Food Policies and Obesity in Low- and Middle-Income Countries

Kibrom Abay, Country Program Leader and Research Fellow, IFPRI

(with: Hosam Ibrahim, University of Minnesota; Clemens Breisinger, IFPRI)

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1. Introduction

- Global overweight and obesity rates have almost tripled since 1975 and account for about 4 million deaths each year (Shekar and Popkin, 2020)

- The rise in overweight and obesity rates has been relatively higher in LMICs (Ng et al., 2014; Shekar and Popkin, 2020).

- About 70 percent of the globally overweight or obese people – nearly 2 billion people – live in LMICs (Shekar and Popkin, 2020).

▪ The prevalence of NCDs has increased sharply in many LMICs over the last few decades, while declining in high-income countries (Miranda et al., 2019).

▪ The overall annual cost of overweight and obesity in LMICs is projected to reach about USD 7 trillion in the next 15 years (Shekar and Popkin, 2020).

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- Several explanations:
  - Change in lifestyle
  - Nutrition transition
  - Demographic transition (urbanization)
- Food and related public policies are also likely to play an important role in the rise of overweight and obesity in LMICs.
  - Globalization and associated food trade can affect the demand and supply of food (Costa-Font and Mas, 2016).
  - Trade liberalization policies have led to an increase in food imports (Thow et al., 2011; Thow and Hawkes, 2009).
  - Fiscal policies of governments, including direct food subsidies can influence local diets and consumption patterns.
  - Many LMICs have food subsidy or agricultural input subsidy programs.

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- This paper examines the implication of alternative trade and fiscal policies, mainly tariff rates on unhealthy foods and government subsidies, on overweight and obesity rates in LMICs.

- We focus on tariff rates on unhealthy foods: sugars and confectionary items, and fats and oils.

- We employ the share of government expenditure on subsidies, including food and agricultural inputs subsidies.

- We also examine potentially heterogenous responses and relationships across wealth quintiles.
  - We hypothesize that poor and rich households may have varying degrees of exposure to these policies.
  - Poorer households are usually more price-sensitive
  - Food subsidies target poorer households.

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2. Food Policies and Nutritional Implications

- Public policies, including trade and fiscal policies, have the potential to shape global/domestic food systems.

- **Trade Policies:** can affect domestic food systems through several channels.
    - Can increase food imports and hence the availability of various foods
    - May encourage flow of foreign direct investment (FDI)
    - Can influence the relative prices of foods and food choices
    - Can influence consumers' income and purchasing power

- **Domestic Fiscal Policies:** Direct food subsidies are common policy instruments in many LMICs
    - These affect consumers' diets through income and substitution effects
    - Subsidizing foods increases consumers' real income and purchasing power
    - Subsidized food items increase the relative price of nonsubsidized foods, encouraging the substitution of the latter with the former.
   - Many LMICs provide agricultural input subsidies for farmers

