TV exposure, food consumption, and health outcomes - evidence from Indonesia

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Rising overweight levels and associated non-communicable diseases pressure health systems especially of lower- and middle-income countries. Exposure to advertisement for unhealthy food products is often blamed as a driver of these epidemiological developments but evidence is scarce. This paper estimates the effect of exposure to television during childhood on consumption of unhealthy food products and related health outcomes in the middle-income country Indonesia. In order to address endogeneity in TV watching and food consumption behaviour this paper exploits exogenous variation stemming from topographical characteristics and introduction of private TV channels in Indonesia. Results suggest that exposure to television during childhood increases consumption of soft drinks and snacks during adulthood. These effects on consumption translate into higher BMI for boys but not for girls.

Keywords: television; advertising; nutrition transition; unhealthy food; soft drinks; overweight.

JEL Codes: D12; I12; I15.

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1 Introduction

Over the past four decades prevalence of overweight and obesity has been rising across the globe. Worldwide, about 1.9 billion adults were overweight (*BMI* > 25) in 2016 which corresponds to 39% of the global adult population. Of these 650 million adults even were obese (*BMI* > 30) and this number almost tripled since 1975. The world thus has transitioned from a state in which underweight prevalence was more than double that of obesity, to one in which more people are obese than underweight (NCD Risk Factor Collaboration and others, 2016).[1] Children are also affected by this epidemic of overweight. The prevalence of overweight among children aged 5-19 has risen from 4% in 1975 to about 18% in 2016. (WHO, 2017). While high-income countries were the first to experience rising overweight levels, the epidemic has by now also spread to low- and middle-income countries. Although prevalence rates of overweight and obesity are still higher in high-income countries 64% of overweight adults live in low- and middle-income countries and only 36% in high-income countries (Keats and Wiggins, 2014; NCD Risk Factor Collaboration and others, 2016).

This epidemic of overweight and obesity is associated with a change in the composition of the diet. Diets are increasingly rich in animal products, sugar, and salt, which is related to a rising consumption of processed foods, snacks, and soft drinks (Monteiro et al., 2013; Stuckler et al., 2012). This trend is commonly understood as the nutrition transition (Popkin, 1993) and it poses important policy challenges for health. Unhealthy diets constitute an important risk-factor for cardiovascular diseases (CVD), diabetes, obesity, and different types of cancer (WHO, 2015b). In 2012, 17.5 million people died from CVD ranking them as the number one cause of death globally. More than three quarters of CVD deaths takes place in low- and middle-income countries, causing substantial economic costs (WHO, 2015a).

There is undoubtedly a wide array of global developments that can affect the nutrition transition and hence drive the epidemic of overweight and related non-communicable diseases. These range from economic factors such as greater openness to trade (in food) (Dragone and Ziebarth, 2015; Giuntella et al., 2017) to more social aspects such as exposure to different cultures (Maystre et al., 2014; Olivier et al., 2008). Recent evidence suggests that social aspects of globalisation are more important in explaining the change in dietary habits than economic aspects of globalisation (Costa-i-Font and Mas, 2014; Oberlander et al., 2017). Among social factors television and in particular advertising are frequently mentioned in the context of the nutrition transition but its effects remain poorly understood (Kearney, 2010). Cross-country

[1] This holds true not only globally but also for all regions except certain parts of sub-Saharan Africa and Asia (NCD Risk Factor Collaboration and others, 2016).

evidence suggests that unhealthy food is one of the most frequently advertised products on television indicating that food advertisement could be one important driver of the obesity epidemic (Kelly et al., 2010, 2014). Children seem to be particularly open to influences. Experimental evidence suggests that exposure to advertising during childhood has a stronger effect on brand recognition and biased quality evaluation than exposure during adulthood. Moreover, exposure to advertisement during childhood can be expected to have long-term effects as developed attitudes persist over time and are difficult to correct (Connell et al., 2014; Ellis et al., 2010).

This paper analyses the effect of TV reception on household food consumption and individual health outcomes in Indonesia. Indonesia is an interesting case study because it is characterised by high frequency of food advertising on television and low levels of regulation. On average, individuals watching TV are exposed to one unhealthy food or beverage advertisement every 4 minutes in Indonesia compared to 12-26 minutes in China, Malaysia, and Korea (Kelly et al., 2014). Combining household survey data with information on television reception I estimate the effect of TV exposure during childhood on household expenditures of snacks and soft drinks and related individual health outcomes during adulthood.

My identification strategy exploits two sources of exogenous variation in TV reception: I first exploit variation in signal strength across districts due to geographical conditions such as mountains. Second, I exploit timely variation due to the introduction of new TV channels over time. Younger individuals were exposed to more TV channels during their childhood than older individuals. Combining these two strategies I can identify exogenous variation in TV reception across cohorts and over time. The validity of my approach rests on the identifying assumption that individuals in areas with and without TV exposure are similar in unobserved characteristics that drive their purchase behaviour once I control for pre-determined observable district characteristics. I provide evidence in support of this assumption by showing that past socio-economic characteristics do not explain TV reception and location of TV transmitters at the district level.

The results show a significant and positive effect of exposure to television during childhood and on household consumption of snacks and soft drinks today. The effect is sizeable as the average effect corresponds to one third of mean expenditures (Indonesian Rupiah, IDR) on snacks and soft drinks. Further analysis suggests a shift in the composition of the diet at the expense of staples, vegetables, and meat. The shift towards more snacks and soft drinks translates into higher BMI levels and overweight prevalence among boys, especially for those living in more affluent households. Parents' health outcomes are not affected. This suggests that parents' tastes were influenced by TV exposure during their own childhood but they only purchase more snacks and soft drinks later in life for their kids. Several robustness checks confirms my results.

This study contributes to the following strands of literature. First, I add to the literature on the relationship between media and food consumption. There are two studies that precisely estimated the effect of TV advertisement on consumption. Bursztyn and Cantoni (2016) analysed the impact on the entire consumption basket but their aggregated data did not allow them to analyse the effect on particular food groups. They exploited the division and reunification of Germany as a natural experiment, so their findings are based on advertising levels of the second half of the 20th century in a high-income country context. The study from Eisenberg et al. (2017) uses American data on advertising and consumption of vitamin products from 2003 until 2009. In contrast to snacks and soft drinks vitamin products are generally perceived as health-enhancing, so the effects of advertisement may differ between these two food categories. Other studies are less precisely estimated and rely on data from children in the USA and Europe (Andreyeva et al., 2011; Giese et al., 2015).[2]. Finally, Anschutz et al. (2009) conducted a lab experiment with children in the Netherlands. Children watched a film for 20 minutes that was interrupted by advertisements for snacks (healthy food for the control group). They find that children children in the treatment group consume more snacks during the film. This experiment sheds light on short-term behavioural response of children to advertising when their behaviour is not influenced by any guardians. I add to this strand of literature by providing precise estimates on the effect of different food groups, notably unhealthy food such as snacks and soft drinks, for a middle-income country using recent data. Moreover, I provide evidence for long-term effects by estimating the impact of exposure to television during childhood and consumption behaviour during adulthood.

