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

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Abstract

Child obesity in developing countries is growing at an alarming pace. This study investigates whether expanding access to piped water at home can contribute to stopping this epidemic. It exploits experimental data from Morocco and longitudinal data from the Philippines and finds that access to piped water at home reduces childhood BMI and obesity rates. This study further shows that the effect is generated by a reduction in the consumption of soft drinks and food prepared outside the home. Finally, the study shows that the effect of access to piped water on healthy nutritional status can be hidden, if access of piped water at home reduces diarrhea prevalence, since this in turn increases BMI.

1 Introduction

As of 2010, there were 43 millions children worldwide age 5 or younger overweight or obese. Of these, 35 millions live in developing countries (Harvard, 2018). In Morocco, the overweight rate for children under five years of age is one of the highest

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in the world, surpassing the US and Mexico. Obesity can seriously deteriorate children heart, lungs, muscles and bones, kidneys and digestive tract, and hormones that control blood sugar and puberty. It increases the likelihood of adult obesity , and with that increases the risk of cardiovascular diseases and of unemployment. This study investigates whether access to drinking water can contribute to the fight against the obesity epidemic in developing countries. Numerous studies have shown the benefits of access to drinking water on waterborne diseases (Galiani, Gertler and Schargrodsky, 2005; Gamper-Rabindran, Khan and Timmins, 2010), but to the best of my knowledge, no study has investigated whether access to piped water at home reduces body weight and obesity rates.

Since lack of piped water at home increases the cost of drinking water, it might induce people to substitute toward soft drinks, or other liquids high in calories. Likewise, lack of piped water at home increases the cost of cooking and of washing dishes, thus, it might induce people to substitute toward eating food outside the home including snacks, fast food and street vendors' food that typically have more calories than home-made food. The two implicit conditions for this to happen is, first, that families that do not have piped water at home do have enough money and do have access to soft drinks, snacks, fast food or street-vendors food. This, of course, is not the case in many rural areas and among extremely poor individuals in developing countries. However, lack of access to piped water at home is far from being a problem exclusively from extremely poor individuals and from rural areas; one in every three urban dwellers in developing countries does not have piped water at home (UnitedNations, 2015). Meanwhile, western food companies are targeting developing countries as the richest nations are shrinking their demand (Jacobs and Richtel, 2017; Euromonitor-International, 2010; Deogun, 1999).

The second condition is that food outside the home, especially high-calorie food like soft drinks, snacks, street vendors food and fast-food, is a substitute of water and home-made food. This condition does not necessarily hold; families might demand only closer substitutes like bottled water or water from private trucks, and communal "home-made" food, for example. In this regard, there is evidence that at least water and soft drinks are substitutes, moreover, that contaminated water and soft drinks are substitutes; Ritter (2018) finds that households without piped water at home were especially responsive to a drastic decrease in the price of soda in Peru, increasing their consumption of soda and their obesity rates, while reducing diarrhea prevalence, suggesting that they reduced their consumption of contaminated water.

In principle, therefore, it is plausible that if families get access to piped water at home they will reduce their consumption of food outside the home, and this might reduce their obesity rates. Empirically, however, it is not easy to test this claim. First, access to piped water at home is typically not random; individuals with a higher income are more likely to have water at home and are also more likely to drink soft drinks and eat fast-food (while in developed countries they might be inferior goods, in developing countries these types of food are typically normal goods), people who have access to piped water at home also typically live in more urbanized areas with more access to stores, street vendors and markets. Second, access to clean water at home might reduce the consumption of food outside the home but it might also reduce diarrhea prevalence, and a reduction in diarrhea prevalence has the opposite effect on BMI (Kremer et al., 2011). Thus, BMI should decrease with the reduction in the consumption from eating outside the home, but increase with the reduction in diarrhea. If the effect on diarrhea is strong enough, it can hide the important benefits of drinking water access for maintaining a heathy weight; after all, having a normal BMI (greater than 18 and smaller than 25) by offsetting the effect of consuming high-calorie snacks and street food with chronic diarrhea is not as healthy as having a normal BMI by consuming home-made food.

This study examines the effect of access to piped water at home on BMI and obesity rates, exploiting both experimental and non-experimental data. The experimental data comes from a social experiment carried out by Devoto et al. (2012) in the city of Tangiers, Morocco. None of the households that took part in the experiment had piped water at home in the baseline but all of them had access to a nearby public tap with clean water. Connection to piped water at home improved the quantity of water consumed but not the quality, and therefore had no effect on diarrhea prevalence Devoto et al. (2012). This context is ideal for the analysis of the present paper, because it allows me to isolate the effect on BMI through the potential effect on consumption of food outside the home, without the potential offsetting effect of diarrhea on BMI. This estimation is relevant not only as an empirical exercise, but also for public policy recommendations; there have been great advances in improved water sources worldwide but access to piped water at home is still very limited (Duflo, Galiani and Mobarak, 2012). Moreover, some studies suggest it is not clear that is socially profitable (Fewtrell et al., 2005; Devoto et al., 2012; Bennett, 2012), these cost and benefit analyses, however, do not include the potential effect of access to piped water at home on obesity rates.