# Food Policies and Nutritional Implications
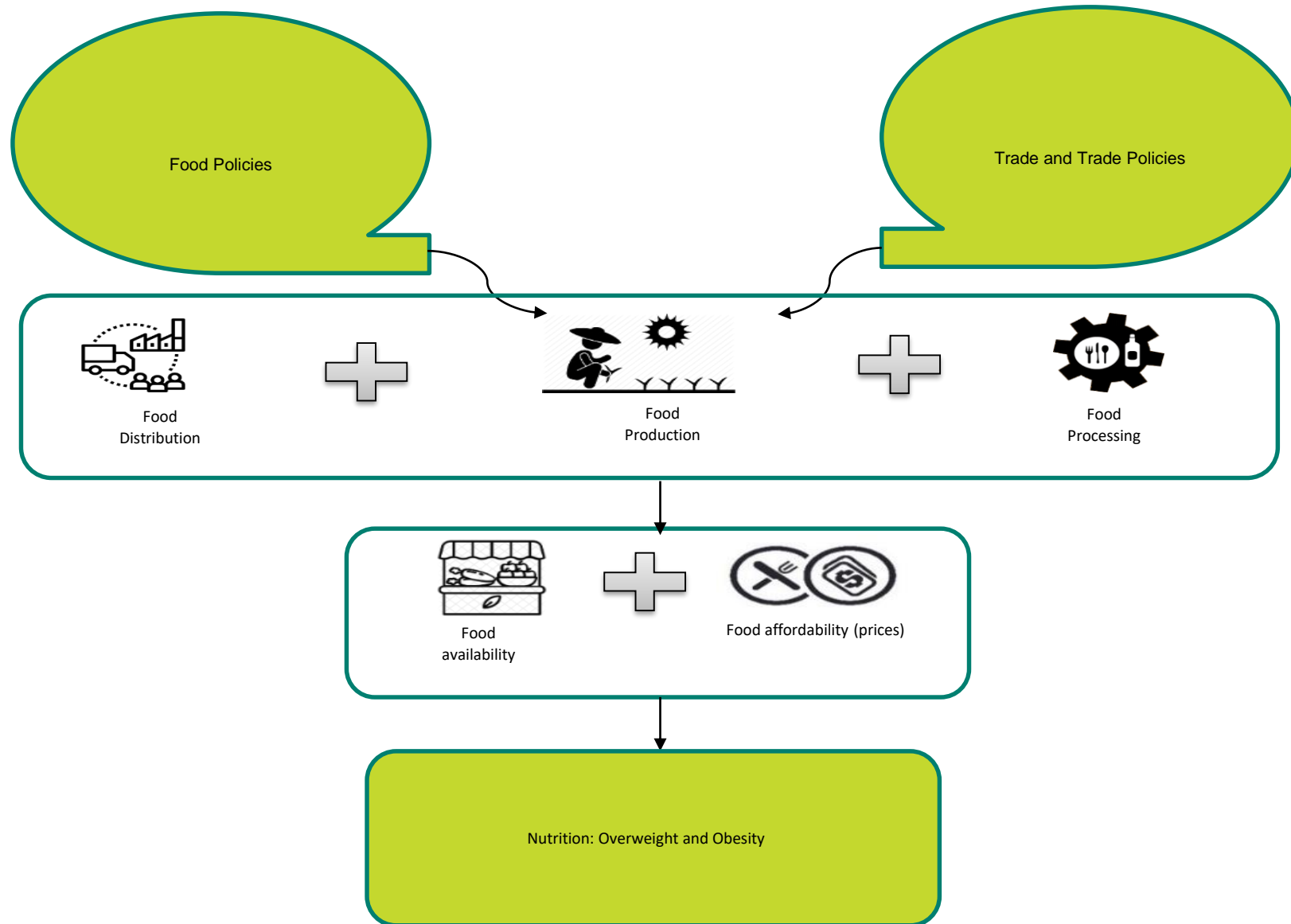
3. Data

- We combine macro-level and micro-level data sources.

- We employ two sources of macro data: the WTO database for tariff rates for several products and countries, and the WDI database from the World Bank for the share of governments' expenditure on subsidies.

- The WTO database provides information on applied tariff rates by commodity

- As "unhealthy" foods are strongly linked with obesity rates, we employ tariff rates on sugars and confectionary products, and on fats and oils.

- We then merge these data with micro-level data from the Demographic and Health Survey (DHS) program

- The DHS data are collected using relatively comparable methods across countries and time, providing detailed anthropometric information for children and adults.

- However, the DHS program mainly focuses on women and children, for which reason we focus our analysis on women.