Second, this paper adds to the literature on the health impact of media exposure. DellaVigna and Ferrara (2015) provide an excellent general review on research on social and economics impacts of the media. They note that regarding the effect of media on health "the evidence is limited and mostly comes from outside economics". Existing evidence use data from high-income countries and exclusively look at the short-term impact on children's health outcomes. In particular, two studies explore the association between advertisement and childrens' health in the USA. The first study from Chou et al. (2008) matches advertisements from fast-food restaurants to location of residence of children in the US in the late 1990s. Using an OLS specification with region fixed effects they find a significant impact on children's BMI

[2] Andreyeva et al. (2011) match advertisement data with location of residence for American children and Giese et al. (2015) uses a questionnaire with re-call data on watching ads for different kinds of food and actual consumption for children in Finland, Germany, and Romania. It is possible that food producers concentrate their advertisement expenditures in regions with existing higher/lower demand for unhealthy food. Similarly, reverse causality cannot be fully ruled out in the study from Giese et al. (2015) as children consuming more unhealthy food may be better able to re-call advertisements of these kind of products.

z-score and prevalence of overweight.[3] The second US study (Andreyeva et al., 2011) also relies on cross-sectional evidence and finds a positive effect on BMI levels for children in the right tail of the BMI distribution. Results of these studies may be biased, if children with higher BMI levels follow a more sedentary lifestyle and thus spend more time watching TV. I contributes to this literature by providing estimates both for children and adults in a middle-income country context. Moreover, I analyse the long-term effect of parents' exposure during childhood on their children's health outcomes. Up-to-date evidence for middle-income countries is of particular importance, as many of these countries are severely affected by the so-called obesity epidemic.

The remainder of this paper is organised as follows. Section 2 describes data and the empirical strategy and section 3 presents results on food consumption and health outcomes. Section 4 concludes.

2 Data and empirical strategy

2.1 Data sources

This section describes the data sources, construction of main variables, and the identification strategy. Data on household food expenditures and biometric data of individuals is obtained from the fourth wave (2007/2008) of the Indonesia Family Life Survey (IFLS). The IFLS provides data on household food expenditures, biometric data, the socio-economic profile of the households, and the district(s) of residence during childhood as well as today. The IFLS represents 83% of the population living in 13 of the nation's 26 provinces. Attrition rates are low as more than 90% of the original households could be re-contacted in 2007 (Strauss et al., 2009). Data on household food expenditures is available for 37 different food sub-categories and are measured in IDR during the last 7 days. For the analysis food expenditures are adjusted to represent per capita expenditures during the period of one month. The IFLS also provides information on household decision-making with respect to food expenditures. Each adult household member is asked to identify one or more household members who are responsible for food expenditures and I identify the decision maker based on the mode value of answers.[4] Biometric data are collected by trained staff and are available at the individual level both for children and adults. Data on height (centimetres) and weight (kilogram) are used as inputs to construct the Body Mass Index (BMI). BMI

[3] Chou et al. (2008) use an instrumental variables strategy to show that their variable measuring advertisements is not endogenous. They do not show these 2SLS estimates so the results they report in their paper are based on their OLS specification.

[4] If there is more than one person in a category I take the oldest person in each category as the decision maker (e.g. oldest daughter).

z-scores for children are calculated based on BMI-for-age tables provided by the WHO[5]. Data on TV exposure is provided in the Village Potential Statistics (PODES) 2006 dataset.[6] The PODES contains the information whether each of the 10 private TV channels could be received in 2006 in a given village.

The main sample consists of one individual per household who makes decision regarding food purchases and consumptions. I exclude decision makers who lived in major cities such as Jakarta and Surabaya where private television started before the rest of the country (Olken, 2009; Sanyoto, 2002). Moreover, I exclude decision makers without valid information on their district of residence during their childhood. The resulting sample consists of 5194 decision makers and thus 5194 households. During her childhood (14-18 years) decision makers in the household were exposed to about one private TV channel. Decision makers are more likely to be female and are about 40 years old. About 45% of them have at least 4 years of schooling or more and only 10% of them have never been in school. About 60% of them are employed or self-employed with the rest being inactive or unpaid family workers. Only 15% of decision makers migrated that is in 2007 they lived in a different district than when they were 14 years old. Households spend on average about 2 Indonesian Rupiahs (IDR) per person per month on soft drinks and about 27 IDR on snacks. The average total food expenditures per person for a household are about 237 IDR so snacks and soft drinks combined constitute about 10% of total food expenditures.
For the health outcomes there are about 5303 children in the sample (0-14 years) of which slightly more than half are younger than 8 years. 8% of children are overweight as indicated by a z-score of their BMI greater than 1 SD (> 2 SD for children aged 0-4 years) (De Onis et al., 2010). Data on BMI and prevalence of overweight is also available for 7940 adults (some of which are decision makers). 40% of adults in the sample are overweight using the conventional cut-off of $BMI > 23kg/m^2$ for Asian populations (WHO, 2004). These prevalences of overweight are comparable to existing evidence for Indonesia (Rachmi et al., 2017).

2.2 Identification strategy

Watching TV and food purchases are both household choices. Therefore, unobserved individual heterogeneity can confound the relationship between TV watching and consumption patterns. Individual that enjoy watching TV may also have a higher preference for snacks and soft drinks. Comparing TV

[5] The WHO provides two set of tables, one for children aged 0-5 years ("Child growth standards") and one for children aged 5-19 years ("Growth reference 5-19 years". Both models take as input age, height, and weight of children
[6] The data are PODES and World Bank calculations, via personal communication with Matthew Wai-Poi, whom I thank for sharing his data with me.

signal variation across districts can only partly mitigate concerns about confounding factors, as districts in closer proximity to large cities or more affluent districts are also more likely to receive higher quality of TV signals. Given these endogeneity concerns, this paper exploits exogenous variation in exposure to TV signals across districts and over time. If the variation in exposure to TV signals is truly exogenous and thus as good as random the casual effect of exposure to TV signals on food expenditures and subsequent health outcomes can be correctly estimated. More precisely, first, I exploit *geographical variation of reception of TV channels due to topography*. The main idea here is that a direct line of sight between an emission station and a district improves reception while mountains block signal transmission. Indeed, physical models show that the strength of TV signals depends on the distance between transmitting and receiving locations, mountains that block signals, diffraction caused by air, and the curvature of the earth. The rule of thumb is that the strongest signals are received in areas with a direct line of sight to the transmitting station. Figure 1 illustrates this concept. Signal reception is reduced for villages situated in the dotted areas, while the hatched areas receive almost no signals.[7]

Second, I exploit *timely variation caused by the introduction of new TV channels* during the liberalisation of the TV market. The television market in Indonesia was not liberalised until the early 1990s. Prior to the liberalisation there was only one state-controlled TV channel, TVRI. In 1986 the government allowed television distribution via satellite dishes and cable networks, which introduced commercial television in Indonesia. As a consequence, until 2007 10 private TV channels were founded in two waves. Table II contains a list of all TV channels in Indonesia in 2007 and since which year they are on air. During a first wave (1987-1995) five commercial television stations were established. In the first years, however, the private TV channels were subscription channels and could only be received by a decoder and only in large cities. Free, over-the-air private broadcasting in the entire country only started from 1993 (Olken, 2009; Sanyoto, 2002). Following major political developments in 1998 the media landscape was further deregulated and between 2000 and 2002 additional five new television channels were founded (Hollander et al., 2009). Older cohorts are thus exposed to fewer TV channels during their childhood than younger cohorts. I combine this variation over time with geographical variation of TV reception across districts.

The main variable of interest is the number of channels received during childhood ($TVChildhood$), which is defined as the time period between age 14 and 18. This variable varies by cohort and district because of the two sources of variation (geographical variation and introduction of new private television channels)

[7] "In the mountain to the left, the area of no reception is caused by the tight angle of refraction required. In the mountain to the right, the area of no reception is caused by double-refraction off the primary and secondary peak" (Olken, 2009).

explained above. The construction of this variable is based on 10 dummy variables of the PODES dataset 2006 indicating whether each of the 10 private TV channels in Indonesia could be received in a given village in 2006. With these 10 dummy variables the share of villages in each district that received signals from a particular TV channel in 2006 is constructed. While there is no information on reception of TV signals prior to 2006[8] infomration on the year in which each channel started operating is available. Consequently, TV reception prior to the introduction of each TV channel is set to zero. For the time between the launch and 2006 I follow the approach of Farré and Fasani (2013) and assume a linear growth rate of the share of villages receiving a particular TV channel in each district between the launch of each TV channel and 2006. Thereby, I obtain TV reception for each channel and year and subsequently sum across channels. Finally, I match TV reception to each individual based on her place of residence at age 14 and average it over the five years when the individual was between 14 and 18 years old.