The non-experimental data comes from the Cebu Longitudinal Health and Nutrition Survey, a cohort of Filipino women and their children from the Metropolitan Cebu area. The childhood obesity in this area is very low, as opposed to the city of Tangiers. Thus, the present study uses this data to apply an “acid” test of the external validity of the experiment in Morocco. Additionally, this data has daily diet information, allowing me to investigate potential channels.

Results from the experiment show that access to piped water at home decreased BMI and obesity rates among children age 0 to 5 in the city of Tangiers, Morocco. Results from the longitudinal analysis, in a very different context with zero childhood obesity in (Cebu, Philippines), also show that access to piped water at home decreased BMI among children age 10 to 19. Furthermore, results from this analysis confirm the hypothesis that access to piped water at home reduces consumption of of soft drinks and food outside the home, and that the effect of access to piped water on BMI through diarrhea is positive and large enough to “hide” the effect of access to piped water on BMI through the reduction in consumption.

Obesity, in particular childhood obesity is increasing at an alarming pace. Very few interventions have thus far proven to be effective in the fight against this epidemic (Cawley, 2015). This study shows that access to piped water at home has additional social benefits and that it can play an important role in the fight against obesity.

2 Experimental Evidence

2.1 Setting and Experimental Design

This study exploits an experiment carried out by Devoto et al. (2012) in the city of Tangiers, north urban area of Morocco. The original purpose of the experiment was to estimate the effect of households' connection to the drinking water network on several well-being indicators including water-borne diseases, time use, social integration and mental well-being. The intervention consisted of information about and assistance with the application for a loan to finance the connection to the water network. The loan was offered by Amendis, the local water provider, as part of a program that sought to increase access to the water and sanitation network. The connection to the water network was at full cost, but the loan was interest-free. The treatment encouraged take-up of the loan by providing information and a marketing campaign, pre-approving the loan and offering the collection of the down-payment at home, saving them the trip to the branch office.

Devoto et al. (2012) selected a sample of 845 households from three zones of the city of Tangiers. The households selected had no water connection at home but had a public tap in their neighborhoods. The randomization was done at a "cluster" level, where a cluster was defined as two adjacent plots or two plots facing each other on the street or up to one house apart. It was stratified by location, water source, the number of children under five, and the number of households within the cluster. Data was collected before the intervention in August 2007 (hereafter "Baseline"), and 5 months after the water connection (6 months after the intervention), in August 2008 (hereafter "Endline").

2.2 Summary Statistics and Balance Check

The sample of the original experiment consists of 315 clusters and 434 households in the treatment group and 311 clusters and 411 households in the control group.

This study works with a subsample, since anthropometric indicators were taken only from children ages 0 to 7 (in the Endline). The resulting number of observation in the Endline is 347, corresponding to 126 clusters and 146 households in the treatment group and 105 clusters and 115 households in the control group.

BMI is calculated by the ratio of weight in kilograms divided by the square of height in meters. Definitions of anthropometric indicators follow the World Health Organization (WHO) 2006 standards. BMI-for-age is age- and sex-specific and represents the (standardized and adjusted) deviation of a child's BMI from the median value of a reference population selected by WHO. Overweight and obese children are defined as those with BMI-for-age greater than one and two standard deviations, respectively. Underweight children are those with BMI-for-age lower than negative two standard deviations.

Table 1 shows the balance check in the baseline from this subsample. One inconvenient of the data is that the number of children with anthropometric indicators in the Baseline is less than half of that in the Endline, and the number is in fact too small to detect significant differences. Fortunately, the most important outcome variable, obesity rate, is actually higher for the treatment group then for the control group.

In terms of household variables, we do have the same number of observations in the baseline and endline. We can see only two significant differences between treatment and control group. One is in the number of children age 15 or less. We can see however, that the difference in the Endline of the number of children age 7 or less (that is our sample of interest) is not significantly different. The second difference is in an assets indicator. This indicator was constructing following Devoto et al. (2012)'s strategy, and should reflect differences in wealth or income. However, in Devoto et al. (2012)'s sample there is no difference in this indicator, and in our sample, there is no significant difference in any other income or wealth indicator.

It is important to notice that by sample design no household in either group had access to piped water at home but all households have access to piped water from a public tab. The average distance to water is 142 meters. This distance might not seem too large, but just not having the water in the convenience of home might make a lot of difference.

Morocco has one of the highest rates of childhood obesity in the world according to the WHO. This sample is not the exemption: between 16% and 18% of the children age 0 to 5 were obese in the baseline. It is important to note, that weight was taken two times, and I work with the average weight in order to calculate the BMI and BMI-for-age. Moreover, I eliminate observations with the BMI from the percentile 99 and 1 in order to eliminate impossible values. Nevertheless, my sample's average is much less precise than those of the reference population; instead of a standard deviation of one, this sample has a standard deviation of circa 2.

