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The Effect of Piped Water at Home on Childhood Overweight Rate. Experimental

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Abstract

Obesity is a global epidemic costing billions of dollars and millions of deaths. The most cost-effective interventions are those that target children, aiming to prevent obesity rather than to reverse it later in life. Roughly 79% of overweight children under five live in middle-income countries, where only about half of the households have access to piped water at home. This study finds that access to piped water at home reduces children's overweight rate in the city of Tangiers. Back-of-envelope calculations suggest that this benefit alone does not render this type of intervention cost-effective, but adds significantly to other potential benefits.

Keywords: obesity; piped water; childhood; developing countries.

JEL Classification: I12, I18, H41, O12

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1 Introduction

Obesity is a global epidemic costing countries around the world billions of dollars, leading also to approximately four million deaths per year (Shekar and Popkin, 2020). The most cost-effective interventions are those that target children by preventing obesity among children rather than attempting to reverse it once they become adults (Cawley, 2010). As of 2016, approximately 6% of children under five worldwide were overweight or obese. Of these, three quarters live in middle-income countries (Shekar and Popkin, 2020). At the same time, while only about 9% of the world population does not have access to improved water sources (Ritchie and Roser, 2020), approximately half of all households in middle-income countries lack access to piped water at home (WHO, 2016*a*). These households spend considerable time fetching water and/or buy it from private sources, sometimes paying up to fifty times as much as as they would for piped utility water (Mitlin et al., 2019; UNESCO, 2019). This study investigates whether access to piped water at home can contribute to the fight against childhood obesity in these countries.

Access to drinking water at home can affect children's BMI and overweight rate through several channels; first, it reduces the cost of drinking water, cooking, and washing dishes relative to drinking and eating food prepared outside the home. Food prepared outside the home, including food from street vendors, fast food, sodas and snacks tend to have a higher calorie content than home-made food. Second, the reduction in the amount of walking and carrying water generates a reduction in energy expenditure. While young children are not typically in charge of fetching water, older children sometimes are. Third, the reduction in time fetching water frees up time that can be invested in the health of adults and children, for example by cooking more at home and thus consuming less food prepared outside the home. Fourth, access to piped water at home typically implies a high initial investment and/or monthly installments, and this decrease in available income can lead to a change in the total consumption of food and/or in the type of food. Fifth, access to drinking water at home can reduce tension and stress by reducing the burden of collecting water, and this reduction in stress can reduce overeating and fat accumulation (Daubenmier et al., 2011; Michels et al., 2012). Finally, access to drinking water at home can affect BMI indirectly through a reduction in diarrheal prevalence since diarrhea reduces calorie absorption (Brown, 2003).

To estimate the causal effect of access to piped water at home on children BMI and overweight rates is not an easy task, for at least two reasons. First, access to piped water at home is typically not randomly assigned; households with and without access to piped water at home differ along many dimensions that can be correlated with BMI and overweight rates. Second, even if we estimate the causal effect of access to piped water on BMI and overweight rates, we might not be able to disentangle the effect of changes in the calorie intake or energy expenditure on BMI from the effect of changes in diarrheal prevalence on BMI. It is valuable to disentangle these two effects, because they can cancel each other out, making it seem as if access to drinking water has no effect on the nutritional status of individuals, as measured by BMI. That conclusion, however, would be misleading; a child with normal BMI driven by the offsetting effects of a diet high in calories and chronic diarrhea is likely significantly less healthy than a child that achieves a normal BMI through a good balance between calorie intake and physical activity.

This study examines the effect of access to piped water at home on children's BMI and overweight rates. The data comes from an intervention carried out by Devoto et al. (2012) in the city of Tangiers, Morocco. The intervention consisted of information about, and assistance with, application for a loan used to connect homes to the water supply. Devoto et al. (2012) found that households were willing to pay a substantial amount of money to have a private tap at home, which in turn decreased their available income but provided them with extra free time. They found no effect on labor supply, or on school participation, but they did find that that having a connection to piped water at home increased time spent in leisure and social activities, increased life satisfaction and well-being. Interestingly, the experiment did not have any effects on diarrhea prevalence, since both treatment and control group had access to a nearby public tap with clean water, and Devoto et al. (2012) did not examine effects on BMI or overweight rates. This context is ideal for the analysis undertaken in this study because it makes it possible to estimate the direct effect on BMI, isolated from the potential effect of diarrhea on BMI. Additionally, the overweight rate for children under five years of age in Morocco is one of the highest in the world, surpassing the US and Mexico (WHO, 2016*b*). Weight and height were collected only from small children, though, so I work only with the subsample of households with at least one child age 5 or less. Nevertheless, my subsample is also well balanced, because the randomization was stratified for number of children of these ages.

I find that access to piped water at home decreases BMI-for-age (BMIz) by 0.38 standard deviations and overweight rates by 16 percentage points, among children age five or younger. While the magnitude of the estimates is large, so are the confidence intervals of my estimates. Thus, the precise point estimates are not as informative as the sign of the effects. Additionally, back-of-envelope calculations show the highest point estimate of the increase in BMI requires approximately an increase of only 79 calories per day. The equivalent of half a can of soda or a Chebakia (a Moroccan street cookie). An effect of this magnitude on food consumption seems plausible.

I further find some interesting heterogeneous effects between households with and without informal connection to the public tap: the effects on BMI and overweight rate were concentrated among children of households that were not informally connected to the public tap. These results are reassuring and somewhat informative regarding potential channels, since I also find that these households are the ones who benefited most in terms of access, price, and time cost of water, and in terms of additional time at home, in particular for household chores.

It is important to acknowledge the limitations in terms of external validity and statistical power of a small social experiment, such as the one exploited in this study. Nonetheless, this study provides causal evidence that access to piped water at home can contribute to the prevention of childhood overweight status, at least in some specific contexts. This is a very important topic with large potential benefits for an epidemic that is very difficult and costly to fight and that affects many areas in the world without piped water at home. The provision of piped water at home requires an expensive investment in most settings and my back-of-envelope calculation suggests that the benefit on childhood overweight status alone is not enough to make this a cost-effective intervention. However, it can add significantly to other potential benefits of providing piped water at home. Seminal studies have found the benefits of access to clean water in reducing the incidence of waterborne diseases (Snow, 1855; Galiani, Gertler and Schargrodsky, 2005; Gamper-Rabindran, Khan and Timmins, 2010; Kremer et al., 2011), but to the best of my knowledge this is the first study that shows the benefit with respect to overweight rates. Future studies should complement this study with additional evidence from other contexts, in order to arrive at a more accurate estimation of the magnitude of the effects on childhood, and possibly adult, overweight rates and to increase our understanding of the mechanisms of such effects.

2 Related Literature

There is an important body of literature related to the potential effect of access to piped water at home on BMI and overweight rates. First of all, there is evidence that drinking water facilitates weight loss by increasing the sensation of fullness, which in turn leads to lower meal energy intake (Dennis et al., 2010; Stookey et al., 2008). By contrast, liquid carbohydrates, like sodas, show little compensatory dietary response, meaning that individuals who consume them do not offset the corresponding increase in calorie intake by reducing their consumption of other caloric foods (DiMeglio, Mattes et al., 2000). Elbel et al. (2015) and Schwartz et al. (2016) find that the installation of water jets in New York City public elementary and middle schools was associated with a three-fold increase in the consumption of water,with some substitution away from milk, and with a modest but significant decrease in BMI and overweight rate. Importantly, well before the installation of water jets, these schools were part of an initiative to improve the children's nutritional environment, offering more fruit and vegetables, removing soda from vending machines, and replacing whole milk with low-fat milk (Elbel et al., 2015). Thus, the alternative to water for this sample of children was not as high in calories and sugar content as the alternative to water that is most often available to children.

Access to piped water at home also reduces the monetary and time cost of eating home-made food relative to food prepared outside the home. Individuals, who are forced to pay high prices to obtain water from private sources or must spend considerable time fetching water for cooking and washing dishes might find buying food from a street vendor an attractive alternative. In most areas of the world, food prepared outside the home is high in sugar and fats. Deep-fried food, for example, is widely available almost everywhere. Hence, a substitution of consumption of food prepared outside the home for home-made food could reduce BMI. In general, previous studies agree that the obesity epidemic is largely result of a change in the type of food consumed rather than solely an increase in the amount of food consumed. Cutler, Glaeser and Shapiro (2003) argue that the switch from individual to mass preparation has lowered the time cost of food consumption and has led to increases not only in quantity but also to changes in the type of the foods consumed, as in the move from boiled potatoes to potato chips and French fries. Other studies have shown how the price of food typically prepared outside the home like pizza and sodas has fallen over the last decades while the real price of fruits and vegetables has increased (Cawley, 2015; Wendt and Todd, 2011). There is also evidence of the effect of proximity to, and lower prices of, sodas, fast food and super markets on BMI and/or obesity rates Currie et al. (2010); Meltzer and Chen (2011); Courtemanche and Carden (2011); Ritter (2019*b*), although other studies have found little or no effect Dunn (2010); Anderson and Matsa (2011); Cotti and Tefft (2013).

The extra time made available by the reduction of time spent fetching water can be used to invest in the health of adults and children. Ruhm (2000) find that obesity rates increase when the economy strengthens, while physical activity is reduced and diet becomes less healthy. In a study of women in the US, Anderson, Butcher and Levine (2003) find that maternal employment increases the probability of overweight children. Courtemanche, Tchernis and Zhou (2017) finds that longer parental work hours lead to larger increases in children's BMI z-scores and probabilities of being overweight and obese. Regarding the mechanisms, studies have found that more hours working increase children's weight by reducing supervision and nutrition (Fertig, Glomm and Tchernis, 2009), by spending less time cooking and eating with children, and by purchasing more prepared foods (Cawley and Liu, 2012).

The investment necessary to obtain piped water at home can also decrease available income. In general, it is believed that the relationship between income and BMI follows a U-shape: additional income increases BMI for lower levels of income but reduces BMI for non- poor individuals (Lakdawalla, Philipson and Bhattacharya, 2005). Akee et al. (2013) find that cash transfers increased BMI and obesity rates significantly more for poorer households, while other studies have found no effect (Cawley, Moran and Simon, 2010) or negative effects (Lindahl, 2005).

Access to drinking water at home can reduce tension and stress, by reducing the burden associated with collecting water (Devoto et al., 2012). A reduction in the stress at home can reduce children's BMI and overweight rates, since stress is associated with overeating, even among young children (Michels et al., 2012). Additionally, elevated cortisol concentrations increases fat accumulation (Daubenmier et al., 2011).

There is also evidence that improvements in water quality increases BMI through its effect on diarrhea prevalence (Kremer et al., 2011; Zhang, 2012). Diarrheal diseases do not affect calorie intake directly but they do reduce calorie absorption (Brown, 2003). Access to drinking water at home may also reduce diarrhea prevalence, since piped water is typically cleaner than water from other sources, and can thus, increase BMI.