The identification strategy for estimating the effect of TV reception during childhood on consumption patterns relies on the premise that households with and without TV reception are similar in all unobserved characteristics that may drive their consumption patterns once I control for observable differences between districts. The 10 private TV channels operate several TV transmitters across the islands of Indonesia. Figure 2 illustrates that individuals living in the province Java and near large cities receive more TV channels than individuals in lower populated areas. It is plausible to assume that locations of the TV transmitters were chosen as to maximise outreach. Therefore, it is likely that transmitters are located closer to urban and more affluent areas. This conjecture is testable by exploiting the launch of five new TV channels in 2001[9]. Table III reports results of the investigation of the correlates of the transmitter location using OLS regressions with province fixed effects. The dependent variable is a binary variable taking the value 1 if a TV transmitter is located in the district in 2001 and 0 otherwise. In column 1 TV transmitter in 2001 is regressed on a geographic determinants such as altitude, aspect, and a dummy for coastal districts. The null hypothesis of the F-test of joint significance cannot be rejected indicating the variables are not jointly statistically significant. Next, I estimate the effect of a an array of economic determinants measured in 2000 on whether a district has a TV transmitter in 2001. Only the dummy variable on whether the primary activity in the village in 2000 is trade is significant at the 10% level. The F-test suggests that the coefficients are not jointly significant. Adding the geographic controls in column 3 renders this coefficient insignificant. Column 4 shows that past snack and soft drink consumption does not explain TV transmitter location. This holds true when adding geographic controls in column 5. This

[8] The question on TV channel recpetion was included for the first time in the PODES in 2006.
[9] I use data of the location of TV transmitters for four of the five new TV channels. Data is kindly provided by B. Olken who obtained it from the government of Indonesia.

result strengthens the argument that districts with a TV transmitter in 2001 are fairly similar to districts without a TV transmitter along a large array of observable characteristics measured in 2000. Consequently, observed differences in consumption patterns may thus be more confidently associated with differences in TV signal reception rather than structural differences across districts.

Although the results of this exercise do not give rise to serious endogeneity concerns this paper nonetheless uses an instrumental variables strategy to strengthen the identification strategy. The main variable of interest, *TVChildhood*, is instrumented by a variable, denoted as *PredictedSignal* which measures the average predicted signal power of the 10 private TV channels in each district in 2006. Olken (2009) constructs this variable using a physical model of electromagnetic signal propagation.[10] The *PredictedSignal* variable takes into account the signal loss due to topography (e.g. mountains blocking signal) and distance between transmitting station and receiving location. In order to disentangle the part of the overall signal strength that is due to topography (e.g. mountains) from the part that is only due to the distance between transmitting and receiving location I additionally include the control variable, *FreeSpaceSignal*. It measures the average counterfactual signal power of the 10 private TV stations taking into account only the distance and assuming a direct line of sight between transmitting station and receiving location. This *FreeSpaceSignal* represents the counterfactual signal power, if nothing had blocked the transmission of the signals. This instrumental variable approach is summarised in the following two equations:
First stage:

$$TVChildhood_{idp} = \beta_0 + \beta_1 PredictedSignal_{dp} + \beta_2 FreeSpaceSignal + \gamma_1 \mathbf{X}_{idp} + \gamma_2 \mathbf{D}_{dp} + \delta_p + \zeta_{idp} \quad (1)$$

The variable *PredictedSignal* captures signal strength determined by topography while *FreeSpaceSignal* captures signal strength based on the distance between sending and receiving station. By controlling for *FreeSpaceSignal* I can isolate the part of the variation in signal strength that is due only to topography but not the distance. These variables measure signal strength in 2006. Since in 2006 there were more TV towers and TV channels than in earlier years the variables overestimate TV exposure in earlier years. I borrow these two variables from Olken (2009).
Columns 1 and 2 of table IV report results from the first stage in order to demonstrate the relevance of the instrument. The instrumental variable *PredictedSignal* has a positive effect on the endogenous

[10] Amongst others, the model takes as inputs the geographic location and height of the transmitting and receiving antennas, frequency of transmission, and characteristics about surface and air.

variable $TVChildhood$ and is significant at the 1% level. Column (2) in addition controls for a first set of plausibly exogenous district characteristics which leaves the magnitude and significance of the coefficient of $PredictedSignal$ unchanged. Given that standard errors are clustered at the district level I use the Kleibergen-Paap rk LM statistic to check whether the excluded instrument is significantly correlated with the endogenous regressors (underidentification test) (Baum et al., 2007). The null hypothesis can be confidently rejected as the corresponding p-values are smaller than 0.01 suggesting that $PredictedSignal$ is a relevant instrument for $TVChildhood$. Moreover, I also check whether my instrument is weak in the sense that the correlation between my instrument $PredictedSignal$ and my endogenous variable $TVChildhood$ is non-zero but weak. Again, given the clustering[11] I report the Kleibergen-Paap rk Wald F statistic and denote it as "Fstat". As suggested by Baum et al. (2007) I compare the Fstat values to the "rule of thumb" that the F statistic should be at least 10 for weak identification. All F-statistics have a value of about 145 so that I can reject the null hypothesis across all specifications. I take this as evidence for the absence of a weak-instrument problem.
Second stage:

$$Y_{idp} = \gamma_0 + \gamma_1 TVChildhood_{idp} + \phi_1 \mathbf{X}_{idp} + \phi_2 \mathbf{D}_{dp} + \delta_p + \varepsilon_{idp} \tag{2}$$

The food consumption outcome variables are the per capita consumption of snacks and soft drinks of a household during one month in province p and district d in 2007 measured in Indonesian Rupiah (IDR). The health outcome variables are the z-score of the BMI and the prevalence of overweight of both children and adults in 2007. The variable of interest ($TVChildhood_{idp}$) measures the strength of TV reception for the decision maker i in the household during her childhood (age 14-18) in district d and province p and is instrumented in equation 1. The vector $\mathbf{X}_{idp}$ denotes a set of individual characteristics of the decision maker. It includes a set of year of birth dummies, a sex dummy, and a categorical variable capturing the education level of the parents of the decision maker (none, one, or both parents attended school). I argue that the variables included in $\mathbf{X}_{idp}$ are pre-determined and cannot be correlated with TV reception during childhood. In the robustness check section I will control for further variables that are potentially correlated with TV reception during childhood (so-called "bad controls"). ($\mathbf{D}_{dp}$) denotes a set of district control variables that captures geographical characteristics at the district level.[12] The vector $\mathbf{D}_{dp}$ includes altitude (in meters), a dummy for coastal districts, and three dummies indicating whether the district's

[11] According to Baum et al. (2007) the Kleibergen-Paap rk statistic is superior to the Cragg-Donald statistic in the presence of clustering.
[12] Since the variable of interest, $TVChildhood_{idp}$ varies at the district-cohort level I cannot include district fixed-effects.

aspect is north-facing, south-facing, or east-facing. These district characteristics do not vary over time and thus cannot be influenced by TV reception. In the robustness check section I will control for further socio-economic district characteristics that could be partially determined by TV exposure in the past. Moreover, province fixed-effects (δ_p) capture time-invariant characteristics at the province level. ε_{idp} denotes the error term. The first stage equation (1) contains the same vector of individual characteristics ($\mathbf{X}_{idp}$), district controls ($\mathbf{D}_{dp}$), and province fixed-effects (δ_p) as the second stage equation (2).