2.3 Empirical Strategy

This section estimates intent-to-treat effects (ITT) and local average treatment effects (LATE). The ITT estimator captures the effect of being selected for treatment (but not necessarily treated). This effect is estimated from the following specification:

$$Y_{i,j} = \beta_o + \beta_1 T_j + \beta_2 X_{i,j} + \varepsilon_{i,j}$$

where $Y_{i,j}$ stands for BMI or other outcome for child i in cluster j, T_j stands for whether the cluster j was selected to the treatment, $X_{i,j}$ stands for baseline characteristics children i in cluster j, and $\varepsilon_{i,j}$ stands for the error term. Baseline characteristics include: a dummy that indicate whether the household was connected by a hose to the neighbor's or a public tap, an assets indicator, the number of adults with a paid job and whether or not the water they had access to before the treatment tasted good.

The LATE estimator captures the effects of actually having received the treatment, using the selection to the treatment as an instrumental variable. The first stage estimates the effect of being selected for the treatment on the probability of being connected to the water network from the following specification:

$$C_{i,j} = \beta_2 + \beta_3 T_j + \beta_4 X_{i,j} + \varepsilon_{i,j}$$

where $C_{i,t}$ stands for whether the child lives in a house connected to the water network.

The second stage estimates the effect of being connected to the water network on some outcome from the following specification:

$$Y_{i,j} = \beta_o + \beta_1 \hat{C}_{i,j} + \beta_2 X_{i,j} + \varepsilon_{i,j}$$

where $\hat{C}_{i,j}$ stands for the predicted probability of being connected to the water network estimated in the first stage.

All the regressions have standard errors clustered at the cluster level. Under the assumption of constant treatment effect, β_1 could be interpreted as the average treatment effect. In the absence of such assumption, this estimator should be interpreted as the effect of access to the water network on weight outcomes of children of the "complier" households. That is, households that were encouraged by the intervention to connect to the water network but would not have done so in the absence of the intervention.

2.4 Results Experimental Evidence

As explained above this intervention relied on an encouragement design as opposed to a direct intervention. Hence, the first question we need to assess is whether the intervention increased water connection significantly. Table 2 shows that, in fact, the intervention successfully encouraged water connections; 80% of the treatment group got connected to the water network, while only 19% of the control group did. Column 2 shows that this estimation changes little with the inclusion of control variables.

Table 3 presents the effect of the treatment on BMI-for-age. The first and third column show the estimated ITT without and with controls, respectively. According to our preferred estimate (column 2), 6 months after the intervention children of the treatment group have average BMI-for-age lower than children of the control group by 0.35 units or 0.18 standard deviations. Column 2 and 4 show the LATE estimates without and with controls, respectively. As expected, these estimates are larger in magnitude but not significant.

Table 3 also presents the effect of the treatment on obesity rates. The first column shows that 6 months after the intervention, 23% of the children of the control group are obese, while only 12% of the children of the treatment group are obese, and this difference is statistically significant. According to the LATE estimator, the effect of being connected to the water network reduced the probability of being obese by almost 10 percentage points. As we know, these estimates capture the effect of access to the water network on the likelihood of being obese of children of the "complier" households. Since the intervention consisted in information and assistance with the loan, but no difference in the loan conditions, those in the pool of households who connected to the network as a consequence of the intervention may not have been very educated but had enough money to repay the loan. Note that this pool of households might have particularly large effects, insofar as low-educated households are less aware of the detrimental consequences of childhood obesity, and households with enough money to repay the loan can also probably afford to buy high-caloric beverages instead of walking to the nearest public tap to drink free water. Thus, my estimated Local Treatment Effect (LATE) might be significantly higher than the average treatment effect of connecting to water network. Still, the effects are so large that, even if the average effect is considerably smaller, it might still be economically and statistically different from zero.

Table 3 shows the effect of the treatment on the BMI and obesity rates calculated with the averages of the two measures there are in the data. It is important to mention, however, that the estimations on the two BMI measures, separately, are almost identical from each others (results from these regression are available upon request). Still, it is possible that the results in BMI and obesity rates are spuriously generated by the small number of observations. Therefore, as a mean to increase the reliability of the results, I test the following hypothesis; if my results reflect the effect of the program, the effect should be smaller for households that before the program were connected to the public tap either through a hose or an informal pipe, since they already had running water at home. On the contrary, if the true effect of the program would be zero, it shouldn't be any different for people that before the program were connected to the public tap either through a hose or an informal pipe. Table 4 shows the estimation results. We can see that the effects of the program on BMI and obesity rates come mostly from households that before the program were not connected to the public tap.