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- Spatial distribution of BMI
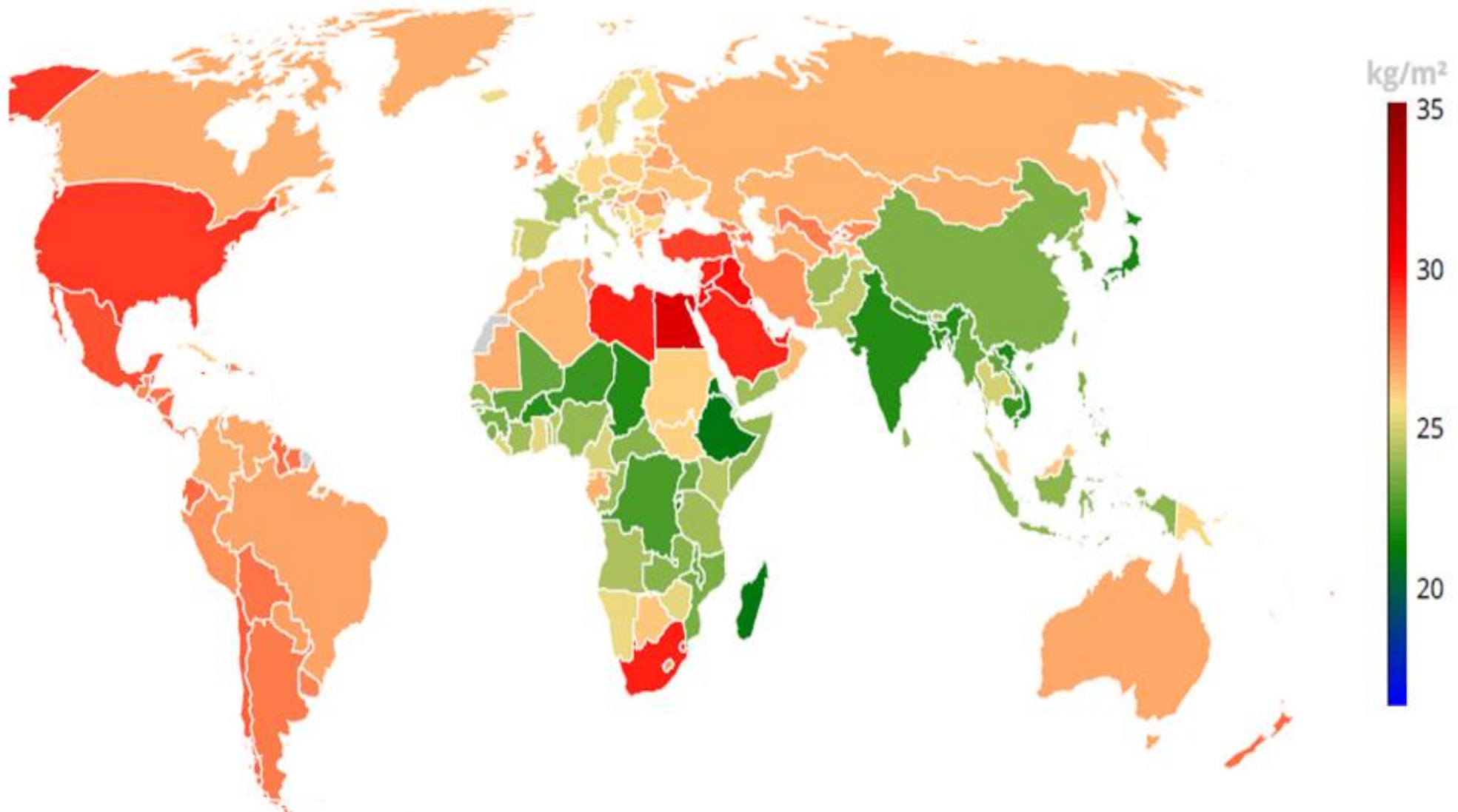
Evolution of trade and food policies