3 Results

3.1 Food consumption and health outcomes

Results for consumption of soft drinks and snacks per capita in IDR are presented in tableIV. Columns 3 to 6 indicate a positive effect of the number of TV channels available during decision maker's childhood on expenditures of snacks and soft drinks in 2007. Both the OLS and 2SLS coefficients are significant at the 1% level. Taking column 6 as an example the coefficient suggests that decision maker's exposure to an additional TV channel during her childhood increases expenditures on snacks and soft drinks per capita by about 8 IDR per month. The mean value of expenditures per capita on snacks and soft drinks is 25 IDR with a standard deviation of 58 IDR. The magnitude of the coefficient thus corresponds to about 30% of mean expenditure on snacks and soft drinks. Columns 7 and 8 show the result separately for snacks and soft drinks. While in absolute terms the coefficient of soft drinks (column 8) is much smaller than the coefficient of snacks (column 7) they both relatively account for about a third of mean expenditures. Both snacks and soft drinks are thus affected to a similar degree by TV exposure.

The increase in expenditures on snacks and soft drinks constitutes a shift in the composition of the diet and not an increase in total food expenditures. Total food expenditures do not increase with higher exposure to TV channels (table V, columns 1). However, the coefficient of the share of snacks and soft drinks in total food expenditures is positive and significant at the 1% level. The share of snacks and soft drinks increases by about 1.6% indicating a shift in the composition of the diet (column 2). The higher share of expenditures on snacks and soft drinks is balanced by a reduction in the share of other food items. The share of staples is reduced by 1.2% and this reduction is significant at the 5% level. The coefficients of the shares of vegetables, meat, dairy % oil are also negative, yet not significant.

The positive effect on snacks and soft drinks is driven by decision makers who are more educated. Splitting the sample into high and low educated decision makers (low education is defined as no or only primary school education) reveals that the effect is positive and significant for high educated decision makers and negative and insignificant for low educated decision makers (table VI). One explanation could be that consuming snacks and soft drink is perceived as demonstrating a certain (higher) status in society. Moreover, with respect to wealth the poorest (wealth quintile 1) and richest (wealth quintile 5) households do not exhibit any significant effects on expenditures on snacks and soft drinks. Poor households may not have the financial means to consume snacks and soft drinks while the insignificant effect of rich households could also stem from the low number of observations of this subgroup. The positive effect is driven by the "middle class", namely households in wealth quintiles 2 to 4. This finding suggests that there is some minimum income threshold households need to pass in order to experience an effect of TV exposure on snack consumption.

Exposure to television also translates into higher BMI levels for children. For the whole sample of children between 0 and 14 years the effect of parent's exposure to television is negative and not significant (Table VII, panel A, column 1). Splitting the sample into different age groups reveals that the negative effect stems from young children (0-7 years) while for older children (8-14 years) the association is positive. Excluding the poorest quintile reveals a positive association between parent's TV exposure and childrens' BMI z-score which is significant at the 5% level (columns 4-6). The coefficient in column 4 suggests that the BMI z-score increases by 0.2 standard deviations and the magnitude of this effect becomes stronger for higher wealth quintiles (columns 5 and 6). Results for the outcome variable propensity to overweight show a similar pattern (panel B). Excluding the poorest quintile one additional TV channel available for parents during their childhood is associated with an increased propensity for an older child to be overweight of 0.13 (Panel B, column 4). This effect is significant at the 5% level. The magnitude of the effect increases when reducing the sample to higher wealth quintiles.
The effect of TV parents' TV exposure is more pronounced for boys than for girls. Taken all wealth quintiles together there is a positive effect on BMI z-score for boys which is significant at the 5% level (table VIII). This effect becomes stronger for more affluent wealth quintiles and remains significant. In contrast, there is no significant effect for girls. The same pattern holds for panel B showing results for the propensity to overweight. Across all specifications the effect for boys is larger in magnitude and significant while the effect for girls is never significant at conventional levels. Consequently, I conclude that the effect of TV exposure on children's BMI z-score and propensity to overweight is driven by boys.

Finally, turning to health outcomes for adults results suggest that for the whole sample the effect on BMI z-score value is positive but not significant at conventional levels (table IX, panel A, column 1).

Splitting the sample by sex indicates that - similar to the findings for children - men are more affected than women as the coefficient for men is positive (yet not significant) and the coefficient for women is negative (columns 2 and 3). I further disentangle the effect by wealth quintile and find a similar patterns but none of the effect is significant at conventional levels. Panel B shows for propensity to overweight. Again, coefficient for women is negative and never significant while the coefficient for men is positive. For more affluent wealth quintiles it is significant at the 10% level suggesting that propensity to overweight increases by 0.06 (column 6).

Why does TV exposure translates into a health effect for children but not for adults? One reason for the lack of strong health effects for adults could be that while they were exposed to more TV channels during their childhood they could not consume more unhealthy food at that time. Since consumption of unhealthy food during childhood is a stronger risk factor for overweight than consumption during adulthood TV exposure did not affect their health outcomes because they did not consume more unhealthy food. One explanation could be that these goods were not available everywhere. Second, It is also possible that their parents - who were presumably deciding over food expenditures - did not purchase snacks and soft drinks, potentially due to tight household budget constraints.

3.2 Robustness check

In order to verify the robustness of my results I conduct several additional estimations. First, I do a placebo test by splitting the sample according to whether the decision maker lived in a community with electricity access when he was 14 years old. Communities without electricity should not be able to receive TV channels and I thus expect to find no effect of exposure to television for this group. I obtain this information from the IFLS 4 community survey. Of the 5175 decision makers about 40% lived in a community without electricity when they were 14 years old. Column 1 of table X confirms that for this group the effect of television exposure is not significant and of small magnitude. In contrast, the effect for the group that lived in a community with electricity access during their childhood is statistically significant at the 1% level and of similar magnitude than the results in the main specification. Thus, the placebo test confirms that TV reception during childhood increases consumption of snacks and soft drinks only for those households whose decision maker lived in a community with electricity.

Second, columns 3 and 4 present results when controlling for further - potentially endogenous - individual and district controls. In column 3 I additionally control for the wealth quintile of the household, education level of the decision maker (no schooling, primary school, high school, university or other) and whether the household owns a TV. The coefficient of TV channels during childhood remains significant at the 1% level and only marginally changes in magnitude. In column 4 I additionally add the following district controls: number of schools in each village, distance in km to province capital, years since electricity introduction, dummy indicating for whether there is a market in the village, percentage of household living in slums, percentage of poor households, and primary activity of the village (agriculture, service, or trade). Adding these controls neither changes significance levels nor magnitude of the coefficient of interest.

Third, I change the definition of the main variable of interest with respect to the childhood years. In the main specification I define childhood as the time period between 14 and 18 years. In column 5 I use a earlier time period (12- 16 years)and in column 6 a later time period (16 - 20 years). For both modifications the coefficient remains positive and significant at the 1% level. In terms of magnitude the coefficient is larger (10.8 versus 8.4) for the earlier childhood period (12-16 years) and smaller (6.2 versus 8.4) for the later childhood period (16- 20 years). One explanation for this variation in magnitude could be that mechanically the mean number of TV channels available increases over time. In a childhood defined as 16 - 20 years an individual is exposed to more TV channels than in her childhood defined as 12 - 16 years. In consequence, the effect of an additional TV channel might have a smaller impact on consumption patterns. An alternative explanation for this result could be that children aged between 12 and 16 years old react more strongly to media content than older children.

Finally, in columns 7 and 8 I changed the definition of the outcome variable, expenditures on snacks and soft drinks (IDR). Column 7 just replicates the main specification where I use a per capita definition. In column 8 I apply the adult equivalence scale proposed by Hagenaars et al. (1994) (also known as the OECD adult equivalence scale). It assigns the value of 1 to the household head, a value of 0.5 to each additional adult, and a value of 0.3 to each child. This change in construction of the expenditure variable does not affect significance or magnitude of the coefficient. The results of these checks increase confidence in the robustness of the main results of this paper.