Finally, the study closest to this is Ritter (2019*a*); exploiting longitudinal data from the city of Cebu, the Philippines, she finds evidence that access to piped water at home decreases BMI among children ages 10 to 19 by 0.21 standard deviations, and obesity rates by 1 percentage point, but only among children with no history of diarrhea. Among children with a history of diarrhea, the effect of access to piped water on BMI is positive and insignificant, suggesting that among these children the effect of access to piped water on diarrhea, and consequently on BMI, might offset the direct effect on BMI. Another interesting result of this study is that access to piped water at home seems to reduce consumption of food prepared outside the home by approximately 40 grams per day or 14%. The empirical strategy applied in her paper is not robust enough to claim causality, but it provides important suggestive evidence about the potential effects of access to piped water at home on BMI.

3 Children BMI and its Connection with Adult Obesity

The most commonly used indicator to screen for weight categories is Body Mass Index (BMI): weight in kilograms by the square of the height in centimeters. BMI is relatively easy to measure, is highly correlated with body fat and extreme values of it are associated with poor health (NHS, 2011). Among adults there are universal criteria for defining overweight and obesity; BMI over 25 and over 30, respectively. Among children there is no fixed threshold, because BMI among children varies by age and gender. The typical way to determine whether a child is maintaining a healthy weight is by comparing his or her BMI with that of children from a reference population of the same age and gender. For the purpose of this study, I follow the World Health Organization (WHO) criteria, since their reference population is the more adequate for my sample; WHO uses a reference population drawn from a sample of children from Brazil, Ghana, India, Norway, Oman and USA. To determine whether a child is overweight, one needs to calculate a BMI Z-score for age and gender (BMIz), which is basically a standardization of BMI using the mean and the variance of the reference population [1]. Children ages 0 to 5 with a BMIz greater than 2 (approximately to the 97th percentile) are classified as overweight, and those with a BMIz greater than 3 (approximately to the 99th percentile) are classified as obese. The criteria change for older children and adolescents. Most studies consider a BMI above the 95 percentile an unhealthy BMI and also highly predictive of adult obesity; approximately, a third of overweight children become obese adults (Serdula et al., 1993).

Finally, another important indicator to asses healthy body weight in children and risk of adult obesity is the age of Adiposity Rebound. BMI typically increases in the first year of life, decreases until age 6 or 7, and "rebounds", that is, starts increasing again. Children, who undergo this rebound by the age of 5 experience an "Early Adiposity Rebound" and are significantly more likely to be obese adults (Rolland-Cachera et al., 1984; Whitaker et al., 1998; Siervogel et al., 1991; Williams and

[1] For the exact formula, please, refer to WHO (2006)

Goulding, 2009). Both overweight and EAR can be influenced by children's net calorie intake (Robertson et al., 1999; Ip et al., 2017).

4 Setting and Experimental Design

This study exploits an experiment carried out by Devoto et al. (2012) in the city of Tangiers, in the 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 offered 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).

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. These public taps were already connected to the water network of Amendis. 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 were 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").

This study works with a subsample of children age 5 or less since they were the only household members from which anthropometric indicators were taken. The endline also records anthropometric indicators from children age 6 and 7, but since the randomization was stratified only for number of children 5 or less, and since the criteria for classifying a child as overweight and obese is different for children under and above age five, I work only with children age 5 or less. Nevertheless, I will also show the results for all children. Additionally, I eliminate from the sample observations with biologically implausible values (BIV) of anthropometric indicators, following the World Health Organization guidelines (WHO, 2006). [2]As it is common with this type of measurement (Himes2009), our sample presents a non-trivial percentage of BIV, 15%. Figure 1 and Table A1 of the Appendix show the estimations without eliminating BIV and following a more stringent criteria than the one used in the main analysis. The figures and tables reveal that the raw distribution contains very extreme values, which affects the estimation of the effect on average BMIz but not on the overweight rate, as we would expect. They also reveal that the results are robust to more stringent trimming criteria. In general, we will see that the results on BMIz of children of all households are less precise and somewhat sensitive to different specifications and changes in the sample, while results on BMIz of children of households without connection to a public tap and the results on overweight rate from both samples are very robust.

The resulting number of observation in the Endline is 258, corresponding to 139 children, 113 households and 93 clusters in the treatment group and 119 children, 93 households and 86 clusters in the control group. Weight was measured two times in this sample, therefore, I use the average of these two measurements. Table A2 of the Appendix, shows the estimations are very similar using the different measurements.

5 Balance Check

Table 1 shows the differences between treatment and control group of my sample. I estimate the difference and the t-statistics controlling for baseline stratifying variables and clustering the standard errors. There are no significant difference in the

[2]A value of height-for-age higher than 6 standard deviations or lower than -6 standard from the reference population is considered and implausible height. Likewise a value of BMI-for-age larger than 5 standard deviations or smaller than -5 standard from the reference population is considered an implausible weight for a given height, age and gender.

anthropometric indicators, but, unfortunately, there is only anthropometric data of a subsample of the children in the baseline. Nevertheless, as we can see in the table, the number of missing observations is not correlated with the treatment and the sample, in general, is very well balanced; there is only one variable, number of children under 15 that is statistically significantly different between the treatment and control group. I will estimate the effect of the treatment controlling for this variable.

The baseline also includes anthropometric data for 44 children for whom I do not have data in the Endline, but half of the attrition is the result of biological implausible values of BMIz that were eliminated from the sample. Table A3 of the Appendix shows no significant difference in the anthropometric indicators of the "attrition" and the "non-attrition" groups either in the treatment nor in the control group. If anything, the point estimate suggests that the attrition group from in the baseline is more likely to be overweight in the treatment group. Therefore, if there is a bias, it would go against my results.

Morocco has one of the highest rates of childhood overweight in the world according to the WHO. This sample is not the exemption: 16% and 6% of the children age 0 to 5 are overweight and obese in the baseline, respectively, and none of the children are underweight. For an easier interpretation of my results, after calculating the overweight rate, I standardized BMI-for-age so that it represents the standardized deviation of a child's BMI from the median value of my sample, rather than from the median value of a reference population. Table 1 also shows the summary statistics of important household variables. By sample design, before the treatment all households are located walking distance from a public tap with piped water free of charge but no household in either group had a formal connection of piped water at home. The average distance to the public tap is approximately 130 meters. This distance might not seem too great, but just the lack of immediate access to water in the convenience of the home might make a significant difference. Despite having access to free water within walking distance, households spend an average of 27 Di per week, or 17 US Dollars per month, buying water from neighbors and water sellers. This is a significant amount of money for households with an average monthly income of 1,504 Di or 210 US Dollars. Table 1 also shows that adults do most of the water fetching; in particular, children age 5 and below seems not to participate in it. Thus, access to water at home should not have an impact on their physical activity.

Some households are located so close to the public tap that they are connected to a public tap, through an informal pipe and therefore already had access to water of the same quality at home since, both private tap water and public tap water were provided by the same water company. As we will see later, I also analyze heterogeneous effects to test whether the treatment was concentrated on those children whose houses were not connected to the public tap. Thus, Tables A1 and A2 show the differences between the treatment and control group of these subsamples of children. These subsamples are also very well balanced, which is not very surprising given that the randomization was stratified by water source, including whether the household has an informal connection to the public tap.

6 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 for the obesity dummy 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 control variables i in cluster j, and $\varepsilon_{i,j}$ stands for the error term. $X_{i,j}$ include the stratification variables used for the randomization: location, water source, number of households per cluster, number of children 5. Additionally, it includes the number of children age 15 or under (the unbalanced variable), age, gender and the baseline levels of BMI-for-age. Table A3 of the Appendix shows the estimations without control variables and controlling for additional variables for the main results. All the regressions have standard errors clustered at the "cluster" level.

Following Young (2019) recommendations for experiments with small number of observations and clustered randomization, I use randomization statistical inference to estimate the p-values. This inference tests whether the treatment-effect (TE) estimate, is unlikely to be observed by chance and is hence statistically significant. In Tables A6 and A7, I also estimate the Sharpened q-values to adjust for multiple hypothesis testing. We can observe that the Sharpened q-values are very similar to the p-values.

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.

Under the assumption of constant treatment effect, β_1 could be interpreted as the average treatment effect. In the absence of such an 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.

7 Results - Experimental Evidence

7.1 Main Results

Table 2 shows the effect of the intervention on the several outcomes previously estimated by Devoto et al. (2012). The purpose here is to confirm the effects for the subsample used in this study and to add a couple of additional estimates relevant for this study. All regressions control for the stratification variables used for the randomization: location, water source, number of households per cluster, number of children 5, for the unbalanced variable: the number of children age 15 or under, and for age, gender and the baseline levels of BMI-for-age. Table A3 of the Appendix shows the estimations without control variables and controlling for additional variables for the main results. The control variables used for the randomization and the variable that is unbalanced in the baseline have some effect on my results, as expected. Other control variables merely increase statistical power. Panel A shows the Intention to Treat (ITT) estimates, while Panel B shows the Second Stage Least Square (2SLS) estimates. Column 1 shows the first stage. We can see that, in fact, the intervention successfully encouraged water connections: 83% of the treatment group established a connection to the water network, while only 23% of the control group did. The F-Statistics associated with the treatment is 88. Column 2 shows that the treatment also significantly increased the number of households that reported having access to a sufficient supply of water from 87% in the control group to 98% in the treatment group; that is, the intervention successfully eliminated reported water shortages.

Table 2 also reveals the effect of the intervention on the time and monetary costs of obtaining water. Column 3 shows that the intervention essentially eliminated the time households spent fetching water; this effect implies additional 71 minutes every three days. According to the 2SLS, connection to the water network freed up 117 minutes every three days, that is, approximately 39 minutes per day to spend on other activities. Devoto et al. (2012) focused mostly on social, labor and educational activities, but for the purpose of this paper it was useful to investigate whether there was an increase in the available time for housework; the 2SLS of

Column 4 reveals that access to piped water double percentage of households that report having more time for housework. I also estimate the effect on monthly water expenditure, but unlike Devoto et al. (2012) I distinguish the installment payments from the consumption expenditure. For the purposes of this paper, this distinction is important because the optimal amount of consumption of water depends on the variable cost not on the value of installments that households need to repay, regardless of the amount of water consumed. Columns 5 and 6 show that while the installment payments are greater for the treatment group, as expected, the monthly expenditure of water consumption is lower, although not significantly, probably due to a lower price per gallon. This result is not surprising and coincides with a vast literature suggesting that in urban areas, households without piped water at home pay a much higher price for water from private sources than households that pay for piped utility water. Finally, columns 7 and 8 shows positive effects on the indexes of life satisfaction and mental health, which can be seen as a proxy for lower levels of stress. The life satisfaction index was created using factor analysis over the following variables: how respondent classified his satisfaction with his life in a scale from 1 to 10, whether his own life improved from the previous year, whether his household life improved from the previous year. The mental health index was created using factor analysis over the following variables: over past seven days, respondent felt, more often than not sad, angry, upset, relaxed, satisfied, happy, worried and tired.