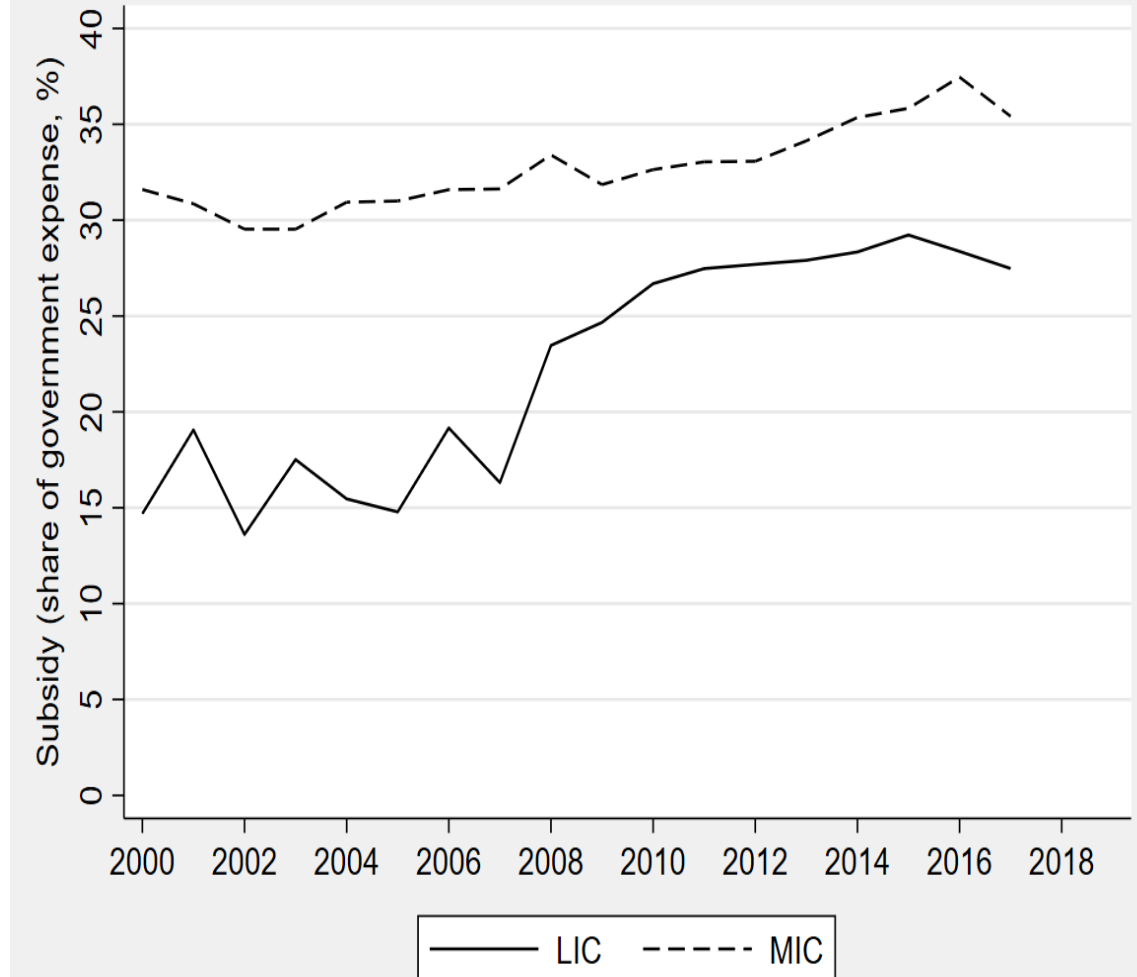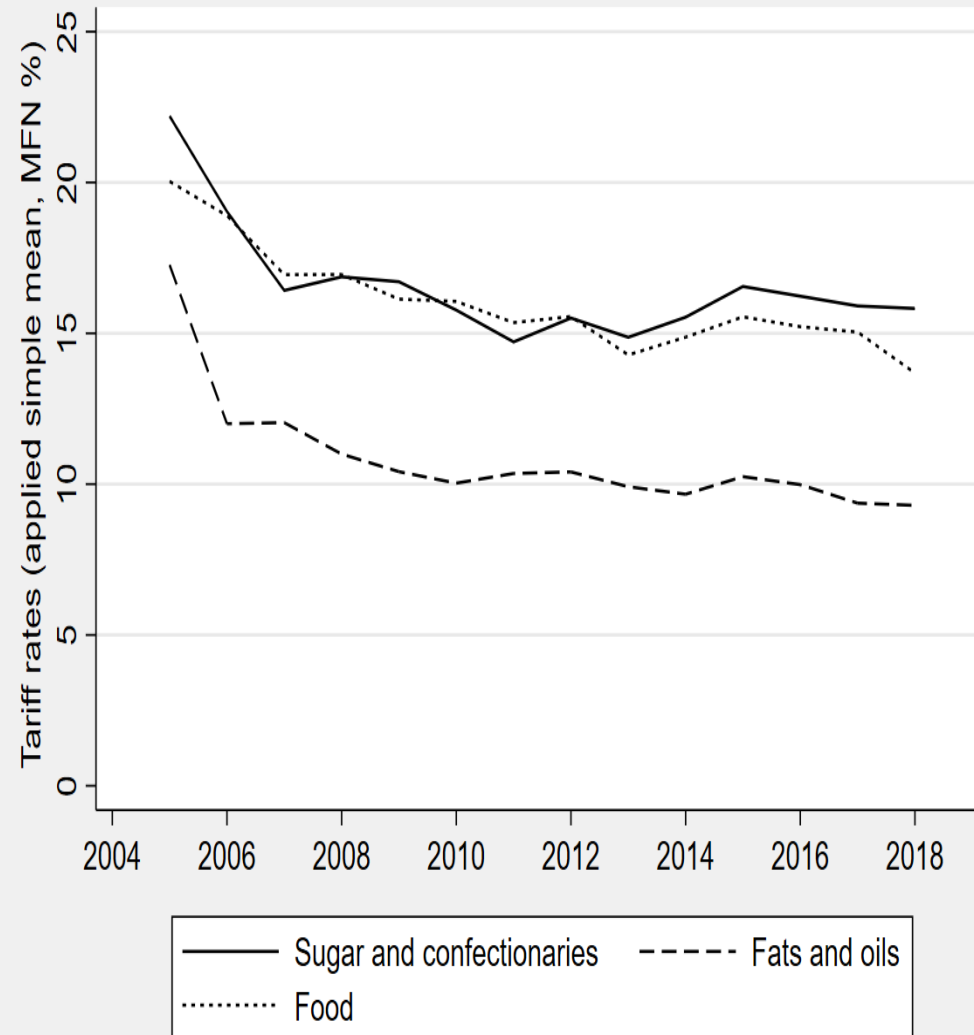
4. Empirical Strategy