3 Non-Experimental Evidence

3.1 Data and Summary Statistics

This section exploits data from the Children of the Cebu Longitudinal Health and Nutrition Survey. This study follows a cohort of Filipino women and their children from the Metropolitan Cebu area who were born between May 1, 1983, and April 30, 1984 . After the baseline, they surveyed children's anthropometric indicators and diet diaries in 1991, 1994, 1998, 2002, 2005. However, I only work with data until 2002, since the WHO standards that are used to calculate the BMI-for-age are comparable only up to age 19 and there are no children age 19 or younger in year 2005. Additionally, information about whether children had piped water at home, our main explanatory variable, was collected only since 1991,[1] and since I use lagged variables to estimate the effect on BMI, I am not able to estimate the effect on BMI for year 1991. Finally, the first round of food diaries in 1991 differs from the following diaries, which means I am also not able to use the food diaries from 1991. I restrict the sample to the urban barangays, which represent 73% of the sample. Nevertheless, the results remain significantly similar when I work with the complete sample.

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[1] Explain how they collected water in the baseline

Table 5 shows the summary statistics of my sample. Children are 15 years old and weight 40 kilos on average. The overweight rate is only 4% and there are no obese children. This represents a very different context from Tangiers. However, this is unsurprising given that even with respect to the urban population/areas from Cebu, only around half of the sample lives within walking distance of a store. Only 12% has access to piped water at home and 36% has access to piped water either inside or outside the house. Walking time to a source of water is 2.4 minutes on average. 41% of women fetched water and spent 40 minutes doing so in the week previous to the baseline. Women at that time, however, were pregnant, so these numbers might be underestimating the real percentage and time of women fetching water regularly.

Table 5 also shows, as we would expect, that children with piped water at home have mothers with higher incomes, live in more populated areas, eat more food outside the home, drink more sodas and are more likely to be overweight.

3.2 Model and Empirical Strategy

This section exploits the longitudinal feature of the data to apply a Fixed Effect Model at the individual level. The effect on food consumption is estimated from the following specification:

$$Y_{i,t} = \beta_o + \beta_1 Water_{i,t} + \beta_2 X_{i,} + \alpha_i + \phi_t + \varepsilon_{i,t}$$

where $Y_{i,t}$ stands for the consumption of food outside the home or other type of consumption of child i in year t, $Water_{i,t}$ stands for whether the child i had piped water at home in year t, $X_{i,t}$ stands for control variables of child i inyear t, α_i and ϕ_t stand for child and year fixed effect, respectively, and $\varepsilon_{i,t}$ stands for the error term. Control variables include: mother's income and fixed effects of the barangay where the child currently lives. The same child can live in several barangays across rounds, because this survey follows the children and their families even if they move.

The effect on standardized BMI-for-age and overweight rate is estimated from the following specification:

$$Y_{i,t} = \beta_o + \beta_1 Water_{i,t-1} + \beta_2 Water_{i,t-1} Diarrhea_{i,s} + \beta_3 X_{i,t-1} + \alpha_i + \phi_t + \varepsilon_{i,t}$$

In this case, I use lagged variables. According to Hall et al. (2011), the total effect of a change in calories on weight takes a little bit more than 3 years. Rounds in this survey happen every 3-4 years, thus by using lagged explanatory variables, the estimated effect correspond to the long-term effect of access to piped water on BMI. We also know that access to water can reduce diarrhea prevalence and this in turn can increase BMI. Unfortunately, there is no data on diarrhea prevalence in all rounds. Thus, in order to control, at least imperfectly, for this off-setting effect, this specification controls for the interaction of access to piped water at home and whether the child's mother experienced at least one episode of diarrhea in the 3 months preceding the baseline, s. I do not use whether the child had diarrhea in the baseline, because as babies most were breastfed and diarrhea among babies is very common even with access to clean water. Thus, β_1 now should capture the effect access to piped water on children, who were exposed to no or little contaminated water; that is the effect on BMI due only to a reduction in the consumption of food outside the home and soft drinks, while β_2 should capture the differential effect of access to piped water on children that were exposed to contaminated water; that is, the additional and off-setting effect on BMI through reduction in diarrhea prevalence. If my predictions are correct, β_1 should be negative and β_2 should be positive.