Table 3 presents the effect of the treatment on BMI-for-age, overweight rate and obesity rate on children age 5 or less. For an easier interpretation of my results, after calculating the overweight rate, I standardized BMI-for-age so that it represents the standardized deviation of a child's BMI from the median value of my sample, rather than from the median value of a reference population. We can see that the treatment has a large but only marginally significant effect on BMI-for-age: a reduction of 0.23 standard deviations. As expected, the 2SLS estimates are similar but larger in magnitude: access to piped water at home reduced BMI-for-age by 0.38 standard deviations. The treatment also reduced the overweight rate by 10 percentage points, while according to the 2SLS, access to the piped water at home reduced the overweight rate by 16 percentage points. Columns 5 and 6 show that there are no significant effects on obesity rates. Figure 1 displays the effect of the effect of treatment on the distribution of BMI-for-age. The graph illustrates what we saw in the results: the distribution of the treatment group is shifted to the left of the control group.

In order to better understand where the effect on BMI comes from, Table 3 also shows the effects of the treatment separately on standardized weight-for-age and on standardized height-for-age. Again, for an easier interpretation of my results, I standardized these measures so that they represent the standardized deviation of a child's weight and height from the median value of my sample, rather than from the median value of a reference population. Although not statistically significant, these results are reassuring in several ways; first, they tell us that the effect on BMI mostly comes from a reduction in the weight of children and not from an increase in their height, which is reasonable, given that while the treatment had the potential to affect the weight of all children, height is rarely affected after age two (Ruel and Hoddinott, 2008). This result is also informative, because it tells us that the treatment has decreased, not increased, the net-calorie intake; second, it is reassuring to see that the effects on weight and height are not in opposite directions, since a changes in the calorie intake should affect weight and height (at least up to age two) in the same direction. Finally, it is good news that the increase in calorie intake has reduced BMI and overweight rate but not height-for-age, since height-for-age is a positive indicator of the nutritional status of the children. Similarly, Table 3 shows that the treatment had no significant impact on underweight rate, which is also good news.

7.2 Heterogeneous Effects and More Information about Potential Channels

In this section, I compare the effects of the program on households that were informally connected to the public tap before the program with those that were not. The intervention should have affected these two groups of households differently, in particular, because the intervention should have increased the access to water more for those households without an informal connection to the public tap.

Columns 1 to 4 of Table 4 reveals no statistically significant difference in the take up of the intervention and in the installment payments between the two types of households. Columns 5 and 6 show, however, a difference in terms of water expenditure: the treatment increased the water bill for households that were informally connected to the public tap before the program significantly more than for the rest of households. Moreover, the monthly water expenditure for households that were not informally connected to the public tap before the program apparently decreased, although, the point estimate is not statistically significant. This result was expected, since households that had an informal connection to the public tap had access to water free of charge, while the rest of households paid a significant amount of money to neighbors and informal vendors for water. As expected also, Columns 7 and 8 show that the increase in the reported access to water was concentrated only in households that were not informally connected to the public tap before the program. If the treatment increased the quantity of water consumed but not the monthly cost, these results imply that the price *per* gallon of water decreased for households that were not informally connected to the public tap before the program.

Table 5 shows that the reduction in the time spent fetching water was also larger for households that were not informally connected to the public tap before the program, but the difference is not statistically significant nor is the effect purely concentrated among these households. Households that were informally connected to the public tap before the program did also benefit from additional time because the connection was not permanent. So many households still needed to walk to the public tap to connect the pipe and then fill containers of water at home. Naturally, their walking distance was shorter and they did not have to transport the containers from the public tap to the house. Moreover, since they could fill the containers at home, they could also do other household chores, such as cooking, while doing this. Columns 3 to 8 reveal, in fact, that only households that were not informally connected to the public tap before the program reported gains in time for housework and for activities at home, in general, while the difference in time gained for activities outside the home is positive and not statistically significant.

There may have been other benefits for households informally connected to the public tap before the program as well; for example, since the informal connections were likely illegal, they might have worried about fines or problems with the authorities and neighbors. Columns 1 and 2 show that the effect of obtaining a private, formal, and permanent connection to the water network reduced the percentage of houses declaring water to be the main problem for the household, and the reduction is somewhat larger for households with connection to the public tap, but the effect is not statistically significant. Columns 3 and 4 also show similar increases for both types of households in terms of life satisfaction, and Columns 5 and 6 show a somewhat larger effect on mental health for households without connection to the public tap, but again the difference is not statistically significant. Hence, it is not clear whether there was a larger reduction in stress for one type of household versus the other one.

Finally, Table 7 shows that the effects on BMI and overweight rate are concentrated among children of households that were not informally connected to the public tap. Figure 2 shows the effect of the treatment on the distribution of the BMIz of children who did not have access to piped water at home in the baseline. Again we can see that the distribution of the treatment group is shifted to the left of the control group. Despite the small statistical power for these estimations, the results are reassuring and somewhat informative about potential channels; they show that the effect on childhood overweight rate is driven by the households who benefited the most in terms of access, price, and time cost of water, and in terms of additional time at home, in particular for household chores.

7.3 Magnitude of the Estimate and Back-of-Envelope Calculation

One possible concern about my results is that the point estimates are large in magnitude. However, we need to take into account several factors. First, the confidence intervals are large as well, and so, the point estimates might not be as informative as the sign of the effects. Second, this is a particular sample with very large childhood overweight rate. Third, there is one important reason why large effects could be expected in this context. As explained above, increases in the energy intake of children of this age may not only increase BMI-for-age, but also increase the probability of an "Early Adiposity Rebound" (Robertson et al., 1999; Ip et al., 2017). Early Adiposity Rebound happens when children's BMI start to increase before age 5, while a Normal Adiposity Rebound typically occurs around age 6 or 7. Hence, the intervention might have prevented EAR among the children in the treatment group. This would mean that the difference in BMIz and overweight rate will shrink as those children in the treatment group experience their AR later on and its BMI starts to increase. The difference, however, would not disappear completely, since there is significant evidence that EAR is predictive of adult obesity (Rolland-Cachera et al., 1984; Whitaker et al., 1998; Siervogel et al., 1991; Williams and Goulding, 2009). Unfortunately, the intervention did not collect several waves of data so that I could directly test whether the treatment delayed AR. Nevertheless, we can at least compare the effects by different age groups. Table A5 shows what this EAR hypothesis would predict, at least in terms of BMIz: the effect is the highest for children age 2-5, and lower when it includes children below 2 and above 5. We do not see, however, the same pattern in terms of overweight rate. Hence, it is not clear that an effect on EAR plays an important role in this case.[3]

Even without considering the potential effect on EAR, our point estimated effects are plausible, as we will see with a back-of-envelope calculation. This is so because, contrary to popular belief, it requires only a small increase in the consumption of calories to bring about large changes in overweight rates. As Cutler, Glaeser and Shapiro (2003) illustrate, an increase of only 100 to 150 calories in the daily consumption of food, for example, the calories contributed by three Oreo cookies or one can of Pepsi, is sufficient to explain the 100% increase in obesity rate in the US between 1965 and 1995 (an increase of 10-12 pounds on the average American). Hall et al. (2011) make a more precise calculation, and arrives at a very similar estimation: it takes approximately 100 calories extra per day to gain 10 pounds.

[3] It is also important to remember that the randomization was stratified only for number of children 5 or less and the baseline do not record anthropometric indicators from children age 6 and 7, hence I cannot control for their baseline levels. Moreover, the criteria for classifying a child as overweight or as obese are different for children under and above age five, and I have assumed the same criteria for all children in this exercise.

It is also common for obesity and overweight rates to change proportionally more than the average BMI of the population. Cutler, Glaeser and Shapiro (2003) argue that part of the explanation relies on self-control problems, since people with self-control problems are more likely to be overweight initially and are more responsive to changes in the time costs of food. Finally, another common misbelief is that it takes a long period of time to gain weight. Hall et al. (2011), however, estimate that 50% of the effect of a change in diet on body weight happens during the first year and 95% happens within three years. Moreover, if changes in consumption are not permanent or if there is strong initial effect that diminishes over time, the long-term effects could be smaller in magnitude than the short term effects. Thus, it takes only a few calories and a relatively short period of time to see large effects on BMI and, in particular, on overweight rates.

In this study, I obtain the highest point estimate for households that are not connected to the public tap; access to piped water at home decreases overweight rate by 19 percentage points and BMI-for-age by 0.48 standard deviations, which corresponds to a decrease of 1.6 pounds[4]. Applying the rule of thumb established by Hall et al. (2011)[5] and assuming that after five months, 21% of the potential effect has occurred, such an increase in weight would require an increase of 79 calories per day. The equivalent of half a can of soda or a single Chebakia (a Moroccan street cookie). An effect of this magnitude on food consumption seems plausible.

8 Cost-Effectiveness

A final and important question is whether the benefits associated with reducing childhood overweight rates are large enough to render this type of investment cost-effective. To answer this question, I make another back-of-envelope calculation to estimate a Cost-effectiveness ratio (CER): $(C-A)/Q$, where C stands for the cost

[4] The estimation on weight is obtained by running the same regression as for BMI-for-age but including also age and height as control variables.

[5] This rule of thumb is based on an estimation made for adults, but to the best of my knowledge, there is no similar estimation made for children.

of the program, A stands for the averted health care costs of adult obesity and Q stands for the quality- adjusted life years (QALYs) saved. The costs averted and QALYs saved were calculated over a period of 25 years, from 40 to 65 years of age, and were discounted at an annual rate of 3%, following Wang et al. (2003); Brown et al. (2007). The cost of the intervention was between US $540 and US $1,340 per household; hence, I assume a cost of US $940. For the benefit, I consider only the averted health care costs for adult obesity. Approximately, 30% of overweight children (under the definition I am using) under the age of 5 become obese adults (Serdula et al., 1993). The estimated effect of access to piped water at home is a reduction of 18 percentage points in the likelihood of overweight among children under the age of 5, and there are 1.5 children under age 5 per household, on average. The estimations for the annual health care cost of an obese adult range from US $ 2,741 for the USA to US $173 for Brazil (Shekar and Popkin, 2020). The largest, but most reliable estimate is from Cawley and Meyerhoefer (2012), so I use this estimate, weighted for the GDP ratio of the two countries, which leads to US $141 annual health care cost per obese adult. I use the estimated QALY from Brown et al. (2007). Given the estimated effect of the program on overweight rate of the children I obtain a CER of circa US $18,000 per QALY.

We can compare this CER with that of other cost-effective programs designed to reduce childhood overweight rates: Planet Health and the Coordinated Approach to Child Health (CATCH) intervention, both US programs. These are school-based programs that include special interdisciplinary curricula. CATCH also includes house visits and changes to the school food service. Controlled trials were used to estimate the effect of the programs: Planet Health reduced obesity rates by 5.5 percentage points among middle-school age girls, while CATCH reduced overweight rates by 11 percentage points among girls and 9 percentage points among boys age 8-11. The effects of these programs in terms of overweight are smaller than the effect estimated in this study, however, the CER of these programs are US $4,300 (Wang et al., 2003) and US$ 900 (Brown et al., 2007) per QALY, respectively. The lower CER is driven by a lower cost of the interventions and by a larger health care cost associated with adult obesity in the US.

