and other tools complement vs. replace one another?
 - For screening of individual children/use in programs?
 - For use in surveys?
- How can ECD support be mainstreamed within agricultural programs?
 - Seasonal agricultural patterns and childcare needs?
 - Addressing maternal depression?
 - Reaching poorer households?
- What are the relationships between ECD and longer-term outcomes?



DISPARITIES IN EARLY EDUCATION ALSO NEED TO BE OVERCOME



Source: Black et al, Lancet 2017; 389(10064): 77-90

Proportion of children aged 3–4 years in early education by country and wealth quintile



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Q&A



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THANK YOU

- To register for upcoming webinars, you can visit **NutritionInnovationLab.org** or **AdvancingNutrition.org**. More details coming soon!
- Recordings and slides for each webinar will also be posted on our websites.



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