Examining the relationship between food market environment, diet diversity & diet-related diseases among urban Indonesian households

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Overview

- Agriculture – Nutrition pathways
- Indicators of nutritional status and diet-related health
  - Issues with methods
- Case study linking food consumption, diet quality and diet-related health

Agriculture – Nutrition Pathways

Pathway	Effect
Overall macroeconomic growth	Modest
Increase agricultural productivity, Lower food prices, Improved Access	Modest
Increasing household income through sale of agricultural products	Variable
Increasing nutrient dense food production for household consumption	Some Evidence
Empowering women through targeted agricultural interventions	Strong Evidence

World Bank. 2013. "Improving Nutrition through Multisectoral Approaches. World Bank Report. January, pp. 1-172. https://openknowledge.worldbank.org/

Indicators of Nutritional Status

- Household hunger scales – 4-week recall (USAID & FAO)
- Household food expenditures
- Food frequency
- Household and individual food consumption (WFP)
  - food recall, food diaries
- Diet diversity scores (WHO, FAO, USAID)
  - Food recall, food diaries usually for 24 hours

Issues with Nutrition Indicators (1)

- Diet intake (consumption) and diet diversity ≠ diet quality
- Diet quality ≠ nutritional status
- Household consumption ≠ individual consumption
  - Intra-household allocation of food
    - Gender, child
- Does not measure dhanges in nutrition resulting from substitution or economic circumstances

Issues with Nutrition Indicators (2)

- Measuring is time consuming
- Recall measures/ methods affect data quality
  - Apples aren't apples and melons aren't melons
  - Seasonality
  - Literacy
- What is purchased is not always what is consumed
  - Offerings, gifts, food waste
- Food-away-from-home
  - Remembering to measure, knowing ingredients
- Nutritional quality of the food
  - Food preparation / cooking methods affect nutrition

Measures of Diet-related Health

- Anthropometric indicators
  - Body Mass Index (BMI, weight/height^2)
  - BMI z-scores
  - Body Adiposity Index (BAI, hip circumference and height)
  - Weight-for-age (W/A) z-scores
  - Height-for-age (H/A) z-scores
  - Weight-for-height (W/H) z-scores
  - Mid-upper arm circumference (MUAC)
- Bio-chemical indicators (blood, urine)
- Clinical indicators (external physical signs)

Issues with Health Indicators

- Underweight, wasting, stunting and obesity
  - Often have both underweight and overweight in same household (dual-burden)
- Indicators do not represent whole "health" picture
  - E.g. Cardiovascular disease, Diabetes
- Indicators vary from region-to-region (e.g. Asia vs. Europe)
- Age and gender specific
  - Adolescents are particularly difficult
- Time consuming and costly
- Requires some level of skill
- Sensitive information
  - Age, weight

Use of Supermarkets and Over-nutrition and Diet Quality in Indonesia

Umberger, W.J., He, X., Minot N., and Toiba, H. 2015. "Examining the Relationship between the Use of Supermarkets and Over-nutrition in Indonesia." *American Journal of Agricultural Economics*. Accepted and forthcoming (March).

Toiba, H., Umberger, W.J. and Minot, N. "Diet Transition and Supermarket Shopping Behaviour: Is there a link?" Submission to *the Bulletin of Indonesian Economic Studies*. August 2014.

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IFPRI INTERNATIONAL FOOD POLICY RESEARCH INSTITUTE
sustainable solutions for ending hunger and poverty
Supported by the CGIAR

ICASEPS

Background: Changing food systems

- Food systems, traditional and modern, are fundamentally connected to the health and welfare of society
  - (Asfaw 2008; Hawkes 2008; Pingali 2007; Reardon and Timmer 2014; Timmer 2013)
- The 'supermarket revolution' impacts domestic and regional food systems
  - (Faiguenbaum, Berdegue and Reardon 2002; Reardon et al. 2003).
- Supermarket penetration in developing countries, may create food market environments that encourage 'obesogenic' diet transition
  - SUPERMARKET EFFECT

Supermarkets, diets & health?