3.3 Channels

The main results suggest a positive and sizeable effect of exposure to TV channels during childhood and higher expenditures on snacks and soft drinks today. I argue that the main channel of this effect is exposure to advertisement of unhealthy food products on television due to very low regulation of the industry. Food and beverages are the most frequently advertised product category in Indonesian television (Purwanegara et al., 2013; Kelly et al., 2014). Table II shows that the share of food and beverage advertisements varies between 33% and 56%. About 80% of food advertisements feature non-core food products. Among these sugar-sweetened drinks is the most frequently advertised product group accounting for one fourth of all non-core food advertisements. Other frequently advertised product groups are snacks such as full cream milk and yoghurt, ice cream, and sweet bread/muffins/cakes (see table XI) .

The strong presence of (food) advertisement is partly due to low regulation of the broadcasting industry. The government made a first attempt to implement broadcasting regulation in 1997[13] but the Act never came into effect. A second attempt to regulate advertisement in 2003 was also successfully challenged by lobby groups. It was not until 2007 that a Broadcast Program Standard was implemented which, however, did not contain a quota of advertisement in children's programs. Moreover, government's ability to sanction any violation is very limited.

Nonetheless, exposure to TV channels could affect consumption also through other channels. First, exposure to more television channels could influence individuals' migration decisions. Individuals with television exposure might be better informed about about the gains from migration and thus are more likely to move. In the new location food supply might different from their original place of residence which could affect their consumption choices. Also Farré and Fasani (2013) found a negative effect of television exposure on migration I nonetheless analyse the effect of television exposure on consumption of snacks and soft drinks by migration status. I compare decision makers who lived in the same district at age 14 and in 2007 to those decision makers who lived in a different district at age 14 and in 2007. Results are presented in table XII in columns 1 and 2. From the 5175 decision makers in the sample 745 migrated since the age of 14. The coefficient for decision makers who migrated is positive but only significant at the 10% level. Interestingly, the magnitude of the coefficient for the migrants is about five times larger than the coefficient for the non-migrants. One explanation could be that migration in Indonesia is typically rural to urban migration. In urban areas supply of snacks and soft drinks, lifestyle, and income levels might explain the higher consumption of these food items. However, migration explains at most only part of the main results because the magnitude of the coefficient for the non-migrant sub-sample is only slightly smaller than the coefficient for the full sample 7.5 versus 8.4) and is still significant at the 5% level.

Second, television-induced changes in employment and business opportunities could change household incomes. Such a shift in the budget constraint could then translate into higher expenditures on snacks and soft drinks. If more women are employed they may additionally have less time to engage in meal

[13] The so-called "Broadcasting Act of 1997".

preparing activities and thus may be more inclined to buy more snacks. However, recalling findings from table V, total food expenditures did not increase due to more TV exposure. I further explore this channel by estimating the effect of TV exposure on the propensity of being employed. Columns 3 and 4 of table XII show no significant effects of TV exposure during childhood on the propensity to being employed. This holds true for all decision makers (column 3) as well as for the sub-sample of female decision makers (column 4) who constitute about 70% of all decision makers. This findings does not support the hypothesis that decision makers (and especially women) are more likely to be employed as a consequence of TV exposure. Finally, columns 5 and 6 look at the effect of TV exposure on p.c. household income (IDR) (including remittances) both in levels and logs. While the coefficients carry positive signs they are not statistically significant at conventional levels indicating no increase in household income due to more TV exposure. Taken together these additional findings suggest that a small part of the effect of TV exposure on consumption of snacks and soft drinks can be explained by migration. While it cannot be fully ruled out that changes in disposable income play some role the additional results presented here suggest that income is not the main channel that entirely explains my main results. Consequently, I argue that the content of the television programs is important in explaining consumption patterns with respect to snacks and soft drinks.

4 Conclusion

Although evidence is still scarce there is a widespread belief that exposure to media and in particular advertisement is one important cause of the nutrition transition that is well under way in high- but also many middle-income countries. This shift in dietary habits towards more processed, unhealthy food products constitutes a vital risk factor for the obesity pandemic and resulting cardiovascular diseases. This paper analyses the influence of exposure to media on consumption of soft drinks and snacks in a middle-income country context with very little regulation of the broadcasting industry. Exploiting the hilly topography of Indonesia this paper identifies the causal effect of exposure to television during childhood on consumption patterns today. I find evidence for a significant positive effect of TV exposure on consumption of snacks and soft drinks. Households spend more on snacks and soft drinks at the expense of staples, vegetables, and meat. Total food expenditures do not increase, so the effect corresponds to a shift in the composition of the diet. I also analyse related health outcomes such as prevalence of overweight for both adults and children and find higher z-score of BMI and prevalence of overweight among children aged between 8 and 15 years. Moreover, I find that the effect is stronger for boys than for girls. Exposure to television seems to have no robust effect on adults' BMI and overweight prevalence.

The main policy implication of my finding is that policy-makers should better regulate the content and frequent of advertisement shown on television.

References

Andreyeva, T., I. R. Kelly, and J. L. Harris (2011). Exposure to food advertising on television: associations with children's fast food and soft drink consumption and obesity. *Economics & Human Biology*, 9(3):221–233.

Anschutz, D. J., R. C. Engels, and T. Van Strien (2009). Side effects of television food commercials on concurrent nonadvertised sweet snack food intakes in young children–. *The American journal of clinical nutrition*, 89(5):1328–1333.

Baum, C. F., M. E. Schaffer, S. Stillman, et al. (2007). Enhanced routines for instrumental variables/gmm estimation and testing. *Stata Journal*, 7(4):465–506.

Bursztyn, L. and D. Cantoni (2016). A tear in the iron curtain: The impact of western television on consumption behavior. *Review of Economics and Statistics*, 98(1):25–41.

Chou, S.-Y., I. Rashad, and M. Grossman (2008). Fast-food restaurant advertising on television and its influence on childhood obesity. *The Journal of Law and Economics*, 51(4):599–618.

Connell, P. M., M. Brucks, and J. H. Nielsen (2014). How childhood advertising exposure can create biased product evaluations that persist into adulthood. *Journal of Consumer Research*, 41(1):119–134.

Costa-i-Font, J. and N. Mas (2014). 'Globesity'? The Effects of Globalization on Obesity and Caloric Intake. *CESifo Working Paper Series*, 4982.

De Onis, M., M. Blössner, and E. Borghi (2010). Global prevalence and trends of overweight and obesity among preschool children. *The American journal of clinical nutrition*, 92(5):1257–1264.

DellaVigna, S. and E. L. Ferrara (2015). Economic and social impacts of the media. Technical report, National Bureau of Economic Research.

Dragone, D. and N. R. Ziebarth (2015). Economic development, novelty consumption, and body weight: Evidence from the east german transition to capitalism.

Eisenberg, M. D., R. J. Avery, and J. H. Cantor (2017). Vitamin panacea: Is advertising fueling demand for products with uncertain scientific benefit? *Journal of health economics*, 55:30–44.

Ellis, A. W., S. J. Holmes, and R. L. Wright (2010). Age of acquisition and the recognition of brand names: On the importance of being early. *Journal of Consumer Psychology*, 20(1):43 – 52.

Farré, L. and F. Fasani (2013). Media exposure and internal migration - evidence from indonesia. *Journal of Development Economics*, 102:48–61.

Giese, H., L. M. König, D. Tăut, H. Ollila, A. Băban, P. Absetz, H. Schupp, and B. Renner (2015). Exploring the association between television advertising of healthy and unhealthy foods, self-control, and food intake in three european countries. *Applied Psychology: Health and Well-Being*, 7(1):41–62.