3.3 Results

Table 6 shows the results on food eaten outside the home, soft drinks, home-made food, and milk. The simple correlation between piped water at home and quantity of food eaten outside the house is positive due to several third factors that are positively correlated with both variables. The first obvious group of variables are those related to time-invariant characteristics of the children, such as wealth, parents' education, and knowledge about nutrition. The first column shows the results from a FE model without any additional control variable. As we can see, controlling for time-invariable characteristics of the children eliminates the apparent positive effect on food eaten outside the house. A second important third factor correlated with both variables is time. In the last decades there has been an increase in the consumption of food outside the house in many developing countries, in particular in the consumption of snacks and fast food, both for families/individuals with and without piped water at home. Simultaneously, there has been an increase in the number of households with access to piped water at home. In order to control for these simultaneous increases, column 2 includes year fixed effects, and as we would expect, our coefficient of interest grows in absolute terms and becomes statistically significant. Column 3 controls for income. Naturally, income is positively correlated with having access to piped water and with eating food outside the house, thus controlling for income increases the magnitude and the significance of our estimated coefficient. Finally, areas with greater access to piped water have typically better access to food outside the home. If individuals move to these areas, we will see an increase in the likelihood of access to both of these things. This data set follow individuals that move; for this reason, column four include fixed effects of the barangay, where they currently live. Again we observe an increase in the magnitude of the estimate. According to our last and preferred estimate, access to piped water at home decreases the consumption of food outside the home by approximately 48 grams per day, which represents a decrease of 15%. A very similar pattern can be observed in the estimation of the effect of piped water at home on soda consumption. According to our last and preferred estimate, access to piped water at home decreases the consumption of soda by approximately 20 milliliters per month, which represents an increase of 29%.

Table 6 also shows the effect on home-made food and milk. Here we see that access to piped water at home has no significant effect on these consumptions. These results are reassuring in several ways. First of all, it enables us to discard the alternative hypothesis that access to piped water at home might be correlated with a decrease in income or another omitted variable that decreases all types of consumption. Second, our story predicts that access to piped water at home should generate a decrease in soft drinks because it generates an increase in the consumption of water, not on milk. An alternative story might be that decrease in soft drinks happens because of an increase in the consumption of milk that is spuriously correlated to access to piped water. Hence, it is reassuring that I find no effect on the consumption of milk. Finally, it is important to note a couple of things related to effect in consumption of home-made food. First of all, although the effect on the quantity in grams of home-made food is not statistically significant, the effect on the percentage of home-made food that children consume is positive and statistically significant, as we can see in Table 7. According to our last and preferred estimate, access to piped water at home increases the consumption of home-made food by approximately 4% points or 5%.Second, while the effect on consumption of home-made food, is positive it is not as large in magnitude as the decrease in food outside the home. Thus access to piped water at home generated a substitution away from food outside the home toward home food but this substitution does not seem to be completely offset (although this difference is not statistically significant). Thus, there should be an effect on weight resulting from a change on the quality of food, but probably also on the quantity of food. Table 9 of the appendix shows very similar estimates when rural areas are included in the sample.

Table 8 shows the results on standardized BMI-for-age and overweight rate (results on obesity rates are omitted, given that rates are close to 0 for this population). The first column shows the effect of a simple fixed effect strategy, and we can see that the difference in BMI within children with and without piped water at home is smaller in magnitude than the cross-child difference, but it is still positive. The second column includes additionally year fixed effects. We can see that including these fixed effects eliminates the significance of the positive correlation between access to piped water at home and BMI. Column 3 includes the interaction of piped water at home and instances in which the child's mother experienced diarrhea in the baseline. We can see that the effect of access to piped water at home on BMI in the absence of diarrhea is negative and the additional effect of access to piped water through diarrhea on BMI-for-age is positive. Column 4 controls additionally for income, and the effect of piped water on BMI becomes statistically significant. Finally, column 5 includes fixed effects of the barangay, where the children currently live, and we again observe an increase in the magnitude of the estimate. According to our last and preferred estimate, access to piped water at home *reduces* BMI-for-age by around 0.23 standard deviations but *increases* BMI-for-age by around 0.31 standard deviation through its reduction on diarrhea prevalence. Table 8 also shows that the same pattern for the estimations of the effect of access to piped water at home on child overweight rate. However, none of the estimations are statistically significant. Finally, table 10 of the appendix shows very similar estimates when rural areas are included in the sample.

4 Conclusions

This study investigates whether expanded access to piped water at home can contribute to the fight against obesity in developing countries. It exploits experimental data from the city of Tangiers, Morocco and longitudinal data from the city of Cebu, the Philippines. Results from the experiment show that access to piped water at home decreased BMI and obesity rates among children age 0 to 5 in the city of Tangiers, Morocco. Results from the longitudinal analysis, in a very different context with zero childhood obesity, also show that access to piped water at home decreased BMI among children age 10 to 19 in Cebu, Philippines. Furthermore, results from this analysis confirm the hypothesis that access to piped water at home reduces consumption of soft drinks and food outside the home, and that the effect of access to piped water on BMI through diarrhea is positive and large enough to "hide" the effect of access to piped water on BMI through the reduction in consumption.

This study suggests that access to piped water at home might play an important role in the fight against obesity in developing countries. It also provides evidence that programs that facilitate water access at home in urban areas can have important health benefits, even in the absence of effects on diarrheal diseases. This result is especially relevant given that, while there have been great advances in improved water sources worldwide, access to piped water at home is still very limited. Finally, this paper contributes to a better understanding of the demand and willingness to pay for piped water at home: the substitution away from food outside the home toward home-made food might generate some monetary savings. Additionally, individuals would likely welcome losing a few extra pounds.