- We employ standard fixed effects estimation considering contemporaneous and lagged policies

$$Y_{ict} = \alpha_c + \beta_1 TF_{ct} + \beta_2 X_{ict} + \beta_3 Z_{ct} + \alpha_t + \varepsilon_{ict} \quad (1)$$

$$Y_{ict} = \alpha_c + \delta_1 TF_{ct-1} + \delta_2 X_{ict} + \delta_3 Z_{ct} + \alpha_t + \varepsilon_{ict} \quad (2)$$

- Where Y_{ict} stands for body weight measures for a woman i in country c and survey year t.
- α_c represents a vector of country fixed effects
- TF_{ct} stands for measures and indicators of trade and fiscal policies for each country and time period.

4. Estimation Results

- Tariff rates on different unhealthy foods are strongly (positively) correlated among each other, thus, we separately estimate equation (1) for each item.

- However, tariff rates and share of spending on subsidies are expected to be negatively correlated, those countries with high subsidies have low tariff.
  - Thus, we control both types of policies (tariff rates and subsidies)

- Trade policies may respond to public health concerns.

- Furthermore, some trade policies may need some time to influence domestic food systems and food environments.

- Overweight and obesity rates are also cumulative outcomes of underlying drivers and causes.

- Thus, we also lag key trade policy indicators and estimate the following slightly different empirical specification

Table 1: Average tariff rates on sugar and confectionery food items and body weight outcomes

	BMI			Overweight			Obesity		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Average tariff rate on sugars and confectionery products	-0.455***	-0.344***	-0.258***	-0.040***	-0.033***	-0.026***	-0.023***	-0.017***	-0.016***
	(0.078)	(0.062)	(0.076)	(0.006)	(0.005)	(0.006)	(0.004)	(0.004)	(0.005)
Subsidies (%)	1.638***	1.180***	0.911***	0.128***	0.094***	0.075***	0.070***	0.048***	0.045***
	(0.199)	(0.170)	(0.221)	(0.016)	(0.014)	(0.018)	(0.012)	(0.011)	(0.016)
Subsidies (%) square	-0.034***	-0.025***	-0.017***	-0.003***	-0.002***	-0.001***	-0.001***	-0.001***	-0.001**
	(0.004)	(0.004)	(0.005)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Woman has primary education, 0/1		0.580***	0.581***		0.050***	0.050***		0.017***	0.017***
		(0.022)	(0.022)		(0.002)	(0.002)		(0.001)	(0.001)
Woman has secondary education, 0/1		0.113***	0.113***		0.009***	0.009***		-0.008***	-0.008***
		(0.024)	(0.024)		(0.002)	(0.002)		(0.002)	(0.002)
Woman has tertiary education, 0/1		0.171***	0.171***		0.023***	0.023***		-0.017***	-0.017***
		(0.027)	(0.027)		(0.002)	(0.002)		(0.002)	(0.002)
Woman has given birth, 0/1		2.620***	2.620***		0.234***	0.234***		0.107***	0.107***
		(0.015)	(0.015)		(0.002)	(0.002)		(0.001)	(0.001)
Poorer wealth quintile, 0/1		0.695***	0.695***		0.059***	0.059***		0.032***	0.032***
		(0.020)	(0.020)		(0.002)	(0.002)		(0.001)	(0.001)
Middle wealth quintile, 0/1		1.206***	1.206***		0.099***	0.099***		0.057***	0.057***
		(0.023)	(0.023)		(0.002)	(0.002)		(0.001)	(0.001)
Richer wealth quintile, 0/1		1.811***	1.812***		0.151***	0.151***		0.082***	0.082***
		(0.026)	(0.026)		(0.002)	(0.002)		(0.002)	(0.002)
Richest wealth quintile, 0/1		2.752***	2.753***		0.229***	0.229***		0.122***	0.122***
		(0.030)	(0.030)		(0.003)	(0.003)		(0.002)	(0.002)
Rural households, 0/1		-0.396***	-0.396***		-0.038***	-0.038***		-0.026***	-0.026***
		(0.022)	(0.022)		(0.002)	(0.002)		(0.001)	(0.001)
Log per capita real GDP, 2010 US$			3.551**			0.257*			0.050
			(1.786)			(0.154)			(0.130)
Country fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.202	0.280	0.280	0.166	0.235	0.235	0.106	0.139	0.139
Number of observations	599291	598209	598209	599291	598209	598209	599291	598209	598209