Giuntella, O., M. Rieger, and L. Rotunno (2017). Weight gains from trade in foods: Evidence from mexico. Working Paper 17/010, Department of Economics, University of Pittsburgh.

Hagenaars, A. J., K. De Vos, M. Asghar Zaidi, et al. (1994). Poverty statistics in the late 1980s: Research based on micro-data.

Hollander, E., L. d'Haenens, and J. Bardoel (2009). Television performance in indonesia: steering between civil society, state and market. *Asian Journal of Communication*, 19(1):39–58.

Kearney, J. (2010). Food consumption trends and drivers. *Philosophical Transactions of the Royal Society of London B: Biological Sciences*, 365(1554):2793–2807.

Keats, S. and S. Wiggins (2014). Future diets: Implications for agriculture and food prices. Technical report, The Overseas Development Institute.

Kelly, B., J. C. Halford, E. J. Boyland, K. Chapman, I. Bautista-Castaño, C. Berg, M. Caroli, B. Cook, J. G. Coutinho, T. Effertz, et al. (2010). Television food advertising to children: a global perspective. *American Journal of Public Health*, 100(9):1730–1736.

Kelly, B., L. Hebden, L. King, Y. Xiao, Y. Yu, G. He, L. Li, L. Zeng, H. Hadi, T. Karupaiah, et al. (2014). Children's exposure to food advertising on free-to-air television: an asia-pacific perspective. *Health promotion international*, P. dau055.

Maystre, N., J. Olivier, M. Thoenig, and T. Verdier (2014). Product-based cultural change: Is the village global? *Journal of International Economics*, 92(2):212–230.

Monteiro, C. A., J.-C. Moubarac, G. Cannon, S. W. Ng, and B. Popkin (2013). Ultra-processed products are becoming dominant in the global food system. *Obesity Reviews*, 14:21–28.

NCD Risk Factor Collaboration and others (2016). Trends in adult body-mass index in 200 countries from 1975 to 2014: a pooled analysis of 1698 population-based measurement studies with 19· 2 million participants. *The Lancet*, 387(10026):1377–1396.

Oberlander, L., A.-C. Disdier, and F. Etilé (2017). Globalisation and national trends in nutrition and health: A grouped fixed-effects approach to intercountry heterogeneity. *Health economics*, 26(9):1146–1161.

Olivier, J., M. Thoenig, and T. Verdier (2008). Globalization and the dynamics of cultural identity. *Journal of International Economics*, 76(2):356–370.

Olken, B. A. (2009). Do television and radio destroy social capital? evidence from indonesian villages. *American Economic Journal: Applied Economics*, 1(4):1–33.

Popkin, B. M. (1993). Nutritional patterns and transitions. *Population and Development Review*, 19(1):138–157.

Purwanegara, M. S., M. T. Indriani, A. Merriska, and E. R. Cha (2013). Media strategy of tv advertising in indonesia. *Sains Humanika*, 64(2).

Rachmi, C., M. Li, and L. A. Baur (2017). Overweight and obesity in indonesia: prevalence and risk factor a literature review. *Public Health*, 147:20–29.

Sanyoto, K. (2002). Indonesian television and the dynamics of transition. *Media fortunes, changing times: ASEAN states in transition*, P. 83.

Strauss, J., F. Witoelar, B. Sikoki, and A. M. Wattie (2009). The fourth wave of the indonesia family life survey: overview and field report. Technical report, RAND.

Stuckler, D., M. McKee, S. Ebrahim, and S. Basu (2012). Manufacturing epidemics: The role of global producers in increased consumption of unhealthy commodities including processed foods, alcohol, and tobacco. *PLoS Med*, 9(6):1–8.

WHO (2015a). Cardiovascular diseases. *Fact Sheet*, 317.

WHO (2015b). Healthy diet. *Fact Sheet*, 394.

WHO (2017). Obesity and overweight. *Fact Sheet*, 311.

WHO, E. C. (2004). Appropriate body-mass index for asian populations and its implications for policy and intervention strategies. *Lancet (London, England)*, 363(9403):157.

Appendix

Tables

Table I: Sample characteristics

	N	Mean	SD	Min	Max
TV channels childhood	5194	0.81	1.48	0.00	8.65
Monthly expenditures on					
snacks and soft drinks p.c. IDR	5194	25.18	58.41	0.00	592.80
Snacks p.c. IDR	5194	23.35	56.15	0.00	520.00
Soft drinks p.c. IDR	5194	1.82	7.19	0.00	86.67
Monthly total food expenditures p.c. IDR	5194	251.95	225.96	0.00	5481.67
Decision maker characteristics					
Age in 2007	5194	39.52	12.96	20.00	70.00
Male	5194	0.29	0.46		
Education No schooling	5194	0.10	0.31		
1-3 yrs school	5194	0.45	0.50		
4-6 yrs school	5194	0.36	0.48		
Graduated	5194	0.08	0.26		
Household has TV	5192	0.72	0.45		
Work status Inactive	5193	0.28	0.45		
Self-employed	5193	0.29	0.46		
Employed	5193	0.29	0.45		
Unpaid family worker	5193	0.14	0.34		
Did not move	5194	0.85	0.35		
Children characteristics (0-14 years)					
% 0-7 years	5303	0.57	0.50		
% 8-14 years	5303	0.43	0.50		
Child overweight	5303	0.08	0.27		
Z-score BMI	5303	-0.48	1.38	-4.94	4.96
Adult health					
Adult overweight (BMI>23)	7940	0.40	0.49		
Z-score BMI	7940	0.02	0.97	-2.43	12.13

Note: TV channels childhood refers to the number of TV channels available during childhood. Food expenditures are measured in Indonesian Rupiahs (IDR). Decision maker did not move is defined as having the same district of residence in 2007 than at age 14. Child overweight is defined as a z-score of $> 1SD$ for children older than 5 years and $> 2SD$ for children between 0 and 4 years old.

Table II: Television channels in Indonesia

TV channels	On air since	Market share (2007)	% of food & beverage ads in total ads (2010)
TVRI (public network)	1962	1.4%	
First wave of private channels			
Anteve	1993	4.2%	53%
Indosiar	1995	14.2%	46%
RCTI	1987	19%	37%
SCTV	1989	17.3%	33%
TPI	1990	12.6%	34%
Second wave of private channels			
Global TV	2001	5.1%	56%
Lativi	2001	4.5%	41%
Metro TV	2000 (november)	1.9%	53%
Trans TV	2001	12.1%	43%
Trans 7 (TV7)	2001	6.4%	44%

Note: All channels are private channels except TVRI. Market share refers to total of private and public TV channels. Data on year of launch and market share in 2007 from Hollander et al. (2009). Data on percentage of food and beverage advertisements in 2010 from Purwanegara et al. (2013). Numbers are calculated based on data for 6 major product categories (food, beverages, medicines, toiletries & cosmetics, household and office equipment) out of a total of 22 categories.