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Table 1: Balance Check - Experimental

	Obs.	**Treatment**	**Control**	**r1**
Age	160	2.7	3.0	0.21
Female	160	53%	59%	0.43
Weight	160	13.7	14.3	0.34
Height	160	90.3	92.2	0.40
BMI	160	16.7	16.9	0.61
BMI-for-age	160	0.9	1.0	0.63
Underweight	160	1%	0%	0.37
Overweight	160	37%	41%	0.63
Obesity	160	26%	18%	0.26
Extreme Obesity	160	12%	11%	0.83
Num. members	350	5.7	5.9	0.41
Num. children <=15	350	2.4	2.8	0.01
Num. children <=7	350	1.8	1.9	0.19
Head male	350	0.9	0.9	0.31
Head age	350	40.9	40.3	0.65
Head married	350	0.9	0.9	0.73
Head no education	350	0.3	32%	0.42
Head primary education	350	0.5	43%	0.14
Assets score	348	0.0	0.4	0.04
Head income	350	1,177	1,156	0.86
Family income	318	4.5	4.7	0.32
Num. rooms per person	346	0.7	0.6	0.24
Piped water at home	348	0%	0%	1.00
Piped water anywhere	348	100%	100%	1.00
Chlorine water	103	0.7	0.6	0.39
Water use in the last 7 days	332	0.4	0.5	0.91
Distance to water (mts)	348	153.0	136.5	0.29
Connection to neighbors	348	0.2	0.2	0.85

Table 2: First Stage Results - Experimental Data

	First Stage	**First Stage**
	coef/se	**coef/se**
Assigned to Treatment Group	0.606***	0.610***
	(0.057)	(0.057)
Controls		X
_cons	0.192***	0.070***
	(0.041)	(0.041)
Number of observations	349	349
R2	0.364	0.364

note: .01 - ***; .05 - **; .1 - *;

Table 3: Results on BMI-for-Age and Obesity Rates - Experimental Data

	BMI			
	ITT	**IV**	**ITTc**	**IVc**
	coef/se	**coef/se**	**coef/se**	**coef/se**
Assigned to Treatment Group	-0.265		-0.348*	
	(0.237)		(0.211)	
Household got connected		-0.437		-0.578
		(0.390)		(0.353)
Control Variables			X	X
_cons	1.036***	1.120***	6.536***	6.477***
	(0.192)	(0.255)	(1.017)	(1.042)
Number of observations	349	349	348	348
R2	0.005	0.005	0.221	0.210

note: .01 - ***; .05 - **; .1 - *;

	Obesity			
	ITT	**IV**	**ITTc**	**IVc**
	coef/se	**coef/se**	**coef/se**	**coef/se**
Assigned to Treatment Group	-0.091**		-0.107**	
	(0.045)		(0.042)	
Household got connected		-0.150**		-0.177**
		(0.076)		(0.072)
Control Variables			X	X
_cons	0.231***	0.260***	1.205***	1.187***
	(0.037)	(0.050)	(0.164)	(0.178)
Number of observations	349	349	348	348
R2	0.014	.	0.178	0.129

note: .01 - ***; .05 - **; .1 - *;

Table 4: Robustness Results on BMI-for-Age and Obesity Rates - Experimental Data

BMI	ITT	IV	ITTc	IVc
	coef/se	coef/se	coef/se	coef/se
Assigned to Treatment Group	-0.425*		-0.526**	
	(0.254)		(0.232)	
Household got connected		-0.711*		-0.871**
		(0.426)		(0.401)
Treatmentxpublictap	1.054		1.091**	
	(0.655)		(0.550)	
Connectedxpublictap		1.701		1.775**
		(1.092)		(0.896)
Control Variables			X	X
Number of observations	348	348	348	348
R2	0.015	.	0.231	0.207

note: .01 - ***; .05 - **; .1 - *;

Obesity	ITT	IV	ITTc	IVc
	coef/se	coef/se	coef/se	coef/se
Assigned to Treatment Group	-0.104**		-0.122***	
	(0.047)		(0.044)	
Household got connected		-0.173**		-0.205***
		(0.080)		(0.078)
Treatmentxpublictap	0.089		0.095	
	(0.126)		(0.108)	
Connectedxpublictap		0.150		0.168
		(0.200)		(0.172)
Control Variables			X	X
Number of observations	348	348	348	348
R2	0.016	.	0.180	0.129

note: .01 - ***; .05 - **; .1 - *;