In general, a program with a CER of US $18,000 per QALY is not considered cost-effective for low and middle-income countries (Woods 2016). If we also consider the savings in monthly water expenditure that represent about US $30 per year, for a total of 25 years, the CER decreases to US$ 7,000 per QALY. This CER still does not represent a cost-effective investment for low and middle-income countries. It is important to consider, however, that the government must have saved some money with the reduction in amount of water consumed from the public taps, a cost saving that we are not including in this calculation, and that access to piped water at home could also reduce overweight rate of older children and adults, for whom I do not have anthropometric data. Hence, while the benefit on childhood overweight alone does not seem to render a cost-effective intervention, they should be added to other benefits to estimate a more comprehensive cost-effectiveness ratio. Finally, if families are willing to pay the full price of the installation and all they require is an interest-free loan and some assistance with the application, as they did in the case of this intervention, the cost for the government is, naturally, much lower.

9 Conclusions

This study investigates whether expanded access to piped water at home can contribute to the fight against obesity in urban areas of middle-income countries, exploiting experimental data from the city of Tangiers, Morocco. Results show that access to piped water at home decreased BMI and overweight rates among children age 5 or younger. I further find that the effects on BMI and overweight rate were concentrated among children of households that were not informally connected to the public tap. These results are reassuring and somewhat informative regarding potential channels, since I also find that these households are the ones who benefited most in terms of access, price, and time cost of water, and in terms of additional time at home, in particular for household chores.

This study provides causal evidence of the potential effect that access to piped water at home can have in the fight against overweight and obesity rates in urban areas of middle-income countries. It also provides evidence that programs that facilitate water access at home can have important health benefits, even in areas with a clean-water source. Back-of-envelope calculations suggest, however, that the effect on early childhood overweight alone is not enough to make this type of intervention cost-effective but it adds significantly to other potential benefits. Future studies should increase the external validity of this study.

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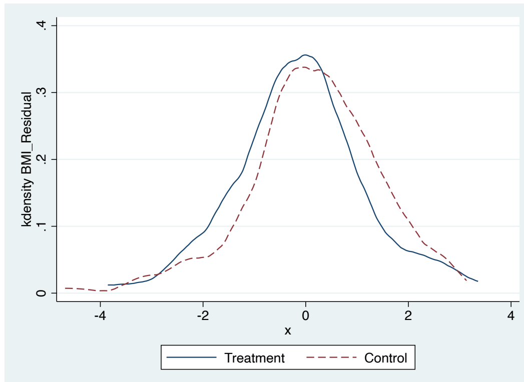
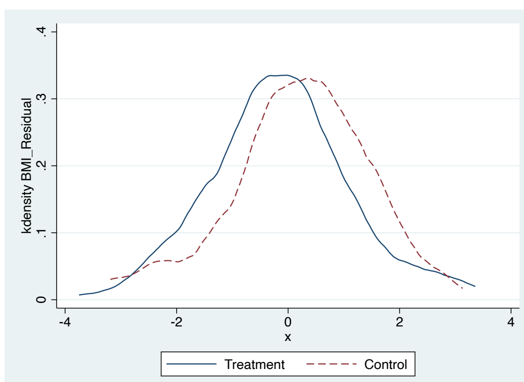
Figure 1: The Effect of the Treatment on BMI-for-Age



Note: Residuals are calculating after regressing BMI-for-Age on location, water source, the number of households, number of children under 5, the number of children under 15, baseline BMI-for-age and a dummy variable for missing observations on baseline std. BMI-for-age. Standard errors are clustered at the cluster level.

Figure 2: The Effect of the Treatment on BMI-for-Age for those Children not Informally Connected to the Public Tap



Note: Residuals are calculating after regressing BMI-for-Age on location, water source, the number of households, number of children under 5, the number of children under 15, baseline BMI-for-age and a dummy variable for missing observations on baseline std. BMI-for-age. Standard errors are clustered at the cluster level.

Table 1: Balance Check

	Obs.	Mean Control	SD Control	Diff. (T-C)	PVal.
Age	221	2.46	1.55	-0.22	0.26
Age (Endline)	258	3.04	1.56	-0.07	0.70
Female (%)	221	0.51	0.50	0.01	0.94
Female (%)(Endline)	258	0.50	0.50	-0.01	0.89
Height-for-age	111	-0.31	1.76	0.25	0.52
Height-for-age (Endline)	258	0.23	1.86	0.09	0.71
Weight-for-age	111	0.28	1.05	0.09	0.71
BMI-for-age (std.)	111	0.07	0.96	-0.07	0.77
Overweight (%)	111	0.13	0.34	0.05	0.57
Obesity (%)	111	0.05	0.23	-0.03	0.66
Underweight (%)	111	0.00	0.00	0.00	.
Missing BMI (%)	258	0.54	0.50	0.01	0.84
Num. adults	258	2.87	1.46	0.28	0.23
Num. children Age 0-14	258	2.91	1.82	-0.55	0.01
Head male (%)	257	0.90	0.30	0.01	0.70
Head age	249	42.73	10.88	-0.96	0.57
Head married (%)	257	0.95	0.22	-0.03	0.44
Head no education (%)	248	0.36	0.48	-0.05	0.48
Head's education att.	213	3.40	3.46	0.27	0.65
Head's income (dirhams)	231	1363.11	1020.86	-82.58	0.63
Family income (dirhams)	258	1510.74	1369.24	24.51	0.91
Working for pay (%)	258	0.21	0.14	0.00	0.96
Adults working for pay (%)	258	0.40	0.24	-0.03	0.40
Assets score	258	0.35	1.67	-0.15	0.53
Num. rooms	257	3.05	1.02	0.37	0.05
Permanent house (%)	258	0.86	0.35	0.01	0.75
Toilet (%)	258	1.00	0.00	0.00	.
Chlorine in water (%)	73	0.56	0.50	0.06	0.66
Clear water (%)	258	0.99	0.09	-0.01	0.72
Treat water (%)	221	0.09	0.29	0.05	0.38
Distance to public tap (mts)	258	130.23	103.62	0.24	0.99
Storage water (%)	255	0.86	0.35	0.03	0.43
N. fetch water per week -Adult	258	1.20	1.70	-0.09	0.71
-Male adult	253	1.20	2.42	0.18	0.70
-Female adult	255	1.19	2.55	-0.35	0.39
-Children age 6-14	151	0.79	1.61	-0.31	0.27
-Children age 0-5	235	0.00	0.00	0.00	.
Minutes feching water last 7 days	256	250.99	455.22	-84.50	0.17
Water Storaged last 7 days (liters)	245	0.47	0.75	0.00	0.98
Water Payment last 7 days (Dirhams)	252	26.41	60.73	8.22	0.43
Report enough water	258	0.73	0.45	-0.03	0.67
Report water problem	254	0.32	0.47	-0.06	0.33

Note: Columns (1) display the number of observations, columns (2) and (3) display the average and standard deviation of the control group, respectively. Columns (4) show the estimated difference in pre-treatment means between treatment and control groups, which is obtained from regressing the variable of interest on the treatment dummy, controlling for the stratification variables: location, water source, the number of households and number of children under 5. Standard errors are clustered at the cluster level and p- values are reported in Columns (5).

Table 2: Effects on Water Access and Other Outcomes

a) Intention to Treat

	(1) Connected to Water Network First Stage	(2) HH reports Enough Water	(3) Minutes fetching water past 3 days	(4) HH reports More Time for Housework	(5) Installment (in Dirhams)	(6) Water Expenditure (in Dirhams)	(7) Life Satisfaction (Std.)	(8) Mental Health (Std.)
Treatment	0.60	0.11	-70.67	0.15	51.28	-11.96	0.64	0.29
	(0.07)	(0.05)	(16.83)	(0.07)	(8.22)	(23.79)	(0.15)	(0.17)
	[0.00]	[0.02]	[0.00]	[0.03]	[0.00]	[0.64]	[0.00]	[0.07]
R^2	0.382	0.173	0.271	0.164	0.248	0.213	0.188	0.128
Observations	258	258	258	253	258	258	258	255

	(1) Connected to Water Network First Stage	(2) HH reports Enough Water	(3) Minutes fetching water past 3 days	(4) HH reports More Time for Housework	(5) Installment (in Dirhams)	(6) Water Expenditure (in Dirhams)	(7) Life Satisfaction (Std.)	(8) Mental Health (Std.)
Mean Control	0.23	0.87	73.91	0.30	16.18	104.39	-0.35	-0.13

b) Local Average Treatment Effect

	(1) Connected to Water Network First Stage	(2) HH reports Enough Water	(3) Minutes fetching water past 3 days	(4) HH reports More Time for Housework	(5) Installment (in Dirhams)	(6) Water Expenditure (in Dirhams)	(7) Life Satisfaction (Std.)	(8) Mental Health (Std.)
Piped Water		0.18	-117.17	0.25	85.02	-19.83	1.06	0.46
		(0.09)	(27.60)	(0.11)	(12.01)	(39.75)	(0.26)	(0.26)
		[0.04]	[0.00]	[0.02]	[0.00]	[0.62]	[0.00]	[0.08]
R^2	0.382	0.246	0.304	0.217	0.387	0.209	0.201	0.121
Observations	258	258	258	253	258	258	258	255

	(1) Connected to Water Network First Stage	(2) HH reports Enough Water	(3) Minutes fetching water past 3 days	(4) HH reports More Time for Housework	(5) Installment (in Dirhams)	(6) Water Expenditure (in Dirhams)	(7) Life Satisfaction (Std.)	(8) Mental Health (Std.)
Mean Control	0.00	0.85	98.30	0.25	-3.70	111.42	-0.61	-0.22

Note: control variables include stratification variables used for the randomization (location, water source, number of households per cluster, number of children 5), number of children under 15, baseline BMIz, age and gender. The life satisfaction index was created using factor analysis over the following variables: how respondent classified his satisfaction with his life in a scale from 1 to 10, whether his own life improved from the previous year, whether his household life improved from the previous year. The mental health index was created using factor analysis over the following variables: over past seven days, respondent felt, more often than not sad, angry, upset, relaxed, satisfied, happy, worried and tired. Standard errors shown in round parentheses and P-values shown in square parentheses. Standard errors are clustered at the cluster level. P-value of the treatment represents the "exact" P-value (randomized inference). Sharpened q-values to adjust for multiple hypothesis testing are presented in the Appendix.