Table III: Determinants of location of TV transmitters in 2001

	TV transmitter in 2001				
	(1)	(2)	(3)	(4)	(5)
Geographical determinants					
Altitude meters 2000	0.000		0.000		0.000
	(0.00)		(0.00)		(0.00)
North-facing districts 2000	-0.023		-0.038		-0.023
	(0.16)		(0.19)		(0.16)
East-facing districts 2000	-0.048		-0.060		-0.048
	(0.11)		(0.10)		(0.11)
South-facing districts 2000	-0.233		-0.246		-0.234
	(0.13)*		(0.15)		(0.13)*
Coastal district 2000	-0.075		-0.076		-0.075
	(0.06)		(0.07)		(0.06)
Economic determinants					
% villages in urban areas 2000		-0.006	0.004		
		(0.07)	(0.07)		
Distance to province capital (km) 2000		-0.000	0.000		
		(0.00)	(0.00)		
Trade primary activity 2000		0.215	0.207		
		(0.12)*	(0.14)		
Agriculture primary activity 2000		0.038	0.036		
		(0.06)	(0.05)		
Ln Food expenditures p.c. 2000		-0.012	-0.003		
		(0.06)	(0.06)		
% of HH in slums 2000		0.010	0.032		
		(0.40)	(0.38)		
Number of schools 2000		0.004	0.003		
		(0.01)	(0.01)		
Nutrition variable					
Snacks and soft drinks p.c. 2000				-0.000	-0.000
				(0.00)	(0.00)
F-statistic, geographical determinants	1.247				
P-value	0.29				
F-statistic, economic determinants		0.648			
P-value		0.72			
Province fixed effects	Yes	Yes	Yes	Yes	Yes
R-squared	0.10	0.12	0.15	0.07	0.10
N	147	147	147	147	147

Note: Sample consists of 147 districts in which decision makers lived when they were 14 years old (5 districts are missing due to missing data for the year 2000).

* p < 0.1, ** p < 0.05 *** p < 0.01.

Table IV: Expenditures on snacks and soft drinks p.c (IDR)

	First stage		Snacks & soft drinks				Snacks	Soft drinks
	(1)	(2)	(3) OLS	(4) OLS	(5) 2SLS	(6) 2SLS	(7) 2SLS	(8) 2SLS
Predicted signal	0.038	0.039						
	(0.003)***	(0.003)***						
TV channels childhood			11.016	10.998	8.459	8.389	7.678	0.711
			(2.659)***	(2.665)***	(2.929)***	(2.950)***	(2.754)***	(0.309)**
YoB dummies and sex	X	X	X	X	X	X	X	X
Education of parents	X	X	X	X	X	X	X	X
Province FE	X	X	X	X	X	X	X	X
District controls I		X		X		X	X	X
Mean of dependent variable					25.18	25.18	23.35	1.82
N'	5194	5175	5194	5175	5194	5175	5175	5175
Number of clusters	152	147	152	147	152	147	147	147
Fstat					148.06	144.66	144.66	144.66
K.-P. rk LM statistic					18.60	18.57		
P-value					0.00	0.00		
R-squared	0.87	0.87	0.12	0.12	0.13	0.13	0.13	0.05

* p < 0.1, ** p < 0.05 *** p < 0.01.

Note: The outcome variable for columns 1 & 2 is the number of TV channels available during childhood of the decision maker (age 14-18). The outcome variable for columns 3 & 4 is the expenditures on snacks & soft drinks p.c. in IDR per month. The variable of interest for the columns 3-6 is the number of TV channels available during childhood of the decision maker (age 14-18). *Education of parents* is measured by a categorical variable indicating whether none, one, or both parents went to school. *District controls* include altitude in meters, dummy for coastal districts, three dummies for north-facing, south-facing, and east-facing districts. Robust standard error are clustered by district of residence at age 14.

Table V: 2SLS results: Changing composition of the diet

	(1) Total food expenditures	(2) Share of snacks & soft drinks	(3) Share of staples	(4) Share of vegetables	(5) Share of meat	(6) Share of dairy & oil
TV channels childhood	5.256 (8.316)	0.016 (0.005)***	-0.012 (0.005)**	-0.004 (0.003)	-0.005 (0.004)	-0.002 (0.003)
YoB dummies and sex	X	X	X	X	X	X
Education of parents	X	X	X	X	X	X
Province FE	X	X	X	X	X	X
District controls I	X	X	X	X	X	X
Mean of dependent variable	251.95	0.08	0.26	0.11	0.17	0.12
N'	5175	5175	5175	5175	5175	5175
Number of clusters	147	147	147	147	147	147
Fstat	144.66	144.66	144.66	144.66	144.66	144.66
R-squared	0.05	0.13	0.10	0.03	0.10	0.06

* p < 0.1, ** p < 0.05 *** p < 0.01.

Note: Total food expenditures are measured in p.c. in IDR. The variable of interest is the number of TV channels available during childhood of the decision maker (age 14-18). The remaining food groups are: spices & sugar (11%), dried food (8%), food eaten outside (4%), coffee, tea & cocoa (3%), and drinking water (1%). *Education of parents* is measured by a categorical variable indicating whether none, one, or both parents went to school. *District controls* include altitude in meters, dummy for coastal districts, three dummies for north-facing, south-facing, and east-facing districts. Robust standard error are clustered by district of residence at age 14.

Table VI: 2SLS results: heterogenous effects by migration status, education, and wealth

	Education		Wealth quintile		
	(1) Low	(2) High	(3) 1 (=poorest)	(4) 2-4	(5) 5 (=richest)
TV channels childhood	8.085 (2.763)***	13.887 (9.950)	1.563 (2.671)	11.072 (4.601)**	-5.856 (16.377)
YoB dummies & sex	X	X	X	X	X
Education of parents	X	X	X	X	X
Province FE	X	X	X	X	X
District controls I	X	X	X	X	X
Individual controls					
District controls II					
N'	4746	391	1387	3137	647
Number of clusters	145	101	119	145	116
Fstat	153.62	63.07	112.12	100.38	19.08
R-squared	0.11	0.35	0.15	0.17	0.15

* p < 0.1, ** p < 0.05 *** p < 0.01.

Note: The dependent variable is expenditures for snacks and soft drinks per capita during the previous month. The variable of interest is the number of TV channels available during childhood of the decision maker (age 14-18). *Education of parents* is measured by a categorical variable indicating whether none, one, or both parents went to school. *District controls* include altitude in meters, dummy for coastal districts, three dummies for north-facing, south-facing, and east-facing districts. Robust standard error are clustered by district of residence at age 14.

Table VII: Health outcomes for children: by age and wealth quintiles

Panel A: BMI z-scores

	All	0-7 yrs	8-14 yrs			
	(1)	(2)	(3) Q1-5	(4) Q>=2	(5) Q>=3	(6) Q>=4
TV channels parents' childhood	-0.046 (0.044)	-0.064 (0.057)	0.105 (0.127)	0.206 (0.114)*	0.272 (0.134)**	0.443 (0.252)*
YoB dummies of decision maker	X	X	X	X	X	X
Province FE	X	X	X	X	X	X
District controls	X	X	X	X	X	X
Education of decision maker's parents	X	X	X	X	X	X
N	5275	3000	2275	1677	1186	727
Number of clusters	145	142	136	134	129	114
Fstat	240.51	228.02	38.87	77.93	59.27	26.14
R-squared	0.04	0.03	0.07	0.08	0.11	0.15

Panel B: Propensity to overweight

	All	0-7 yrs	8-14 yrs			
	(1)	(2)	(3) Q1-5	(4) Q>=2	(5) Q>=3	(6) Q>=4
TV channels parents' childhood	-0.012 (0.007)	-0.018 (0.008)**	0.051 (0.038)	0.126 (0.058)**	0.152 (0.069)**	0.257 (0.111)**
YoB dummies of decision maker	X	X	X	X	X	X
Province FE	X	X	X	X	X	X
District controls	X	X	X	X	X	X
Education of decision maker's parents	X	X	X	X	X	X
N	5275	3000	2275	1677	1186	727
Number of clusters	145	142	136	134	129	114
Fstat	240.51	228.02	38.87	77.93	59.27	26.14
R-squared	0.02	0.03	0.04	0.05	0.07	0.14

* $p < 0.1$, ** $p < 0.05$ *** $p < 0.01$.