- Diets may change for the worse when poorer consumers start using supermarkets, with highly processed and high-fat foods replacing less refined and more nutrient rich foods
  - (Asfaw, 2007)
- Diet transition and the proliferation of Western food consumption patterns may be one cause of increases in non-communicable diet-related diseases (NCDs)
  - obesity, cardiovascular disease and type II diabetes.
  - (Matejowsky 2009; Mendez and Popkin 2004; Popkin 1999, 2006; Prentice 2006)
- However, there may be positive effects
  - greater diet diversity, lower food prices?
  - (Hawkes 2008)

Indonesian Scenario

- Per capita income growth ~5.5% (World Bank 2013)
- Increasing modern retail penetration in both urban and rural areas
  - Hypermarkets, supermarkets, mini-markets
- Shift towards obesogenic diet – (Reardon et al. 2014)
  - Increased consumption of animal fats, oils, sugars and highly processed foods
- Nutrition transition
- Increase in non-communicable diseases
- ~16% obese in Indonesia in 2010 (Roemling and Qaim, 2012)
  - Higher in women
  - 14% of children aged 5 or younger,
  - 9% of children 6-12 years of age
  - Jakarta – 20% of children aged 5 or younger

Study aims

- Test whether a causal relationship exists between:
  - Food market environment,
  - Household food consumption patterns
  - Diet quality
  - Diet-related health outcomes
- "Supermarket Effect" on diet-related health status (over-nutrition)?

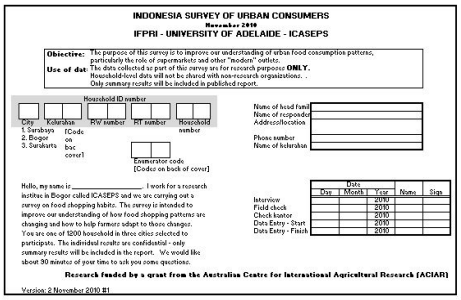
- Unique household-level data
  - Urban Indonesian households, shopping behavior, food consumption and health status
- Diet-related health status
  - Adults (ages 19-65)
  - Children (ages 2-18)
- Address endogeneity

Design of urban consumer survey

- Sample
  - 1180 urban households in three cities
  - Stratified random sample
  - Over-sampling of higher-income households
  - Over-sampling of areas near supermarkets

Design of urban consumer survey

- 16-page questionnaire
  - Household member characteristics
  - **Height and weight**
  - Assets and housing
  - Shopping attitudes and behaviour
  - Food & non-food expenditures
  - Perceptions
  - Attitudes toward certification
  - Nutrition and health status
- Data collection
  - 33 enumerators 3 teams
  - Nov 2010 to Feb 2011



INDONESIA SURVEY OF URBAN CONSUMERS

November 2010

IFPRI - UNIVERSITY OF ADELAIDE - ICASEPS

Objective: The purpose of this survey is to improve our understanding of urban food consumption patterns, particularly the role of supermarkets and other "modern" outlets.

Use of data: The data collected as part of this survey are for research purposes **ONLY.** Household-level data will not be shared with non-research organizations. . . Only summary results will be included in published report.

Household ID number

City (Code on box cover): 1. Surabaya 2. Bogor 3. Surakarta

Kelurahan | RW number | RT number | Household number

Enumerator code (Codes on back of cover)

Name of head fund
Name of respondent
Address/location
Phone number
Name of kelurahan

Hello, my name is _____. I work for a research institute in Bogor called ICASEPS and we are carrying out a survey on food shopping habits. The survey is intended to improve our understanding of how food shopping patterns are changing and how to help farmers adapt to these changes. You are one of 1200 household in three cities selected to participate. The individual results are confidential - only summary results will be included in the report. We would like about 30 minutes of your time to ask you some questions.

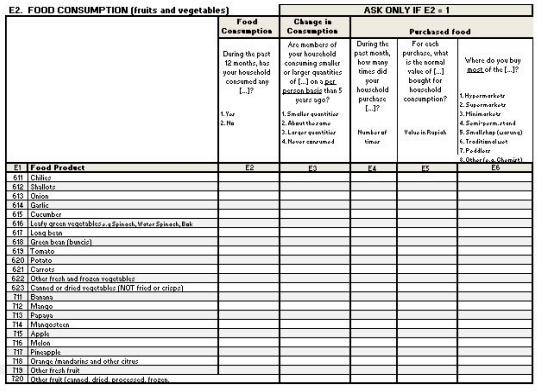
Date	Day	Month	Year	Name	Sign
Interview			2010		
Field check			2010		
Check kantor			2010		
Data Entry - Start			2010		
Data Entry - Finish			2010		