Table 3: Effects on Anthropometric Indicators

a) Intention to Treat

	(1) BMI-for-Age (St. Dev)	(2) Overweight Child	(3) Obese Child	(4) Weight-for-Age (St. Dev)	(5) Height-for-Age (St. Dev)	(6) Underweight Child
Treatment	-0.23	-0.10	-0.02	-0.17	-0.00	0.01
	(0.13)	(0.05)	(0.03)	(0.12)	(0.13)	(0.02)
	[0.09]	[0.02]	[0.42]	[0.20]	[0.98]	[0.58]
R^2	0.213	0.159	0.107	0.251	0.206	0.079
Observations	258	258	258	258	258	258

	(1) BMI-for-Age (St. Dev)	(2) Overweight Child	(3) Obese Child	(4) Weight-for-Age (St. Dev)	(5) Height-for-Age (St. Dev)	(6) Underweight Child
Mean Control	0.10	0.18	0.08	0.07	-0.01	0.03

b) Local Average Treatment Effect

	(1) BMI-for-Age (St. Dev)	(2) Overweight Child	(3) Obese Child	(4) Weight-for-Age (St. Dev)	(5) Height-for-Age (St. Dev)	(6) Underweight Child
Piped Water	-0.38	-0.16	-0.04	-0.29	-0.01	0.02
	(0.22)	(0.08)	(0.06)	(0.20)	(0.22)	(0.04)
	[0.08]	[0.05]	[0.48]	[0.16]	[0.98]	[0.62]
R^2	0.179	0.086	0.096	0.244	0.206	0.074
Observations	258	258	258	258	258	258

	(1) BMI-for-Age (St. Dev)	(2) Overweight Child	(3) Obese Child	(4) Weight-for-Age (St. Dev)	(5) Height-for-Age (St. Dev)	(6) Underweight Child
Mean Control	0.17	0.22	0.09	0.12	-0.01	0.02

Note: control variables include stratification variables used for the randomization (location, water source, number of households per cluster, number of children 5), number of children under 15, baseline BMIz, age and gender. Standard errors shown in round parentheses and P-values shown in square parentheses. Standard errors are clustered at the cluster level. P-value of the treatment represents the "exact" P-value (randomized inference). Sharpened q-values to adjust for multiple hypothesis testing are presented in the Appendix.

Table 4: Heterogeneous Effect on Water Access

a) Intention to Treat

	(1) Connected to Water Network First Stage No Public Tap	(2) Connected to Water Network First Stage Public Tap	(3) Installment (in Dirhams) No Public Tap	(4) Installment (in Dirhams) Public Tap	(5) Water Expenditure (in Dirhams) No Public Tap	(6) Water Expenditure (in Dirhams) Public Tap	(7) HH reports Enough Water No Public Tap	(8) HH reports Enough Water Public Tap
Treatment	0.59	0.69	52.08	47.19	-23.21	45.78	0.13	-0.02
	(0.07)	(0.14)	(8.72)	(20.99)	(26.83)	(32.27)	(0.06)	(0.10)
	[0.00]	[0.00]	[0.00]	[0.00]	[0.33]	[0.06]	[0.00]	[0.68]
R^2	0.383	0.383	0.248	0.248	0.217	0.217	0.181	0.181
Observations	258	258	258	258	258	258	258	258

	(1) Connected to Water Network First Stage No Public Tap	(2) Connected to Water Network First Stage Public Tap	(3) Installment (in Dirhams) No Public Tap	(4) Installment (in Dirhams) Public Tap	(5) Water Expenditure (in Dirhams) No Public Tap	(6) Water Expenditure (in Dirhams) Public Tap	(7) HH reports Enough Water No Public Tap	(8) HH reports Enough Water Public Tap
Mean Control	0.23	0.21	17.65	11.43	132.54	12.88	0.85	0.96

Difference

	(1) Connected to Water Network First Stage	(2) Installment (in Dirhams)	(3) Water Expenditure (in Dirhams)	(4) HH reports Enough Water
Treatment × No Public Tap	-0.10	4.88	-68.99	0.15
	(0.16)	(22.26)	(40.01)	(0.10)
	[0.65]	[0.86]	[0.06]	[0.10]
R^2	0.383	0.248	0.217	0.181
Observations	258	258	258	258

b) Local Average Treatment Effect

	(1) Connected to Water Network First Stage No Public Tap	(2) Connected to Water Network First Stage Public Tap	(3) Installment (in Dirhams) No Public Tap	(4) Installment (in Dirhams) Public Tap	(5) Water Expenditure (in Dirhams) No Public Tap	(6) Water Expenditure (in Dirhams) Public Tap	(7) HH reports Enough Water No Public Tap	(8) HH reports Enough Water Public Tap
Piped Water	1.00	1.00	88.52	68.43	-38.29	67.70	0.22	-0.03
	(0.00)	(0.00)	(13.35)	(28.57)	(45.72)	(47.10)	(0.09)	(0.14)
	[0.00]	[0.00]	[0.00]	[0.02]	[0.40]	[0.15]	[0.02]	[0.81]
R^2	1.000	1.000	0.388	0.388	0.212	0.212	0.241	0.241
Observations	258	258	258	258	258	258	258	258

	(1) Connected to Water Network First Stage No Public Tap	(2) Connected to Water Network First Stage Public Tap	(3) Installment (in Dirhams) No Public Tap	(4) Installment (in Dirhams) Public Tap	(5) Water Expenditure (in Dirhams) No Public Tap	(6) Water Expenditure (in Dirhams) Public Tap	(7) HH reports Enough Water No Public Tap	(8) HH reports Enough Water Public Tap
Mean Control	0.00	0.00	-2.21	-7.87	152.50	-12.81	0.81	0.97

Difference

	(1) Connected to Water Network First Stage	(2) Installment (in Dirhams)	(3) Water Expenditure (in Dirhams)	(4) HH reports Enough Water
Connected x No Public Tap	0.00	20.09	-105.99	0.26
	(0.00)	(31.38)	(62.94)	(0.15)
	[0.74]	[0.52]	[0.09]	[0.09]
R^2	1.000	0.388	0.212	0.241
Observations	258	258	258	258

Note: control variables include stratification variables used for the randomization (location, water source, number of households per cluster, number of children 5), number of children under 15, baseline BMIz, age and gender. Standard errors shown in round parentheses and P-values shown in square parentheses. Standard errors are clustered at the cluster level. P-value of the treatment represents the "exact" P-value (randomized inference). Sharpened q-values to adjust for multiple hypothesis testing are presented in the Appendix.

Table 5: Heterogeneous Effect on Time

a) Intention to Treat

	(1) Minutes fetching water past 3 days No Public Tap	(2) Minutes fetching water past 3 days Public Tap	(3) HH reports More Time for Housework No Public Tap	(4) HH reports More Time for Housework Public Tap	(5) HH reports More Time Activities at Home No Public Tap	(6) HH reports More Time Activities at Home Public Tap	(7) HH reports More Time Activities Outside No Public Tap	(8) HH reports More Time Activities Outside Public Tap
Treatment	-73.79	-54.65	0.23	-0.22	0.25	-0.02	0.22	0.25
	(18.04)	(24.91)	(0.07)	(0.18)	(0.06)	(0.16)	(0.07)	(0.15)
	[0.00]	[0.00]	[0.00]	[0.01]	[0.00]	[0.74]	[0.00]	[0.00]
R^2	0.272	0.272	0.188	0.188	0.185	0.185	0.277	0.277
Observations	258	258	253	253	258	258	258	258

	(1) Minutes fetching water past 3 days No Public Tap	(2) Minutes fetching water past 3 days Public Tap	(3) HH reports More Time for Housework No Public Tap	(4) HH reports More Time for Housework Public Tap	(5) HH reports More Time for Activities at Home No Public Tap	(6) HH reports More Time Activities at Home Public Tap	(7) HH reports More Time Activities Outside No Public Tap	(8) HH reports More Time Activities Outside Public Tap
Mean Control	83.04	44.21	0.26	0.43	-0.05	0.16	-0.26	-0.36

Difference

	(1) Minutes fetching water past 3 days	(2) HH reports More Time for Housework	(3) HH reports More Time Activities at Home	(4) HH reports More Time Activities Outside
Treatment × No Public Tap	-19.14	0.44	0.27	-0.03
	(25.64)	(0.20)	(0.18)	(0.16)
	[0.61]	[0.04]	[0.09]	[0.82]
R^2	0.272	0.188	0.185	0.277
Observations	258	253	258	258

b) Local Average Treatment Effect

	(1) Minutes fetching water past 3 days No Public Tap	(2) Minutes fetching water past 3 days Public Tap	(3) HH reports More Time for Housework No Public Tap	(4) HH reports More Time for Housework Public Tap	(5) HH reports More Time Activities at Home No Public Tap	(6) HH reports More Time Activities at Home Public Tap	(7) HH reports More Time Activities Outside No Public Tap	(8) HH reports More Time Activities Outside Public Tap
Piped Water	-125.22	-79.00	0.37	-0.31	0.42	-0.03	0.37	0.36
	(30.30)	(33.88)	(0.12)	(0.28)	(0.11)	(0.25)	(0.12)	(0.21)
	[0.00]	[0.02]	[0.00]	[0.26]	[0.00]	[0.90]	[0.00]	[0.09]
R^2	0.305	0.305	0.191	0.191	0.102	0.102	0.253	0.253
Observations	258	258	253	253	258	258	258	258

	(1) Minutes fetching water past 3 days No Public Tap	(2) Minutes fetching water past 3 days Public Tap	(3) HH reports More Time for Housework No Public Tap	(4) HH reports More Time for Housework Public Tap	(5) HH reports More Time Activities at Home No Public Tap	(6) HH reports More Time Activities at Home Public Tap	(7) HH reports More Time Activities Outside No Public Tap	(8) HH reports More Time Activities Outside Public Tap
Mean Control	112.12	56.65	0.18	0.50	-0.16	0.17	-0.35	-0.44

Difference

	(1) Minutes fetching water past 3 days	(2) HH reports More Time for Housework	(3) HH reports More Time Activities at Home	(4) HH reports More Time Activities Outside
Connected x No Public Tap	-46.22	0.69	0.45	0.01
	(36.66)	(0.31)	(0.27)	(0.24)
	[0.21]	[0.03]	[0.10]	[0.97]
R^2	0.305	0.191	0.102	0.253
Observations	258	253	258	258

Note: control variables include stratification variables used for the randomization (location, water source, number of households per cluster, number of children 5), number of children under 15, baseline BMIz, age and gender. Standard errors shown in round parentheses and P-values shown in square parentheses. Standard errors are clustered at the cluster level. P-value of the treatment represents the "exact" P-value (randomized inference). Sharpened q-values to adjust for multiple hypothesis testing are presented in the Appendix.