Table 5: Summary Statistics - Longitudinal Data

	Total		Piped Water at Home	
			With	Without
	Obs.	Mean	Mean	Mean
Age (in years)	4,012	14.93	15.29	14.83
		(2.97)	(2.97)	(2.96)
Male (%)	4,012	0.52	0.54	0.52
		(0.50)	(0.50)	(0.50)
Height (in cm)	3,977	147.39	150.29	146.55
		(12.79)	(11.85)	(12.94)
Weight (in kg)	3,998	39.93	42.36	39.22
		(11.09)	(10.91)	(11.04)
Standardized BMI for age	4,012	-0.88	-0.78	-0.91
		(1.00)	(1.05)	(0.98)
Overweight (%)	4,012	0.04	0.05	0.04
		(0.20)	(0.21)	(0.19)
Obesity (%)	4,012	0.00	0.00	0.00
		(0.00)	(0.00)	(0.00)
Underweight (%)	4,012	0.13	0.12	0.13
		(0.34)	(0.33)	(0.34)
Piped water at home (%)	4,012	0.23	1.00	0.00
		(0.42)	(0.00)	(0.00)
Piped water anywhere (%)	4,012	0.49	1.00	0.34
		(0.50)	(0.00)	(0.47)
Mother fetched water 1st. Round (%)	4,000	0.41	0.28	0.45
		(0.49)	(0.45)	(0.50)
Min. p/week m. fetched water 1st. Round	4,000	40.43	27.64	44.15
		(59.16)	(47.62)	(61.62)
Walking time to store (in minutes)	1,859	7.66	7.51	7.71
		(7.45)	(6.32)	(7.81)
Mother's income	3,679	206.45	474.83	128.87
		(3,972)	(8,349)	(423)
Density (n. of houses within 50 mts)	4,012	19.14	19.54	19.02
		(2.99)	(2.07)	(3.20)
Food outside the home (grs/day)	3,993	317.51	374.58	300.97
		(277)	(299)	(267)
Home-made food (grs/day)	3,984	633.54	635.68	632.91
		(335)	(336)	(334)
Soft drinks (mls/day)	3,988	70.79	95.13	63.71
		(131)	(150)	(125)
Milk (mls/day)	3,972	3.49	4.88	3.09
		(11.32)	(13.80)	(10.47)

Table 6: Results on Consumption - Longitudinal Data

	Food outside the home (grs/day)				**Soft drinks (mls/day)**			
	(1) **coef/se**	**(2)** **coef/se**	**(3)** **coef/se**	**(4)** **coef/se**	**(1)** **coef/se**	**(2)** **coef/se**	**(3)** **coef/se**	**(4)** **coef/se**
HH has piped water inside home or yard	-0.76	-32.73*	-39.38**	-47.59**	12.82	-10.81	-16.94*	-20.37**
	(18.41)	(18.83)	(19.65)	(20.75)	(9.50)	(9.26)	(9.49)	(9.90)
Individual FE	X	X	X	X	X	X	X	X
Year FE		X	X	X		X	X	X
Income			X	X			X	X
Barangay FE				X				X
Observations	4,375	4,375	4,019	4,019	4,370	4,370	4,015	4,015
R2	0.00	0.06	0.06	0.09	0.00	0.14	0.14	0.16

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

	Home-made food (grs/day)				**Milk (mls/day)**			
	(1) **coef/se**	**(2)** **coef/se**	**(3)** **coef/se**	**(4)** **coef/se**	**(1)** **coef/se**	**(2)** **coef/se**	**(3)** **coef/se**	**(4)** **coef/se**
HH has piped water inside home or yard	46.62**	-7.89	3.16	10.15	1.57*	1.26	1.00	0.68
	(21.73)	(20.30)	(21.63)	(22.49)	(0.91)	(0.94)	(1.00)	(0.93)
Individual FE	X	X	X	X	X	X	X	X
Year FE		X	X	X		X	X	X
Income			X	X			X	X
Barangay FE				X				X
Observations	4,365	4,365	4,011	4,011	4,352	4,352	3,998	3,998
R2	0.00	0.13	0.13	0.16	0.00	0.00	0.00	0.06

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

Table 7: Results on Consumption - Longitudinal Data

	Home-made food (%)				**All Food (mls/day)**			
	(1) **coef/se**	**(2)** **coef/se**	**(3)** **coef/se**	**(4)** **coef/se**	**(1)** **coef/se**	**(2)** **coef/se**	**(3)** **coef/se**	**(4)** **coef/se**
HH has piped water inside home or yard	0.02	0.02	0.03*	0.04**	52.29*	-35.44	-35.31	-38.26
	(0.014)	(0.014)	(0.015)	(0.016)	(27.206)	(25.818)	(27.240)	(28.615)
Individual FE	X	X	X	X	X	X	X	X
Year FE		X	X	X		X	X	X
Income			X	X			X	X
Barangay FE				X				X
Observations	4,375	4,375	4,019	4,019	4,370	4,370	4,015	4,015
R2	0.00	0.06	0.06	0.09	0.00	0.14	0.14	0.16