Research funded by a grant from the Australian Centre for International Agricultural Research (ACIAR)

Version: 2 November 2010 B1

Food expenditure module and data

- 67 food categories
  - 7 rice & grain products
  - 3 beans, soy, and tofu
  - 12 animal products
  - 23 fruits & vegetables
  - 22 other (processed, beverages, etc)
- **Expenditures**
  - **Frequency of purchase**
  - **Normal value of purchase**
  - **Main type of store where purchased**



E2. FOOD CONSUMPTION (fruits and vegetables) — ASK ONLY IF E2 = 1

		Food Consumption	Change in Consumption	Purchased food		
		During the past 12 months, has your household consumed any [...]? 1.Yes 2.No	Are members of your household consuming smaller or larger quantities of [...] on a per person basis than 5 years ago? 1.Smaller quantities 2.About the same 3.Larger quantities 4.Never consumed	During the past month, how many times did your household purchase [...]? Number of times	For each purchase, what is the normal value of [...] bought for household consumption? Value in Rupiah	Where do you buy most of the [...]? 1.Hypermarkets 2.Supermarkets 3.Minimarkets 4.Semi-permanent 5.Small stalls (warung) 6.Traditional mart 7.Peddlers 8.Other (e.g. Chemist)
E1	Food Product	E2	E3	E4	E5	E6
611	Chilies					
612	Shallots					
613	Onion					
614	Garlic					
615	Cucumber					
616	Leafy green vegetables: e.g Spinach, Water Spinach, Bok					
617	Long bean					
618	Green bean (buncis)					
619	Tomato					
620	Potato					
621	Carrots					
622	Other fresh and frozen vegetables					
623	Canned or dried vegetables (NOT fried or crispy)					
711	Banana					
712	Mango					
713	Papaya					
714	Mangosteen					
715	Apple					
716	Melon					
717	Pineapple					
718	Orange/mandarine and other citrus					
719	Other fresh fruit					
720	Other fruit (canned, dried, processed, frozen					

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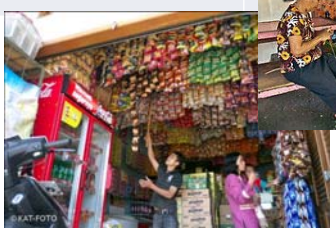
Types of food outlets

Type	Definition
Hypermarket	Very large, modern stores with 10 or more cash registers. Examples: Carrefour, Giant, Macro, and Hypermart.
Supermarket	Medium or large modern stores with 3-9 cash registers. Examples: Hero, Matahari, Asia, and Yogya.
Minimarket	Small, modern stores with 1-2 cash registers. Examples: Alfa and Indomart.

Types of food outlets

Type	Definition
Semi-permanent stand	Vendor who sells from a table, stand, cart, or stall that can be moved, but generally stays in one place during the day. Does not include vendors in a wet market .
Small shop (warung)	Small store selling food products in a building or part of a house, often located in a residential area.



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Types of food outlets

Type	Definition
Traditional (wet) market	Collection of numerous food vendors under one roof or in one location, usually renting space in the building
Peddler	Small-scale vendors operating on foot, on bicycle, with a cart, or from a car/truck, who moving around during the day.

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Measures of Diet-Related Health Status

- BMI, BMI z-scores, Overweight and Obese

- BMIs = individual's weight (kilograms) divided by height^2 (meters^2).
- BMI z-scores = used to normalize BMI (Wang and Chen 2012)
  - Adults
    - Demeaned individual BMI divided by group standard deviation,
    - Group means and standard deviations of BMI are calculated within each age-and-gender-specific cell.
  - Children
    - Group means and standard deviations from the US CDC Growth Charts (2000).