Table 6: Heterogeneous Effect on Life Satisfaction and Mental Health

a) Intention to Treat

	(1) HH reports Water Main Problem No Public Tap	(2) HH reports Water Main Problem Public Tap	(3) Life Satisfaction No Public Tap	(4) Life Satisfaction Public Tap	(5) Mental Health No Public Tap	(6) Mental Health Public Tap
Treatment	-0.28	-0.47	0.65	0.58	0.31	0.21
	(0.08)	(0.17)	(0.16)	(0.37)	(0.19)	(0.37)
	[0.00]	[0.00]	[0.00]	[0.00]	[0.06]	[0.20]
R^2	0.198	0.198	0.188	0.188	0.128	0.128
Observations	258	258	258	258	255	255

	(1) HH reports Water Main Problem No Public Tap	(2) HH reports Water Main Problem Public Tap	(3) Life Satisfaction No Public Tap	(4) Life Satisfaction Public Tap	(5) Mental Health No Public Tap	(6) Mental Health Public Tap
Mean Control	0.52	0.61	-0.35	-0.34	-0.18	-0.00

Difference

	(1) HH reports Water Main Problem	(2) Life Satisfaction	(3) Mental Health
Treatment × No Public Tap	0.18	0.07	0.10
	(0.19)	(0.39)	(0.41)
	[0.35]	[0.87]	[0.79]
R^2	0.198	0.188	0.128
Observations	258	258	255

b) Local Average Treatment Effect

	(1) HH reports Water Main Problem No Public Tap	(2) HH reports Water Main Problem Public Tap	(3) Life Satisfaction No Public Tap	(4) Life Satisfaction Public Tap	(5) Mental Health No Public Tap	(6) Mental Health Public Tap
Piped Water	-0.49	-0.68	1.11	0.85	0.49	0.32
	(0.12)	(0.24)	(0.29)	(0.48)	(0.30)	(0.51)
	[0.00]	[0.00]	[0.00]	[0.08]	[0.10]	[0.54]
R^2	0.414	0.414	0.194	0.194	0.118	0.118
Observations	258	258	258	258	255	255

	(1) HH reports Water Main Problem No Public Tap	(2) HH reports Water Main Problem Public Tap	(3) Life Satisfaction No Public Tap	(4) Life Satisfaction Public Tap	(5) Mental Health No Public Tap	(6) Mental Health Public Tap
Mean Control	0.62	0.75	-0.63	-0.53	-0.28	-0.00

Difference

	(1) HH reports Water Main Problem	(2) Life Satisfaction	(3) Mental Health
Connected x No Public Tap	0.20	0.26	0.17
	(0.27)	(0.54)	(0.59)
	[0.46]	[0.63]	[0.78]
R^2	0.414	0.194	0.118
Observations	258	258	255

Note: control variables include stratification variables used for the randomization (location, water source, number of households per cluster, number of children 5), number of children under 15, baseline BMIz, age and gender. Standard errors shown in round parentheses and P-values shown in square parentheses. Standard errors are clustered at the cluster level. P-value of the treatment represents the "exact" P-value (randomized inference). Sharpened q-values to adjust for multiple hypothesis testing are presented in the Appendix.

Table 7: Heterogeneous Effect on Anthropometric Indicators

a) Intention to Treat

	(1) BMI-for-Age (St. Dev) No Public Tap	(2) BMI-for-Age (St. Dev) Public Tap	(3) Overweight Child No Public Tap	(4) Overweight Child Public Tap	(5) Obese Child No Public Tap	(6) Obese Child Public Tap
Treatment	-0.28	0.04	-0.12	-0.00	-0.02	-0.03
	(0.14)	(0.31)	(0.05)	(0.11)	(0.04)	(0.09)
	[0.04]	[0.73]	[0.01]	[0.96]	[0.44]	[0.31]
R^2	0.216	0.216	0.162	0.162	0.107	0.107
Observations	258	258	258	258	258	258

	(1) BMI-for-Age (St. Dev) No Public Tap	(2) BMI-for-Age (St. Dev) Public Tap	(3) Overweight Child No Public Tap	(4) Overweight Child Public Tap	(5) Obese Child No Public Tap	(6) Obese Child Public Tap
Mean Control	0.17	-0.15	0.20	0.14	0.07	0.11

Difference

	(1) BMI-for-Age (St. Dev)	(2) Overweight Child	(3) Obese Child
Treatment × No Public Tap	-0.32	-0.11	0.01
	(0.35)	(0.12)	(0.09)
	[0.33]	[0.28]	[0.95]
R^2	0.216	0.162	0.107
Observations	258	258	258

b) Local Average Treatment Effect

	(1) BMI-for-Age (St. Dev) No Public Tap	(2) BMI-for-Age (St. Dev) Public Tap	(3) Overweight Child No Public Tap	(4) Overweight Child Public Tap	(5) Obese Child No Public Tap	(6) Obese Child Public Tap
Piped Water	-0.48	0.06	-0.19	-0.00	-0.04	-0.05
	(0.25)	(0.46)	(0.09)	(0.17)	(0.06)	(0.13)
	[0.06]	[0.89]	[0.04]	[0.99]	[0.52]	[0.72]
R^2	0.174	0.174	0.079	0.079	0.097	0.097
Observations	258	258	258	258	258	258

	(1) BMI-for-Age (St. Dev) No Public Tap	(2) BMI-for-Age (St. Dev) Public Tap	(3) Overweight Child No Public Tap	(4) Overweight Child Public Tap	(5) Obese Child No Public Tap	(6) Obese Child Public Tap
Mean Control	0.28	-0.17	0.24	0.15	0.07	0.12

Difference

	(1) BMI-for-Age (St. Dev)	(2) Overweight Child	(3) Obese Child
Connected x No Public Tap	-0.54	-0.19	0.01
	(0.53)	(0.20)	(0.14)
	[0.31]	[0.33]	[0.97]
R^2	0.174	0.079	0.097
Observations	258	258	258

Note: control variables include stratification variables used for the randomization (location, water source, number of households per cluster, number of children 5), number of children under 15, baseline BMIz, age and gender. Standard errors shown in round parentheses and P-values shown in square parentheses. Standard errors are clustered at the cluster level. P-value of the treatment represents the "exact" P-value (randomized inference). Sharpened q-values to adjust for multiple hypothesis testing are presented in the Appendix.

A Appendix: Balance Checks in Subsamples

Table A1: Balance Check Households with Connection to a Public Tab

	Obs.	Mean Control	SD Control	Diff. (T-C)	PVal.
Age	37	2.77	1.66	-0.54	0.34
Age (Endline)	44	3.07	1.77	-0.12	0.81
Female (%)	37	0.59	0.50	-0.04	0.82
Female (%)(Endline)	44	0.57	0.50	-0.06	0.70
Height-for-age	22	0.26	1.62	-0.86	0.26
Height-for-age (Endline)	44	0.70	2.28	-0.71	0.30
Weight-for-age	22	0.35	0.93	-0.28	0.58
BMI-for-age (std.)	22	-0.23	0.84	0.30	0.60
Overweight (%)	22	0.08	0.28	0.11	0.62
Obesity (%)	22	0.00	0.00	0.08	0.52
Underweight (%)	22	0.00	0.00	0.00	.
Missing BMI (%)	44	0.54	0.51	-0.03	0.85
Num. adults	44	2.86	1.51	1.22	0.04
Num. children Age 0-14	44	1.79	1.20	0.46	0.23
Head male (%)	44	0.89	0.31	-0.06	0.56
Head age	42	41.73	10.93	5.79	0.25
Head married (%)	44	0.96	0.19	-0.04	0.47
Head no education (%)	42	0.23	0.43	0.24	0.14
Head's education att.	36	5.09	3.74	-2.28	0.13
Head's income (dirhams)	38	1500.00	1351.89	-448.50	0.44
Family income (dirhams)	44	1521.36	1568.11	141.12	0.81
Working for pay (%)	44	0.26	0.16	-0.08	0.12
Adults working for pay (%)	44	0.42	0.26	-0.12	0.13
Assets score	44	1.43	1.44	-0.71	0.17
Num. rooms	44	2.93	1.05	0.93	0.06
Permanent house (%)	44	0.93	0.26	0.09	0.30
Toilet (%)	44	1.00	0.00	0.00	.
Chlorine in water (%)	11	0.50	0.55	-0.08	0.80
Clear water (%)	44	1.00	0.00	-0.00	0.71
Treat water (%)	43	0.15	0.36	-0.05	0.70
Distance to public tap (mts)	44	53.47	36.29	-8.82	0.69
Storage water (%)	44	1.00	0.00	0.01	0.79
N. fetch water per week -Adult	44	0.36	0.31	-0.26	0.51
-Male adults	43	0.57	0.68	0.21	0.70
-Female adults	44	0.13	0.29	-0.63	0.15
-Children age 6-14	19	0.78	2.33	-1.18	0.27
-Children age 0-5	39	0.00	0.00	0.00	.
Minutes feching water last 7 days	44	162.87	313.66	-42.11	0.73
Water Storaged last 7 days (liters)	44	0.55	0.73	0.62	0.21
Water Payment last 7 days (Dirhams)	44	2.29	10.31	-6.05	0.39
Report enough water	44	0.75	0.44	-0.17	0.30
Report water problem	44	0.46	0.51	-0.16	0.39

Note: Columns (1) display the number of observations, columns (2) and (3) display the average and standard deviation-of the control group, respectively. Columns (4) show the estimated difference in pre-treatment means between treatment and control groups among households without connection to a public tab, which is obtained from regressing the variable of interest on the treatment dummy, controlling for the interaction of the treatment dummy and a dummy for households not connected to a public tab, and for the stratification variables: location, water source, the number of households and number of children under 5. Standard errors are clustered at the cluster level and p- values are reported in Columns (5).

Table A2: Balance Check Households without Connection to a Public Tab

	Obs.	Mean Control	SD Control	Diff. (T-C)	PVal.
Age	184	2.37	1.51	-0.17	0.43
Age (Endline)	214	3.03	1.50	-0.06	0.75
Female (%)	184	0.49	0.50	0.01	0.87
Female (%)(Endline)	214	0.48	0.50	0.00	0.99
Height-for-age	89	-0.48	1.79	0.45	0.30
Height-for-age (Endline)	214	0.09	1.70	0.23	0.37
Weight-for-age	89	0.25	1.09	0.16	0.55
BMI-for-age (std.)	89	0.17	0.99	-0.14	0.58
Overweight (%)	89	0.14	0.35	0.04	0.64
Obesity (%)	89	0.07	0.26	-0.04	0.47
Underweight (%)	89	0.00	0.00	0.00	.
Missing BMI (%)	214	0.54	0.50	0.02	0.76
Num. adults	214	2.87	1.45	0.11	0.64
Num. children Age 0-14	214	3.25	1.84	-0.73	0.00
Head male (%)	213	0.90	0.30	0.03	0.47
Head age	207	43.02	10.91	-2.13	0.20
Head married (%)	213	0.94	0.23	-0.02	0.54
Head no education (%)	206	0.40	0.49	-0.10	0.19
Head's education att.	177	2.86	3.20	0.74	0.22
Head's income (dirhams)	193	1325.93	917.85	-18.29	0.91
Family income (dirhams)	214	1507.47	1311.62	4.23	0.99
Working for pay (%)	214	0.19	0.13	0.01	0.49
Adults working for pay (%)	214	0.40	0.23	-0.02	0.70
Assets score	214	0.02	1.61	-0.05	0.84
Num. rooms	213	3.09	1.02	0.27	0.16
Permanent house (%)	214	0.84	0.37	0.00	0.99
Toilet (%)	214	1.00	0.00	0.00	.
Chlorine in water (%)	62	0.57	0.50	0.08	0.57
Clear water (%)	214	0.99	0.10	-0.01	0.73
Treat water (%)	178	0.07	0.25	0.07	0.23
Distance to public tap (mts)	214	153.84	106.23	1.82	0.92
Storage water (%)	211	0.82	0.39	0.04	0.45
N. fetch water per week -Adult	214	1.46	1.87	-0.07	0.83
-Male adults	210	1.40	2.73	0.17	0.74
-Female adults	211	1.52	2.83	-0.30	0.52
-Children age 6-14	132	0.79	1.51	-0.21	0.52
-Children age 0-5	196	0.00	0.00	0.00	.
Minutes feching water last 7 days	212	278.10	488.89	-91.90	0.18
Water Storaged last 7 days (liters)	201	0.44	0.76	-0.11	0.37
Water Payment last 7 days (Dirhams)	208	34.00	67.72	10.75	0.36
Report enough water	214	0.73	0.45	-0.00	0.97
Report water problem	210	0.28	0.45	-0.05	0.48

Note: Columns (1) display the number of observations, columns (2) and (3) display the average and standard deviation-of the control group, respectively. Columns (4) show the estimated difference in pre-treatment means between treatment and control groups among households without connection to a public tab, which is obtained from regressing the variable of interest on the treatment dummy, controlling for the interaction of the treatment dummy and a dummy for households connected to a public tab, and for the stratification variables: location, water source, the number of households and number of children under 5. Standard errors are clustered at the cluster level and p- values are reported in Columns (5).