Table 1: Average tariff rate on fats and oils and body weight outcomes

	BMI			Overweight			Obesity		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Average tariff rate on fats and oils	-0.539***	-0.415***	-0.320***	-0.047***	-0.039***	-0.033***	-0.027***	-0.021***	-0.020***
	(0.092)	(0.073)	(0.094)	(0.007)	(0.006)	(0.008)	(0.005)	(0.004)	(0.006)
Subsidies (%)	1.743***	1.274***	1.010***	0.137***	0.103***	0.085***	0.075***	0.052***	0.051***
	(0.215)	(0.182)	(0.248)	(0.018)	(0.015)	(0.021)	(0.013)	(0.012)	(0.017)
Subsidies (%) square	-0.039***	-0.029***	-0.021***	-0.003***	-0.002***	-0.002***	-0.002***	-0.001***	-0.001**
	(0.005)	(0.004)	(0.006)	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)
Woman has primary education, 0/1		0.580***	0.581***		0.050***	0.050***		0.017***	0.017***
		(0.022)	(0.022)		(0.002)	(0.002)		(0.001)	(0.001)
Woman has secondary education, 0/1		0.113***	0.113***		0.009***	0.009***		-0.008***	-0.008***
		(0.024)	(0.024)		(0.002)	(0.002)		(0.002)	(0.002)
Woman has tertiary education, 0/1		0.171***	0.171***		0.023***	0.023***		-0.017***	-0.017***
		(0.027)	(0.027)		(0.002)	(0.002)		(0.002)	(0.002)
Woman has given birth, 0/1		2.620***	2.620***		0.234***	0.234***		0.107***	0.107***
		(0.015)	(0.015)		(0.002)	(0.002)		(0.001)	(0.001)
Poorer wealth quintile, 0/1		0.695***	0.695***		0.059***	0.059***		0.032***	0.032***
		(0.020)	(0.020)		(0.002)	(0.002)		(0.001)	(0.001)
Middle wealth quintile, 0/1		1.206***	1.206***		0.099***	0.099***		0.057***	0.057***
		(0.023)	(0.023)		(0.002)	(0.002)		(0.001)	(0.001)
Richer wealth quintile, 0/1		1.811***	1.812***		0.151***	0.151***		0.082***	0.082***
		(0.026)	(0.026)		(0.002)	(0.002)		(0.002)	(0.002)
Richest wealth quintile, 0/1		2.752***	2.753***		0.229***	0.229***		0.122***	0.122***
		(0.030)	(0.030)		(0.003)	(0.003)		(0.002)	(0.002)
Rural households, 0/1		-0.396***	-0.396***		-0.038***	-0.038***		-0.026***	-0.026***
		(0.022)	(0.022)		(0.002)	(0.002)		(0.001)	(0.001)
Log per capita real GDP, 2010 US$			3.062			0.207			0.019
			(1.872)			(0.162)			(0.137)
Country fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.202	0.280	0.280	0.166	0.235	0.235	0.106	0.139	0.139
Number of observations	599291	598209	598209	599291	598209	598209	599291	598209	598209

Notes: Standard errors, clustered at each DHS cluster for each survey round, are given in parentheses. The base education outcome is no education, while the base wealth quintile is the poorest wealth quintile. BMI = Body mass index (kg/m^2) * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

6. Heterogenous Responses and Robustness Exercises

- Trade and fiscal policies may have differential impacts for poorer and richer households.
  - Engel curve: poorer households allocate larger share of their budget (income) to food consumption
  - Healthy foods are more expensive than unhealthy foods (Headey and Alderman, 2019; Hirvonen et al., 2020)
  - Most subsidy programs, including those for food and for agricultural inputs, target poorer households.

- To empirically test these hypotheses, we split our full sample across wealth quintiles and estimate the empirical specification in equation (1)

- The relationship between tariff rates on unhealthy foods and body weight appears to be strong for the poorest households, while such relationships disappear for wealthier households.

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Table 5: Heterogeneous implications of tariff rates on sugars and confectionery products

	Poorest quintile		Poorer quintile		Middle quintile		Richer quintile		Richest quintile	
	BMI	Overweight	BMI	Overweight	BMI	Overweight	BMI	Overweight	BMI	Overweight
Average tariff rate on	-0.617***	-0.050***	-0.531***	-0.045***	-0.265*	-0.023*	0.059	-0.011	-0.142	-0.021
sugar and confectionery	(0.130)	(0.012)	(0.138)	(0.012)	(0.144)	(0.013)	(0.147)	(0.012)	(0.174)	(0.014)
Subsidies (%)	2.499***	0.152***	1.616***	0.099***	0.832*	0.055	0.088	0.047	0.483	0.080**
	(0.394)	(0.037)	(0.405)	(0.037)	(0.425)	(0.037)	(0.434)	(0.036)	(0.502)	(0.040)
Subsidies (%) square	-0.056***	-0.003***	-0.034***	-0.002**	-0.013	-0.001	0.005	-0.001	-0.012	-0.002*
	(0.010)	(0.001)	(0.010)	(0.001)	(0.010)	(0.001)	(0.011)	(0.001)	(0.012)	(0.001)
Other controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.310	0.239	0.302	0.248	0.296	0.254	0.273	0.234	0.224	0.193
Number of observations	115,450	115,450	121,445	121,445	120,987	120,987	118,672	118,672	121,655	121,655