- Measure of overweight and obese
  - WHO (Adults only):
    - Overweight = BMI >25
    - Obese = BMI > 30
  - Indonesian (Adults only, WHO, 2004:)
    - Overweight = BMI >22
    - Obese = BMI > 27
  - Relative measure (Adults and Children):
    - Overweight = BMI exceeds the 85th percentile within his/her age-gender-specific group
    - Obese = BMI exceeds the 95th percentile within his/her age-gender-specific group

Empirical Analysis

$$Y_{ijk} = constant + \beta Supermarket_{jk} + \gamma' x_{ijk} + \theta' h_{jk} + \omega' m_k + u_{jik}$$

- Y_{ijk} = individual health status of adults and children
  - BMI z-score, a continuous proxy for BMI (kg/m^2)
  - Binary indicators for overweight and obese, where
    - *i, j* and *k* denote individual, household and city, respectively
- *Supermarket = share of total household(j) food expenditures made at modern food retail outlets (hypermarkets, supermarkets and mini-markets)*
- x_{ijk} *= individual characteristics*
- h_{jk} *= household characteristics*
- m_k *= city-level time-invariant fixed effects*
- u_{ijk} *= i.i.d error term*

Endogeneity- BMI & Supermarket Expenditures

- Endogeneity - unobserved characteristics affecting food expenditures at supermarkets and health outcomes?
  - E.g. preferences for processed food
- IV regression models estimated using
  - Standard IV
  - Lewbel's (2012, JBES) approach with 2SLS
    - Volpe, Okrent and Leibtag (2013); Schroeter, Anders and Carlson (2013).
    - Assumes heteroskedastic errors
- Instruments
  - IV = *High-quality food products*
  - Lewbel = *Age, number of refrigerators, and household ownership of a motorbike, car, or truck.*

Sample Summary Statistics (1)

Variables	Adult	Child
Household (# of households)	1060	777
Individuals (# individuals)	3269	1398
Supermarket (explanatory variable, 0 to 100)	15.90 (16.21)	16.56 (16.41)
BMI (continuous)	22.60 (4.22)	18.12 (4.46)
Overweight (1 = overweight /obese, 0 otherwise)	0.19 (0.39)	0.20 (0.40)
Obese (1 = obese, 0 otherwise)	0.09 (0.28)	0.09 (0.28)
Time to the Nearest Supermarket (minutes, IV)	7.65 (4.94)	7.68 (4.92)
Age (years of age)	38.9 (12.72)	10.31 (4.91)
Male (1 if male, 0 otherwise)	0.46 (0.50)	0.50 (0.50)

Sample Summary Statistics (2)

Variables	Adult	Child
Education (years completed, continuous)	11.14 (4.34)	N/A
Muslim (1 if Muslim, 0 otherwise)	0.82 (0.39)	0.83 (0.37)
Income (1 if in category, 0 otherwise)		
< 0.5 million IDR per month	0.04 (0.21)	0.04 (0.19)
0.5 to 1 million IDR per month	0.09 (0.29)	0.08 (0.28)
> 1 to 2 million IDR per month	0.25 (0.44)	0.27 (0.45)
> 2 to 5 million IDR per month	0.35 (0.48)	0.35 (0.48)
> 5 to 10 million IDR per month	0.15 (0.36)	0.14 (0.34)
> 10 million IDR per month	0.11 (0.31)	0.12 (0.32)
Family size (continuous)	4.44 (1.73)	4.99 (1.61)
Number of refrigerators (continuous)	0.83 (0.65)	0.83 (0.65)
Own motorbike, car or truck (1 if own)	0.81 (0.41)	0.80 (4.9)
Surabaya	1725 (53%)	699 (50%)
Bogor	777 (24%)	386 (28%)
Surakarta	767 (23%)	313 (22%)

Estimation of Adult BMI z-scores (n = 3269)

BMI z-scores	OLS	IV	Lewbel	IV+Lewbel
Supermarket	-0.001	-0.0105	-0.0014	-0.0022
Age	0.001	0.0056	0.0012	0.0016
Age^2	0.0000	-0.0001	0.0000	0.0000
Male	-0.002	-0.0195	-0.0028	-0.0043
Education	0.0043	0.012	0.0047	0.0053
Muslim	0.2548***	0.2371***	0.2541***	0.2526***
0.5-1 mil. IDR per month	0.033	0.0145	0.0322	0.0306
1 to 2 mil. IDR per month	0.0259	0.0085	0.0252	0.0237
2-5 mil. IDR per month	0.0263	0.0498	0.0274	0.0294
5 - 10 mil. IDR per month	0.1804	0.2573	0.1838	0.1903
> 10 mil. IDR per month	0.1596	0.2912	0.1655	0.1766
Family size	-0.0352***	-0.0337***	-0.0351***	-0.0350***
Refrigerators	0.0747*	0.0901*	0.0753*	0.0766*
Own motorbike, car, truck	0.0975	0.1362	0.0993	0.1025
Bogor	-0.1347***	-0.1277**	-0.1343***	-0.1337***
Surakarta	-0.0449	-0.0658	-0.0459	-0.0476