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

Table 8: Results on Body Mass Index and Overweight Rate- Longitudinal Data

	Standardized BMI-for-Age				
	(1)	**(2)**	**(3)**	**(4)**	**(5)**
	coef/se	**coef/se**	**coef/se**	**coef/se**	**coef/se**
HH has piped water inside home or yard (lagged)	0.139***	0.041	-0.140	-0.174*	-0.234**
	(0.045)	(0.046)	(0.087)	(0.100)	(0.106)
HH has piped water inside home or yard (lagged)			0.217**	0.246**	0.305**
x Diarrhea 1st Round			(0.100)	(0.113)	(0.121)
Individual FE	X	X	X	X	X
Year FE		X	X	X	X
Diarrhea			X	X	X
Income				X	X
Barangay FE					X
Number of observations	4,061	4,061	4,061	3,668	3,654
R2	0.004	0.082	0.083	0.084	0.117

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

	Overweight Rate				
	(1)	**(2)**	**(3)**	**(4)**	**(5)**
	coef/se	**coef/se**	**coef/se**	**coef/se**	**coef/se**
HH has piped water inside home or yard (lagged)	0.017	0.015	-0.015	-0.019	-0.024
	(0.013)	(0.013)	(0.013)	(0.017)	(0.023)
HH has piped water inside home or yard (lagged)			0.036*	0.046*	0.051*
x Diarrhea 1st Round			(0.020)	(0.024)	(0.029)
Individual FE	X	X	X	X	X
Year FE		X	X	X	X
Diarrhea			X	X	X
Income				X	X
Barangay FE					X
Number of observations	4,061	4,061	4,061	3,668	3,654
R2	0.001	0.003	0.003	0.006	0.061

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

Table 9: Results on Consumption- Longitudinal Data (Urban and Rural Areas)

	Food outside the home (grs/day)				**Soft drinks (mls/day)**			
	(1) coef/se	**(2) coef/se**	**(3) coef/se**	**(4) coef/se**	**(1) coef/se**	**(2) coef/se**	**(3) coef/se**	**(4) coef/se**
HH has piped water inside home or yard	1.44	-31.35*	-38.81**	-48.49**	10.85	-10.08	-16.02*	-17.98**
	(17.16)	(17.59)	(18.48)	(19.65)	(8.86)	(8.62)	(8.92)	(9.41)
Individual FE	X	X	X	X	X	X	X	X
Year FE		X	X	X		X	X	X
Income			X	X			X	X
Barangay FE				X				X
Observations	6,057	6,057	5,606	5,606	6,050	6,050	5,600	5,600
R2	0.00	0.08	0.08	0.12	0.00	0.13	0.13	0.15

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

	Home-made food (grs/day)				**Milk (mls/day)**			
	(1) coef/se	**(2) coef/se**	**(3) coef/se**	**(4) coef/se**	**(1) coef/se**	**(2) coef/se**	**(3) coef/se**	**(4) coef/se**
HH has piped water inside home or yard	42.94**	-5.01	3.67	10.31	1.56*	1.27	0.91	0.59
	(20.09)	(18.71)	(19.99)	(21.16)	(0.84)	(0.87)	(0.91)	(0.85)
Individual FE	X	X	X	X	X	X	X	X
Year FE		X	X	X		X	X	X
Income			X	X			X	X
Barangay FE				X				X
Observations	6,039	6,039	5,590	5,590	6,034	6,034	5,585	5,585
R2	0.00	0.13	0.13	0.16	0.00	0.00	0.00	0.06

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

Table 10: Results on Body Mass Index and Overweight Rate- Longitudinal Data (Urban and Rural Areas)

	Standardized BMI-for-Age				
	(1)	**(2)**	**(3)**	**(4)**	**(5)**
	coef/se	**coef/se**	**coef/se**	**coef/se**	**coef/se**
HH has piped water inside home or yard (lagged)	0.139***	0.041	-0.136	-0.165*	-0.268***
	(0.042)	(0.043)	(0.084)	(0.097)	(0.102)
HH has piped water inside home or yard (lagged)			0.210**	0.230**	0.322***
x Diarrhea 1st Round			(0.096)	(0.109)	(0.116)
Individual FE	X	X	X	X	X
Year FE		X	X	X	X
Diarrhea			X	X	X
Income				X	X
Barangay FE					X
Number of observations	5,754	5,754	5,754	5,176	5,158
R2	0.003	0.103	0.104	0.102	0.140

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

	Overweight Rate				
	(1)	**(2)**	**(3)**	**(4)**	**(5)**
	coef/se	**coef/se**	**coef/se**	**coef/se**	**coef/se**
HH has piped water inside home or yard (lagged)	0.014	0.011	-0.026	-0.018	-0.020
	(0.011)	(0.011)	(0.017)	(0.016)	(0.021)
HH has piped water inside home or yard (lagged)			0.044**	0.041*	0.046*
x Diarrhea 1st Round			(0.021)	(0.021)	(0.027)
Individual FE	X	X	X	X	X
Year FE		X	X	X	X
Diarrhea			X	X	X
Income				X	X
Barangay FE					X
Number of observations	5,754	5,754	5,754	5,176	5,158
R2	0.001	0.003	0.003	0.005	0.049

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