Table A3: Difference between “Non-Attrition” and “Attrition” Samples

Treatment Group

	Obs	Mean Non Attrition	SD Non Attrition.	Diff.	Pval
BMI-for-age	82	0.49	1.40	-0.01	0.98
Overweight (%)	82	0.18	0.39	-0.10	0.29
Obesity (%)	82	0.05	0.23	-0.03	0.64
Underweight (%)	82	0.00	0.00	0.07	0.26

Control Group

	Obs	Mean Non Attrition	SD Non Attrition.	Diff.	Pval
BMI-for-age	73	0.70	1.28	0.08	0.85
Overweight (%)	73	0.12	0.33	0.04	0.74
Obesity (%)	73	0.05	0.23	0.04	0.58
Underweight (%)	73	0.00	0.00	0.00	.

Note: Columns (1) display the number of observations, columns (2) and (3) display the average and standard deviation of the “non-attrition” group, respectively. Columns (4) show the estimated difference in pre-treatment means between children in the “non-attrition” group and in the “attrition” group, which is obtained from regressing the variable of interest on the attrition dummy, controlling for the stratification variables: location, water source, the number of households and number of children under 5. Standard errors are clustered at the cluster level and p- values are reported in Columns (5).

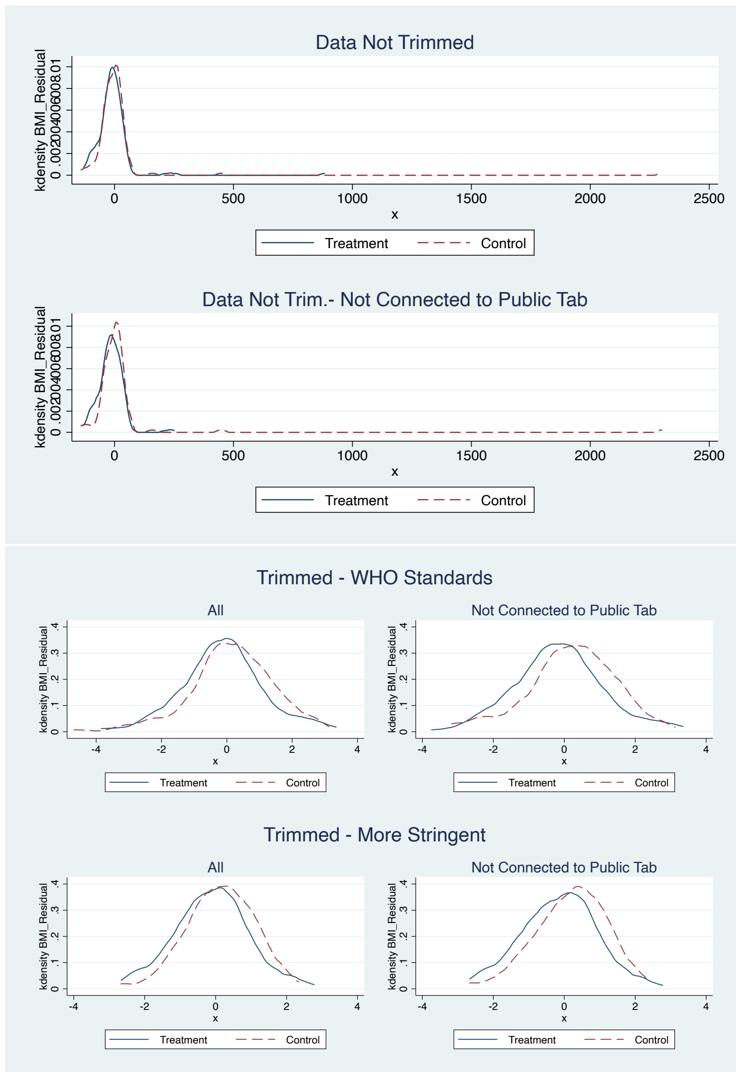
B Appendix: Sensitivity Analysis

This section presents the sensitivity of the main results to different trims of BMIz, different measures of BMIz, to control variables and to different ages of the children. Additionally, I estimate the Sharpened q-values to adjust for multiple hypothesis testing. In general, we will see that the results on BMIz of children of all households are less precise and somewhat sensitive to different specifications and changes in the sample, while results on BMIz of children of households without connection to a public tap and the results on the overweight rate of both samples are very robust.

Figure 1 and Table A1 show the estimations without eliminating BIV and following a more stringent criteria than the one used in the main analysis. As it is common with this type of measurements (Himes2009), our sample presents a non-trivial percentage of BIV, 15%. The figures and tables reveal that the raw distribution contains very extreme values, which affects the estimation of the effect on average

BMIz but not on the overweight rate, as we would expect. They also reveal that the results are robust to more stringent trimming criteria.

Figure 1: Sensitivity to Different Trims of BMI-for-age



Note: Trim 1 (WHO standards): height-for-age higher than 6 or lower than -6 standard deviations, BMI-for-age larger than 5 or smaller than -5 standard deviations . Trim 2 (More stringent): height-for-age higher than 4 or lower than -4 standard deviations, BMI-for-age larger than 3 or smaller than -3 standard deviations (WHO standards).

Table A1: Sensitivity to Different Trims of BMI-for-age

Main Effects

	(1) BMI-for-Age (St. Dev) No Trim	(2) BMI-for-Age (St. Dev) Trim 1	(3) BMI-for-Age (St. Dev) Trim 2	(4) Overweight Child No Trim.	(5) Overweight Child Trim 1	(6) Overweight Child Trim 2
Treatment	-0.14	-0.23	-0.28	-0.14	-0.23	-0.28
	(0.21)	(0.13)	(0.15)	(0.21)	(0.13)	(0.15)
	[0.33]	[0.06]	[0.04]	[0.33]	[0.06]	[0.04]
R^2	0.074	0.213	0.212	0.074	0.213	0.212
Observations	301	258	229	301	258	229

Effects on Households without Connection to a Public Tap

	(1) BMI-for-Age (St. Dev) No Trim	(2) BMI-for-Age (St. Dev) Trim 1	(3) BMI-for-Age (St. Dev) Trim 2	(4) Overweight Child No Trim	(5) Overweight Child Trim 1	(6) Overweight Child Trim 2
Treatment	-0.25	-0.28	-0.36	-0.25	-0.28	-0.36
	(0.25)	(0.14)	(0.16)	(0.25)	(0.14)	(0.16)
	[0.02]	[0.03]	[0.01]	[0.02]	[0.03]	[0.01]
R^2	0.086	0.216	0.218	0.086	0.216	0.218
Observations	301	258	229	301	258	229

Note: Trim 1 (WHO standards): height-for-age higher than 6 or lower than -6 standard deviations, BMI-for-age larger than 5 or smaller than -5 standard deviations . Trim 2 (More stringent): height-for-age higher than 4 or lower than -4 standard deviations, BMI-for-age larger than 3 or smaller than -3 standard deviations (WHO standards). Control variables include stratification variables used for the randomization (location, water source, number of households per cluster, number of children 5), number of children under 15, baseline BMIz, age and gender. Standard errors shown in round parentheses and P-values shown in square parentheses. Standard errors are clustered at the cluster level. P-value of the treatment represents the "exact" P-value (randomized inference).

Table A2: Sensitivity to Different Measurements of BMI-for-age

Main Effects

	(1) BMI-for-Age (St. Dev) Measure 1	(2) BMI-for-Age (St. Dev) Measure 2	(3) BMI-for-Age (St. Dev) Average	(4) Overweight Child Measure 1	(5) Overweight Child Measure 2	(6) Overweight Child Average
Treatment	-0.27	-0.27	-0.27	-0.27	-0.27	-0.27
	(0.13)	(0.13)	(0.13)	(0.13)	(0.13)	(0.13)
	[0.02]	[0.02]	[0.02]	[0.02]	[0.02]	[0.02]
R^2	0.227	0.227	0.227	0.227	0.227	0.227
Observations	260	260	260	260	260	260

Effects on Households without Connection to a Public Tap

	(1) BMI-for-Age (St. Dev) Measure 1	(2) BMI-for-Age (St. Dev) Measure 2	(3) BMI-for-Age (St. Dev) Average	(4) Overweight Child Measure 1	(5) Overweight Child Measure 2	(6) Overweight Child Average
Treatment	-0.31	-0.31	-0.31	-0.31	-0.31	-0.31
	(0.14)	(0.14)	(0.14)	(0.14)	(0.14)	(0.14)
	[0.01]	[0.01]	[0.01]	[0.01]	[0.01]	[0.01]
R^2	0.229	0.229	0.229	0.229	0.229	0.229
Observations	260	260	260	260	260	260

Note: Columns (3) and (6) show the average of the two measurements or the measurement that is not a biological implausible value. Control variables include stratification variables used for the randomization (location, water source, number of households per cluster, number of children 5), number of children under 15, baseline BMIz, age and gender. Standard errors shown in round parentheses and P-values shown in square parentheses. Standard errors are clustered at the cluster level. P-value of the treatment represents the "exact" P-value (randomized inference).

Table A3 shows the estimations without control variables and controlling for additional variables for the main results. The control variables used for the randomization and the variable that is unbalanced in the baseline have some effect on my results, as expected. Other control variables merely increase statistical power.

