The Hidden Role of Piped Water in the Prevention of Obesity in Developing Countries. Experimental and Non-Experimental Evidence

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AEA, 2019

Childhood Obesity in the World.

- As of 2010: 43 million children age $<= 5$ overweight or obese worldwide.
- 35 million live in developing countries.
- In Morocco, 13% children age $<= 5$ overweight or obese
    - one of the highest in the world, surpassing the US and Mexico.

This Study...

- ... investigates whether access to drinking water at home can contribute to the fight against the obesity epidemic in developing countries.
- Benefits of access to drinking water on waterborne diseases (Galiani et al. 2006, Gamper-Rabindran et al. 2010, Duflo et al.2012),

Potential Effect of Access to Piped Water

Lack of piped water at home:

$\rightarrow$ more time and effort to obtain water

$\rightarrow$ higher likelihood waterborne diseases

$\rightarrow\rightarrow$ higher cost of drinking water, cooking and of washing dishes.

$\rightarrow\rightarrow\rightarrow$ more food outside the home (snacks, soft drinks, fast food and street vendors' food)

$\rightarrow\rightarrow\rightarrow\rightarrow$ greater BMI/Obesity

$\rightarrow\rightarrow$ more physical activity

$\rightarrow\rightarrow\rightarrow\rightarrow$ lower BMI/Obesity (but typically kids are not in charge of fetching water).

Street Food in Morocco

Empirically

Off-Setting Effects

$\uparrow AccessWater \rightarrow\downarrow FoodOutSideHome \rightarrow\downarrow BMI$

$\uparrow QualityWater \rightarrow\downarrow FoodOutSideHome \rightarrow\downarrow BMI$

$\uparrow QualityWater \rightarrow \downarrow Diarrhea \rightarrow\uparrow BMI$

- Why is it important to disentangle these effects?

Why disentangle these effects?

- If the effect on diarrhea is strong enough, it can hide the important benefits of water access for maintaining a heathy weight.
  - "normal" BMI due to healthy eating not due to chronic diarrhea.
- Policy relevant:
  - 1/3 urban dwellers in developing countries does not have piped water at home (United Nations, 2015)
  - Not clear that is socially profitable (Fewtrell et al, 2005; Devoto et al, 2012; Bennett 2012), these studies do not include reductions on obesity rates.

Preliminary Results

- Results from the experiment in the city of Tangiers:
  - ▸ access to piped water at home decreased BMI and obesity rates among children age 0 to 5.
- Results from the longitudinal analysis in Cebu:
  - ▸ access to piped water at home decreased BMI among children age 10 to 19.
  - ▸ reduces their consumption of food outside the home,
  - ▸ effect through diarrhea is positive and large enough to "hide" the effect of access to piped water on BMI through the reduction in consumption.

Experimental Data.

- Experiment in Tangiers, Morocco:
- Very high obesity rates
- No effect on diarrhea prevalence (Devoto et al. 2012).
  - ▸ Ideal to isolate the effect!
- Problem: no data on consumption

Non-Experimental Data.

- Longitudinal data from Cebu, Philippines
- Data on children anthropometric ind. and daily diet
- Very different context (far away, more rural, poorer, no childhood obesity): external validity

Morocco Experiment- Setting

- This study exploits an experiment carried out by (Devoto et al. 2012) in the city of Tangiers, north urban area of Morocco.

- Households had access to an interest-free loan for the connection to the water network (at full cost) provided by local authorities.
- The treatment encouraged take-up of a loan (information, marketing campaign, pre-approving the loan and collecting of the down-payment at home).

Morocco Experiment

- The randomization was done at a "cluster" level (two adjacent plots or two plots facing each other)
- It was stratified by location, water source, the number of children 5 or younger, and the number of households within the cluster.
- This study works with the subsample of children ages 0 to 7 (in the Endline), since anthropometric indicators were taken only from them.
- Baseline was collected in August 2007, and Endline 5 months after the water connection (6 months after the intervention).