Regression Estimates: Overweight & Obese Adults

	International cut-off		Indonesian cut-off		Relative measure	
	Overweight	**Obese**	**Overweight**	**Obese**	**Overweight**	**Obese**
			LPM			
Supermarket	0.0003	-0.0002	-0.0005	-0.0001	-0.0001	0.0004
			IV			
Supermarket	0.0152	-0.0017	0.0072	0.002	-0.0001	-0.0051
			Lewbel			
Supermarket	0.0025	-0.0007	-0.0017	-0.0013	-0.0003	0.0002
			IV+Lewbel			
Supermarket	0.0031	-0.0007	-0.0012	0.0011	-0.0003	0.000
Individual attributes	YES	YES	YES	YES	YES	YES
HH attributes	YES	YES	YES	YES	YES	YES
City dummies	YES	YES	YES	YES	YES	YES
Observations	3269	3269	3269	3269	3269	3269
if binary=1	788 (24.10%)	156 (4.8%)	1677 (51.3%)	434 (13.3%)	616 (18.90%)	282 (8.6%)

Estimation of Child BMI z-scores (n = 1398)

BMI z-scores	OLS	IV	Lewbel	IV+Lewbel
Supermarket	0.0084*	0.0017	0.017	0.0164
Age	0.0909*	0.0792	0.1057**	0.1045**
Age^2	-0.0076***	-0.0072**	-0.0081***	-0.0081***
Male	0.0725	0.0722	0.0729	0.0729
Education of household head	-0.0134	-0.0068	-0.0217	-0.0211
Muslim	-0.2370*	-0.2615	-0.2058	-0.2082
0.5-1 mil. IDR per month	-0.7427***	-0.7478***	-0.7363***	-0.7368***
1 to 2 mil. IDR per month	-0.6961***	-0.6950***	-0.6974***	-0.6973***
2-5 mil. IDR per month	-0.7618***	-0.7326**	-0.7988***	-0.7959***
5 to 10 mil. IDR per month	-0.5327*	-0.4696	-0.6127*	-0.6065*
>10 mil. IDR per month	-0.4329	-0.3289	-0.5647	-0.5544
Family size	-0.0196	-0.0175	-0.0222	-0.022
Refrigerators	0.2822**	0.2976*	0.2628**	0.2643**
Own motorbike, car, or truck	0.0326	0.0488	0.0121	0.0137
Bogor	0.0061	0.0049	0.0075	0.0074
Surakarta	0.053	0.0297	0.0826	0.0803
Constant	0.3921	0.4554	0.312	0.3183

Estimation of Overweight & Obese Children by Household Income Groups

Outcome:	Overweight				Obese			
Income group:	**Low**	**Middle**	**High**	**All**	**Low**	**Middle**	**High**	**All**
				LPM				
Supermarket	-0.0001	-0.0002	0.0044**	0.0015	-0.0003	-0.0011	0.0019	0.0004
				IV				
Supermarket	0.0078	-0.0097	0.0621***	-0.0019	0.0118	-0.0138	0.002	0.0008
				Lewbel				
Supermarket	-0.0117	0.0064	0.0193**	0.0089	0.0223	-0.0037	0.0155**	-0.0016
				IV+Lewbel				
Supermarket	0.0003	0.0013	0.0197***	0.0028	0.0011	-0.0002	0.0038**	0.0002
Individual attributes	YES	YES	YES	YES	YES	YES	YES	YES
Parental attributes	YES	YES	YES	YES	YES	YES	YES	YES
HH attributes	YES	YES	YES	YES	YES	YES	YES	YES
City dummies	YES	YES	YES	YES	YES	YES	YES	YES
Observations	543	467	388	1398	543	467	388	1398