Table A3: Sensitivity to Different Control Variables

Connected to water network (First Stage)

	(1) Unbalanced	(2) Unbalanced	(3) Balanced	(4) Balanced	(5) Balanced
Treatment	0.57	0.60	0.60	0.60	0.60
	(0.07)	(0.06)	(0.07)	(0.07)	(0.06)
	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]
Observations	258	258	258	258	258

Households reports enough water - ITT

	(1) Unbalanced	(2) Unbalanced	(3) Balanced	(4) Balanced	(5) Balanced
Treatment	0.05	0.10	0.11	0.11	0.11
	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)
	[0.22]	[0.02]	[0.02]	[0.02]	[0.02]
Observations	258	258	258	258	258

Monthly Water Expenditure - ITT

	(1) Unbalanced	(2) Unbalanced	(3) Balanced	(4) Balanced	(5) Balanced
Treatment	-17.72	-23.50	-11.45	-11.96	-11.04
	(26.14)	(24.65)	(23.98)	(23.79)	(22.49)
	[0.49]	[0.33]	[0.63]	[0.64]	[0.64]
Observations	258	258	258	258	258

Minutes spent fetching water past 3 days - ITT

	(1) Unbalanced	(2) Unbalanced	(3) Balanced	(4) Balanced	(5) Balanced
Treatment	-61.45	-76.98	-70.66	-70.67	-70.69
	(16.35)	(21.34)	(17.11)	(16.83)	(16.16)
	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]
Observations	258	258	258	258	258

BMI Z-Score

	(1) Unbalanced	(2) Unbalanced	(3) Balanced	(4) Balanced	(5) Balanced
Treatment	-0.18	-0.20	-0.23	-0.23	-0.23
	(0.13)	(0.14)	(0.14)	(0.13)	(0.13)
	[0.16]	[0.15]	[0.10]	[0.09]	[0.10]
Observations	258	258	258	258	258

Overweight

	(1) Unbalanced	(2) Unbalanced	(3) Balanced	(4) Balanced	(5) Balanced
Treatment	-0.08	-0.09	-0.10	-0.10	-0.10
	(0.04)	(0.05)	(0.05)	(0.05)	(0.05)
	[0.07]	[0.04]	[0.03]	[0.02]	[0.02]
Observations	258	258	258	258	258

(1) No control variables. (2) Controls for stratification variables used for the randomization. (3) Controls for (2) and for the unbalanced variable, the number of children under 15. (4) Controls for (3), baseline BMIz, age and gender (controls used in the original regressions). (5) Controls for (2), and control variables used by Devoto et al. (2012): number of children under 15, quintile in asset distribution, quantity of water storage the week before baseline, and distance to the public tap. Standard errors shown in round parentheses and P-values shown in square parentheses. Standard errors are clustered at the cluster level. P-value of the treatment represents the “exact” P-value (randomized inference).

Table A4: Sensitivity to Different Control Variables- Heterogeneous Effect

Connected to water network (First Stage)

	(1) Unbalanced	(2) Unbalanced	(3) Balanced	(4) Balanced	(5) Balanced
Treatment	0.55	0.58	0.59	0.59	0.58
	(0.08)	(0.07)	(0.07)	(0.07)	(0.07)
	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]
Observations	258	258	258	258	258

Households reports enough water - ITT

	(1) Unbalanced	(2) Unbalanced	(3) Balanced	(4) Balanced	(5) Balanced
Treatment	0.08	0.11	0.13	0.13	0.13
	(0.05)	(0.06)	(0.06)	(0.06)	(0.06)
	[0.06]	[0.01]	[0.01]	[0.00]	[0.00]
Observations	258	258	258	258	258

Monthly Water Expenditure - ITT

	(1) Unbalanced	(2) Unbalanced	(3) Balanced	(4) Balanced	(5) Balanced
Treatment	-47.56	-37.24	-22.66	-23.21	-20.37
	(30.90)	(27.40)	(27.15)	(26.83)	(26.62)
	[0.06]	[0.11]	[0.34]	[0.33]	[0.41]
Observations	258	258	258	258	258

Minutes spent fetching water past 3 days - ITT

	(1) Unbalanced	(2) Unbalanced	(3) Balanced	(4) Balanced	(5) Balanced
Treatment	-69.26	-81.90	-73.93	-73.79	-73.75
	(20.04)	(23.40)	(18.33)	(18.04)	(17.84)
	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]
Observations	258	258	258	258	258

Household reports more time for household chores - ITT

	(1) Unbalanced	(2) Unbalanced	(3) Balanced	(4) Balanced	(5) Balanced
Treatment	0.19	0.23	0.22	0.23	0.23
	(0.09)	(0.07)	(0.07)	(0.07)	(0.07)
	[0.01]	[0.00]	[0.00]	[0.00]	[0.01]
Observations	253	253	253	253	253

BMI Z-Score

	(1) Unbalanced	(2) Unbalanced	(3) Balanced	(4) Balanced	(5) Balanced
Treatment	-0.25	-0.25	-0.31	-0.28	-0.28
	(0.14)	(0.15)	(0.15)	(0.14)	(0.15)
	[0.05]	[0.07]	[0.03]	[0.04]	[0.04]
Observations	258	258	258	258	258

Overweight

	(1) Unbalanced	(2) Unbalanced	(3) Balanced	(4) Balanced	(5) Balanced
Treatment	-0.09	-0.11	-0.12	-0.12	-0.12
	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)
	[0.03]	[0.02]	[0.01]	[0.01]	[0.01]
Observations	258	258	258	258	258

(1) No control variables. (2) Controls for stratification variables used for the randomization. (3) Controls for (2) and for the unbalanced variable, the number of children under 15. (4) Controls for (3), baseline BMIz, age and gender (controls used in the original regressions). 5) Controls for (2), and control variables used by Devoto et al. (2012): number of children under 15, quintile in asset distribution, quantity of water stored the week before baseline, and distance to the public tap. Standard errors shown in round parentheses and P-values shown in square parentheses. Standard errors are clustered at the cluster level. P-value of the treatment represents the "exact" P-value (randomized inference).

Table A5: Heterogeneous Effect by Age

	(1) BMI-for-Age (St. Dev) Age 0-5	(2) BMI-for-Age (St. Dev) Age 2-5	(3) BMI-for-Age (St. Dev) Age 0-7	(4) Overweight Child Age 0-5	(5) Overweight Child Age 2-5	(6) Overweight Child Age 0-7
Treatment	-0.23	-0.32	-0.08	-0.10	-0.09	-0.08
	(0.13)	(0.13)	(0.13)	(0.05)	(0.05)	(0.04)
	[0.08]	[0.02]	[0.51]	[0.03]	[0.05]	[0.04]
R^2	0.213	0.273	0.186	0.159	0.141	0.128
Observations	258	208	323	258	208	323

Households without Access to a Public Tap

	(1) BMI-for-Age (St. Dev) Age 0-5	(2) BMI-for-Age (St. Dev) Age 2-5	(3) BMI-for-Age (St. Dev) Age 0-7	(4) Overweight Child Age 0-5	(5) Overweight Child Age 2-5	(6) Overweight Child Age 0-7
Treatment	-0.28	-0.38	-0.15	-0.12	-0.10	-0.10
	(0.14)	(0.15)	(0.14)	(0.05)	(0.05)	(0.04)
	[0.02]	[0.00]	[0.22]	[0.01]	[0.03]	[0.00]
R^2	0.216	0.278	0.191	0.162	0.141	0.132
Observations	258	208	323	258	208	323

Note: control variables include stratification variables used for the randomization (location, water source, number of households per cluster, number of children 5), number of children under 15, baseline BMIz, age and gender. Standard errors shown in round parentheses and P-values shown in square parentheses. Standard errors are clustered at the cluster level. P-value of the treatment represents the “exact” P-value (randomized inference).

Table A6: Multiple Hypothesis Adjustment (1)

Main Effects

	Coefficient	P-Value	Sharpened Q-val.
Connected to Water Network First Stage	0.60	0.00	0.00
HH reports Enough Water	0.11	0.02	0.03
Minutes fetching water past 3 days	-70.67	0.00	0.00
HH reports More Time for Housework	0.15	0.03	0.05
Installment (in Dirhams)	51.28	0.00	0.00
Water Expenditure (in Dirhams)	-11.96	0.64	0.47
Life Satisfaction (Std.)	0.64	0.00	0.00
Mental Health (Std.)	0.29	0.07	0.08
BMI-for-Age (St. Dev)	-0.23	0.09	0.09
Overweight Child	-0.10	0.02	0.03
Obese Child	-0.02	0.42	0.31
Weight-for-Age (St. Dev)	-0.17	0.20	0.17
Height-for-Age (St. Dev)	0.00	0.98	0.58
Underweight Child	0.01	0.58	0.45

Households without Access to a Public Tap

	Coefficient	P-Value	Sharpened Q-val.
Connected to Water Network First Stage	0.59	0.00	0.00
Installment (in Dirhams)	52.08	0.00	0.00
Water Expenditure (in Dirhams)	-23.21	0.33	0.24
HH reports Enough Water	0.13	0.00	0.00
Minutes fetching water past 3 days	-73.79	0.00	0.00
HH reports More Time for Housework	0.23	0.00	0.00
HH reports More Time Activities at Home	0.25	0.00	0.00
HH reports More Time Activities Outside	0.22	0.00	0.00
HH reports Water Main Problem	-0.28	0.00	0.00
Life Satisfaction (Std.)	0.65	0.00	0.00
Mental Health (Std.)	0.31	0.06	0.07
BMI-for-Age (St. Dev)	-0.28	0.04	0.05
Overweight Child	-0.12	0.01	0.02
Obese Child	-0.02	0.44	0.32

Note: control variables include stratification variables used for the randomization (location, water source, number of households per cluster, number of children 5), number of children under 15, baseline BMIz, age and gender. Standard errors shown in round parentheses and P-values shown in square parentheses. Standard errors are clustered at the cluster level. P-value of the treatment represents the “exact” P-value (randomized inference).

Table A7: Multiple Hypothesis Adjustment (2)

Households with Access to a Public Tap

	Coefficient	P-Value	Sharpened Q-val.
Connected to Water Network First Stage	0.69	0.00	0.00
Installment (in Dirhams)	47.19	0.00	0.00
Water Expenditure (in Dirhams)	45.78	0.06	0.07
HH reports Enough Water	-0.02	0.68	0.47
Minutes fetching water past 3 days	-54.65	0.00	0.00
HH reports More Time for Housework	-0.22	0.01	0.02
HH reports More Time Activities at Home	-0.02	0.74	0.47
HH reports More Time Activities Outside	0.25	0.00	0.00
HH reports Water Main Problem	-0.47	0.00	0.00
Life Satisfaction (Std.)	0.58	0.00	0.00
Mental Health (Std.)	0.21	0.20	0.17
BMI-for-Age (St. Dev)	0.04	0.73	0.47
Overweight Child	0.00	0.96	0.58
Obese Child	-0.03	0.31	0.24

Difference between both types of Households

	Coefficient	P-Value	Sharpened Q-val.
Connected to Water Network First Stage	-0.10	0.65	0.47
Installment (in Dirhams)	4.88	0.86	0.53
Water Expenditure (in Dirhams)	-68.99	0.06	0.07
HH reports Enough Water	0.15	0.10	0.10
Minutes fetching water past 3 days	-19.14	0.61	0.47
HH reports More Time for Housework	0.44	0.04	0.05
HH reports More Time Activities at Home	0.27	0.09	0.09
HH reports More Time Activities Outside	-0.03	0.82	0.51
HH reports Water Main Problem	0.18	0.35	0.25
Life Satisfaction (Std.)	0.07	0.87	0.53
Mental Health (Std.)	0.10	0.79	0.50
BMI-for-Age (St. Dev)	-0.32	0.33	0.24
Overweight Child	-0.11	0.28	0.22
Obese Child	0.01	0.95	0.58

Note: control variables include stratification variables used for the randomization (location, water source, number of households per cluster, number of children 5), number of children under 15, baseline BMIz, age and gender. Standard errors shown in round parentheses and P-values shown in square parentheses. Standard errors are clustered at the cluster level. P-value of the treatment represents the "exact" P-value (randomized inference).