Balance Check

	Obs.	Treatment	Control	P-Value (T=C)
BMI-for-age	159	0.9	1.0	0.69
Obesity	159	26%	17%	0.19
Num. members	344	5.7	5.9	0.39
Num. children <=7	344	1.6	1.9	0.01
Num. children <=7 (Endline)	344	1.8	1.9	0.23
Assets score	344	0.0	0.4	0.03
Head income	344	1,189	1,173	0.89
Family income	315	4.5	4.7	0.27
Num. rooms per person	342	0.7	0.6	0.23

First Stage

	Piped Water at Home
	coef/se
Treatment	0.617***
	(0.056)
Mean Control Group	0.196
Number of observations	344
R2	0.376

Note: Control variables include number of kids age 7 or younger and assest quintile. Standard errors are clustered at cluster level.

Note: *** p<0.01, ** p<0.05, * p<0.1

Diarrhea

Diarrhea Prevalence
coef/se

Treatment	0.005
	(0.109)
Mean Control Group	0.219
Number of observations	309
R2	0.064

Note: Control variables include number of kids age 7 or younger and assest quintile. Standard errors are clustered at cluster level.
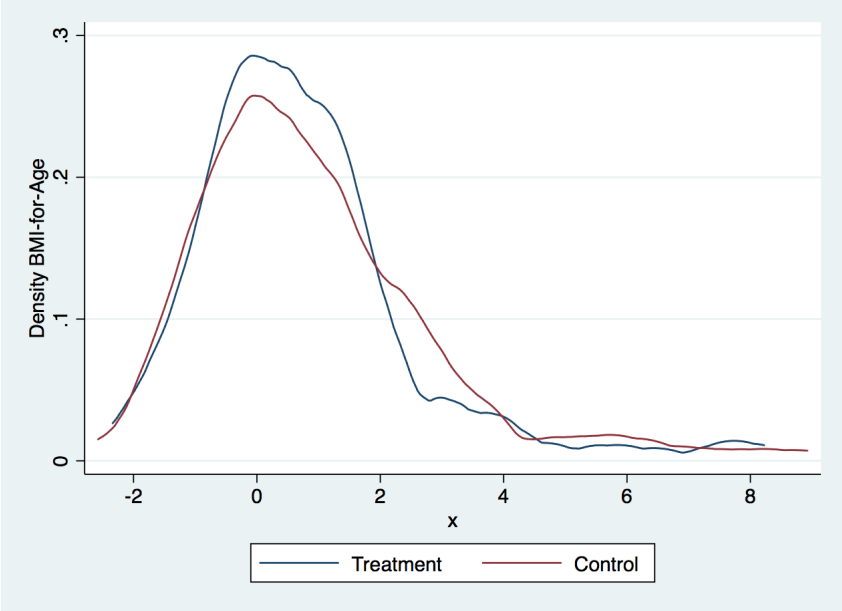
Note: *** p<0.01, ** p<0.05, * p<0.1

Results- BMI Distribution 5 Months after the Connection

Results

	Std. BMI for Age		Obesity Rate	
	ITT	2SLQ	ITT	2SLQ
	coef/se	coef/se	coef/se	coef/se
Treatment	-0.150	-0.243	-0.101**	-0.164**
	(0.124)	(0.201)	(0.047)	(0.078)
Mean Control Group	0.043	0.073	0.216***	0.242***
Number of observations	344	344	344	344
R2	0.026	0.020	0.034	.

Robustness

- It is possible, however, that my results are spuriously generated by the small number of observations.

Test

$$Y_{i,t} = \beta_o + \beta_1 T_{i,t-1} + \beta_2 T_{i,t-1} PublicTap_{i,t-1} + \beta_3 X_{i,t} + \varepsilon_{i,t}$$

- Test also for alternative story (income effect).

Robustness

	Std. BMI for Age		Obesity Rate	
	ITT	**2SLQ**	**ITT**	**2SLQ**
	coef/se	coef/se	coef/se	coef/se
Treatment	-0.248*	-0.411*	-0.120**	-0.198**
	(0.132)	(0.221)	(0.049)	(0.085)
Treatment x public tap	0.584*	0.965	0.116	0.197
	(0.355)	(0.615)	(0.130)	(0.213)
Public tap	-0.197	-0.379	-0.034	-0.071
	(0.236)	(0.327)	(0.094)	(0.124)
Mean Control Group	0.065	0.121	0.218***	0.249***
Number of observations	344	344	344	344
R2	0.038	0.004	0.038	.

Magnitudes

Common Misbeliefs:

- It requires a significant change in calories to obtain a change in the obesity rate of a society.