'Healthy' food expenditure shares

- Assumption that a close relationship exists between food expenditures and diet
- Volpe, Okrent and Leibtag (2013) "The effect of supercenter-format stores on the healthfulness of consumers' grocery purchases" *AJAE (Oct)*.
  - Used 'USDA Dietary Guidelines for Americans 2010' to categorise 'healthy' vs. other food

$$exphealthy_i = \frac{\sum_g exp_{ig} | g \in healthful}{\sum_{g=1}^{65} exp_{ig}}$$

- *exp* = expenditures
- *i* = household
- *g* = food group

'Healthy' food expenditure shares

$$Exphealthy_i = \alpha + \beta\, Supermktshare_i + \delta' X_i + \varepsilon_i$$

- $Exphealthy_i$ = *share of food expenditures on "healthy food"*
- *Supermarktshare = share of food expenditures at modern retail outlets*
- X_i = *female, age, age2, education, income, Hourjob, Housework, Not_employed, Physical activity, Share food away, Label Surabaya, Bogor*

Results- *Exphealthy*

	OLS	IV	Lewbel	IV+Lewbel
Supermarket	-0.196***	-1.118*	-0.190***	-0.204***
Female	1.946	4.865*	1.926	1.971
Age	0.648***	0.558**	0.648***	0.647***
Age2	-0.006***	-0.005*	-0.006***	-0.006***
Education	0.055	1.383	0.046	0.066
Income	0.000	0.000	0.000	0.000
Hourjob	-0.016	-0.064	-0.015	-0.016
Housework	0.353	1.398	0.345	0.362
Not employed	4.940**	1.79	4.962***	4.913***
Physical activity	0.183*	0.302*	0.182*	0.184*
Surabaya	0.562	4.996	0.531	0.6
Bogor	0.962	4.403	0.938	0.992
Share of food away	-0.182***	-0.234***	-0.182***	-0.183***
Label	0.182	1.234	0.174	0.191
Constant	58.900***	54.914***	58.928***	58.866***

Results- *Exphealthy- Elasticities*

OLS	IV	Lewbel	IV+Lewbel	OLS
Supermarket	-0.043	-0.247	-0.042	-0.045
Female	0.023	0.059	0.023	0.024
Age	0.392	0.338	0.392	0.392
Age2	-0.167	-0.145	-0.167	-0.167
Education	0.008	0.193	0.006	0.009
Income	0.002	0.044	0.002	0.002
Hourjob	-0.004	-0.017	-0.004	-0.004
Housework	0.000	0.001	0.000	0.000
Not employed	0.002	0.001	0.002	0.002
Physical activity	0.006	0.010	0.006	0.006
Surabaya	0.004	0.034	0.004	0.004
Bogor	0.003	0.014	0.003	0.003
Share of food away	-0.02	-0.026	-0.02	-0.02
Label	0.000	0.000	0.000	0.000

Summary (BMI)

- For Adults, no conclusive evidence of a statistically significant relationship between supermarket share of expenditures and the prevalence of overweight and obese adults in a household
- This is after controlling for individual and household characteristics and using instrumental variable approaches to control for unobservable characteristics
  - Religion (Muslim) have higher BMIs
  - Larger family size have lower BMIs
  - Bogor (medium-sized city) lower BMIs than Surabaya

Summary (BMI)

- For children, some evidence to support a link between the use of supermarkets and the probability of a child being overweight or obese
  - **Only true for high-income households**
- Family background and socio-economic factors affect individual BMIs differently and effects are non-linear
  - Age and Age^2
- High income, and a large share of food purchased at supermarkets, may be sufficient to change diets and result in higher prevalence of overweight and obese children.

Summary (Diet Quality)

- **Lower** household expenditure shares on **healthy foods are associated with higher food expenditure shares at "supermarkets"**
  - After controlling for income and education
- **Higher** expenditure shares on **healthy foods**
  - Older, more active, unemployed, **less food consumed away from home**

Conclusions

- Supermarket revolution is associated with
  - Dietary transformation in Indonesia
  - Over-nutrition of children in high-income households
- Diet transition is a concern because of negative impacts on economic growth, development and long term social welfare
- Policy solutions are difficult
- Future work should consider alternate indicators of
  - Individual-level diet quality information
  - Dual-burden
  - Diet quality
  - Nutritional status, diet-related health
  - Food market environment

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