Notes: Standard errors, clustered at each DHS cluster in each survey round, are given in parentheses. The base education outcome is no education, while the base wealth quintile is the poorest wealth quintile. BMI = Body mass index (kg/m2). * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 6: Heterogeneous implications of tariff rates on fats and oils

	Poorest quintile		Poorer quintile		Middle quintile		Richer quintile		Richest quintile	
	BMI	Overweight	BMI	Overweight	BMI	Overweight	BMI	Overweight	BMI	Overweight
Average tariff rates on	-0.764***	-0.061***	-0.657***	-0.055***	-0.328*	-0.029*	0.073	-0.014	-0.176	-0.026
fats and oils	(0.161)	(0.015)	(0.171)	(0.015)	(0.178)	(0.016)	(0.183)	(0.015)	(0.215)	(0.017)
Subsidies (%)	2.735***	0.171***	1.820***	0.116***	0.934*	0.064	0.065	0.051	0.537	0.088**
	(0.441)	(0.042)	(0.455)	(0.042)	(0.478)	(0.042)	(0.488)	(0.040)	(0.565)	(0.045)
Subsidies (%) square	-0.066***	-0.004***	-0.042***	-0.003**	-0.017	-0.001	0.006	-0.001	-0.014	-0.002*
	(0.011)	(0.001)	(0.012)	(0.001)	(0.013)	(0.001)	(0.013)	(0.001)	(0.015)	(0.001)
Other controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.310	0.239	0.302	0.248	0.296	0.254	0.273	0.234	0.224	0.193
Number of observations	115450	115450	121445	121445	120987	120987	118672	118672	121655	121655

Notes: Standard errors, clustered at each DHS cluster in each survey round, are given in parentheses. The base education outcome is no education, while the base wealth quintile is the poorest wealth quintile. BMI = Body mass index (kg/m2). * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

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Concluding Remarks and Policy Options

▪ Our findings show significant relationships between trade and fiscal policies and women's body weight outcomes.

  o Temporal dynamics in tariff rates on unhealthy and energy-dense foods are negatively associated with body weight outcomes.

  o An increase in tariff rate on sugar and confectionary foods is associated with reduction in overweight and obesity rates.

  o Those countries increasing their tariff rates on fats and oils are more likely to experience a reduction in average body weight.

  o An increase in government subsidy rate is significantly associated with higher overweight and obesity rates.

▪ More importantly, we also find that the implications of these fiscal policies appear to be more pronounced among poorer households.

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- These findings have important implications for informing public health policies in LMICs
  - Beyond public health policies to address the rise in overweight and obesity rates in LMICs.
  - Governments should consider making these fiscal and trade policies nutrition-sensitive.
- Recent debate on considering health costs in cost-benefit analysis of new trade agreements (WHO, 2015).
- However, trade policies usually require complex arrangements
- Most countries have focused on domestic policies
  - For instance, many governments have enacted alternative forms of taxes on energy-dense foods (e.g., Alsukait et al., 2020; Baker et al., 2018; Thow et al., 2018; Zhen et al., 2014).
- Our findings reinforce that government subsidies, especially those which encourage consumption of unhealthy diets, may have adverse public health implications.

THANK YOU

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Food policies and obesity in low- and middle-income countries

Kibrom A. Abay [a,*], Hosam Ibrahim [b], Clemens Breisinger [a]

[a] International Food Policy Research Institute (IFPRI), Egypt
[b] University of Minnesota, United States

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