  - 3 Oreo cookies could explain the obesity increase in the US in the last decades (Culter et al. 2003)
  - Obesity rates change proportionally more than average weight of the population. Culter et al. (2003): self-control.

- It takes a long period of time to gain weight.
  - 65% of the effect on weight of a change in diet happens by 1 year and 95% happens by 3 years (Hall et al. 2011). Moreover, changes in consumption might not permanent.

My Results:

- 3 pounds $\rightarrow$ 111 calories per day. (1.5 Chebakia or street cookie).
- LATE: compliers are high income, low education

Cebu: Non-Experimental Evidence.

- Cebu Longitudinal Health and Nutrition Survey

- Cohort of children of the born 1983-1984
- Anthropometric indicators and diet diaries
- Rounds: 1994, 1998, 2002. (Ages 10- 19)
- Empirical strategy: child Fixed Effect

Cebu: Summary Statistics.

	Total		Piped Water at Home	
			With	**Without**
	Obs.	**Mean**	**Mean**	**Mean**
Age (in years)	5,377	15.03	15.51	14.96
		(2.99)	(3.01)	(2.98)
BMI-for-age	5,377	-0.89	-0.75	-0.91
		(0.97)	(1.06)	(0.96)
Overweight (%)	5,377	4%	6%	3%
		(0.18)	(0.23)	(0.18)
Obesity (%)	5,377	0%	0%	0%
		(0.00)	(0.00)	(0.00)
Diarrhea (%)	5,377	86%	86%	86%
		(0.35)	(0.35)	(0.35)
Urban (%)	5,636	72%	96%	67%
		(0.45)	(0.19)	(0.47)
Piped water at home (%)	5,636	17%	100%	0%
		(0.38)	(0.00)	(0.00)
Piped water anywhere (%)	5,636	38%	100%	25%
		(0.49)	(0.00)	(0.43)
Home-made food (%)	5,540	71%	66%	73%
		(0.21)	(0.21)	(0.20)

Results: Food Out-side the Home.

	Food outside the home (grs/day)		Soft drinks (mls/day)	
	(1) coef/se	**(2)** coef/se	**(1)** coef/se	**(2)** coef/se
Piped water inside home or yard	-41.334**	-44.555**	-12.666	-17.525*
	(17.995)	(19.377)	(9.030)	(9.596)
Piped water inside home or yard x no diarrhea		20.994		31.980
		(51.299)		(26.661)
Number of observations	5,636	5,636	5,636	5,636
R2	0.118	0.118	0.159	0.159

Note: *** p<0.01, ** p<0.05, * p<0.1

Note: regressions include individual FE, year FE, Barangay FE and controls for family income and number of children.

Results: Home-made Food.

	Home-made food (grs/day)		Milk (mls/day)	
	(1) coef/se	(2) coef/se	(1) coef/se	(2) coef/se
HH has piped water inside home or yard	6.762	-1.577	0.328	0.246
	(20.102)	(22.522)	(0.723)	(0.775)
Piped water inside home or yard x no diarrhea		54.430		0.560
		(45.959)		(2.035)
Number of observations	5,583	5,583	5,631	5,631
R2	0.167	0.167	0.046	0.046

Note: *** p<0.01, ** p<0.05, * p<0.1

Note: regressions include individual FE, year FE, Barangay FE and controls for family income and number of children.

Cebu: BMI-for-Age.

	Std BMI-for-age		Overweight Rate	
	(1) coef/se	**(2)** coef/se	**(1)** coef/se	**(2)** coef/se
Piped water inside home or yard (lag)	0.014	-0.263***	0.018	-0.016
	(0.051)	(0.099)	(0.013)	(0.020)
Piped water inside home or yard x diarrhea (lag)		0.319***		0.040
		(0.114)		(0.025)
Number of observations	5,377	5,377	5,377	5,377
R2	0.143	0.145	0.045	0.045

Note: *** p<0.01, ** p<0.05, * p<0.1

Note: regressions include individual FE, year FE, Barangay FE and lagged controls for family income and number of children.

Contributions.

- Access to piped water at home might play an important role in the fight against obesity in developing countries.

- Cost and benefit analyses of piped water at home might be sub-estimating the benefits.
- Better understanding of the demand and willingness to pay for piped water at home.