Note: Panel A: The dependent variable is z-score of Body Mass Index (BMI) for children. Panel B: The dependent variable is the propensity to be overweight for children. Q stands for wealth quintile (Q1=poorest, Q5=richest). For both panels the variable of interest is the number of TV channels available during childhood of the decision maker (age 14-18) which is the parent of the children. *Education of parents* is measured by a categorical variable indicating whether none, one, or both parents went to school.*District controls* include altitude in meters, dummy for coastal districts, three dummies for north-facing, south-facing, and east-facing districts. Robust standard error are clustered by parents' district of residence at age 14.

Table VIII: Health outcomes for children: by wealth and sex

Panel A: BMI z-scores

	Q1-5		Q>=2		Q>=3		Q>=4	
	(1) M	(2) F	(3) M	(4) F	(5) M	(6) F	(7) M	(8) F
TV channels parents' childhood	0.421 (0.192)**	-0.645 (0.286)**	0.502 (0.215)**	-0.434 (0.281)	0.688 (0.235)***	-0.244 (0.426)	1.035 (0.423)**	0.431 (0.282)
YoB dummies of decision maker	X	X	X	X	X	X	X	X
Province FE	X	X	X	X	X	X	X	X
District controls	X	X	X	X	X	X	X	X
Education of decision maker's parents	X	X	X	X	X	X	X	X
N	1155	1120	838	839	594	592	363	364
Number of clusters	126	127	125	122	118	113	100	93
Fstat	15.74	9.01	37.45	44.52	47.82	16.48	24.76	21.80
R-squared	0.12	0.07	0.14	0.10	0.20	0.12	0.28	0.17

Panel B: Propensity to overweight

	Q1-5		Q>=2		Q>=3		Q>=4	
	(1) M	(2) F	(3) M	(4) F	(5) M	(6) F	(7) M	(8) F
TV channels parents' childhood	0.060 (0.072)	-0.009 (0.023)	0.143 (0.094)	0.002 (0.025)	0.224 (0.093)**	0.008 (0.029)	0.537 (0.170)***	0.026 (0.032)
YoB dummies of decision maker	X	X	X	X	X	X	X	X
Province FE	X	X	X	X	X	X	X	X
District controls	X	X	X	X	X	X	X	X
Education of decision maker's parents	X	X	X	X	X	X	X	X
N	1155	1120	838	839	594	592	363	364
Number of clusters	126	127	125	122	118	113	100	93
Fstat	15.74	9.01	37.45	44.52	47.82	16.48	24.76	21.80
R-squared	0.09	0.04	0.13	0.05	0.18	0.06	0.30	0.12

* $p < 0.1$, ** $p < 0.05$ *** $p < 0.01$.

Note: Panel A: The dependent variable is z-score of Body Mass Index (BMI) for children. Panel B: The dependent variable is the propensity to be overweight for children. Q stands for wealth quintile (Q1=poorest, Q5=richest). For both panels the variable of interest is the number of TV channels available during childhood of the decision maker (age 14-18) which is the parent of the children. *Education of parents* is measured by a categorical variable indicating whether none, one, or both parents went to school.*District controls* include altitude in meters, dummy for coastal districts, three dummies for north-facing, south-facing, and east-facing districts. Robust standard error are clustered by parents' district of residence at age 14.

Table IX: Adult BMI z-score and prevalence of overweight

Panel A: BMI z-score

	Q1-5			Q>=2		Q>=3		Q>=4	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	All	M	F	M	F	M	F	M	F
TV channels	-0.007	0.027	-0.030	0.019	-0.020	0.074	-0.013	0.060	0.042
childhood	(0.018)	(0.029)	(0.028)	(0.050)	(0.034)	(0.053)	(0.045)	(0.070)	(0.057)
YoB dummies and sex	X	X	X	X	X	X	X	X	X
Education of parents	X	X	X	X	X	X	X	X	X
Province FE	X	X	X	X	X	X	X	X	X
District controls I	X	X	X	X	X	X	X	X	X
N	7908	3493	4415	2591	3253	1817	2268	1082	1358
Number of clusters	148	144	144	141	141	136	139	128	130
Fstat	136.39	100.15	153.56	57.37	97.60	34.20	96.44	19.90	48.83
R-squared	0.12	0.10	0.10	0.10	0.11	0.11	0.11	0.14	0.14

Panel B: Propensity to overweight

	Q1-5			Q>=2		Q>=3		Q>=4	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	All	M	F	M	F	M	F	M	F
TV channels	-0.003	0.018	-0.016	0.018	-0.005	0.065	0.001	0.083	0.031
childhood	(0.011)	(0.016)	(0.014)	(0.027)	(0.016)	(0.033)**	(0.024)	(0.049)*	(0.040)
YoB dummies and sex	X	X	X	X	X	X	X	X	X
Education of parents	X	X	X	X	X	X	X	X	X
Province FE	X	X	X	X	X	X	X	X	X
District controls I	X	X	X	X	X	X	X	X	X
N	7908	3493	4415	2591	3253	1817	2268	1082	1358
Number of clusters	148	144	144	141	141	136	139	128	130
Fstat	136.39	100.15	153.56	57.37	97.60	34.20	96.44	19.90	48.83
R-squared	0.10	0.08	0.08	0.08	0.09	0.08	0.10	0.11	0.12

* $p < 0.1$, ** $p < 0.05$ *** $p < 0.01$.

Note: Panel A: The dependent variable is the z-score of the Body Mass Index (BMI) for adults. Panel B: The dependent variable is the propensity to be overweight for adults. Q stands for wealth quintile (Q1=poorest, Q5=richest). For both panels the variable of interest is the number of TV channels available during childhood of the adult (age 14-18). *Education of parents* is measured by a categorical variable indicating whether none, one, or both parents went to school.*District controls* include altitude in meters, dummy for coastal districts, three dummies for north-facing, south-facing, and east-facing districts. Robust standard error are clustered by district of residence at age 14.

Table X: Robustness checks: Expenditures on snacks and soft drinks p.c. (IDR)

	Electricity childhood		More controls		Childhood years		Expenditure units	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	No	Yes					p.c.	a.e.
TV channels childhood	0.125	8.760	8.123	8.496			8.391	8.397
	(1.425)	(3.265)***	(2.760)***	(2.777)***			(2.950)***	(2.890)***
TV channels childhood (12-16 years)					10.859			
					(3.910)***			
TV channels childhood (16-20 years)						6.165		
						(2.157)***		
YoB dummies and sex	X	X	X	X	X	X	X	X
Education of parents	X	X	X	X	X	X	X	X
Province FE	X	X	X	X	X	X	X	X
District controls I	X	X	X	X	X	X	X	X
Individual controls			X	X				
District controls II				X				
Mean of dependent variable							25.18	37.02
N	2126	3049	5171	5171	5175	5168	5175	5167
Number of clusters	124	145	147	147	147	147	147	147
Fstat	62.41	122.81	144.75	141.15	219.65	160.50	144.69	144.85
R-squared	0.06	0.14	0.18	0.18	0.12	0.13	0.13	0.11

* p < 0.1, ** p < 0.05 *** p < 0.01.

Note: The dependent variable is expenditures for snacks and soft drinks per capita during the previous month. The variable of interest is the number of TV channels available during childhood of the decision maker (age 14-18). In column 5 expenditures are calculated as per capita and in column 6 as adult equivalence rates. *Education of parents* is measured by a categorical variable indicating whether none, one, or both parents went to school.*District controls* include altitude in meters, dummy for coastal districts, three dummies for north-facing, south-facing, and east-facing districts. *Individual controls* include wealth quintiles, a categorical variable measuring education of the decision maker, TV ownership. *District controls II* include the number of schools in each village,distance in km to province capital, years since electricity introduction, market dummy, percentage of households living in slums, percentage of poor households, primary activity (agriculture, service or trade). Robust standard error are clustered by district of residence at age 14.

Table XI: Food and beverage advertisements by product groups

	ads/hour/channel
Non-core food	16.7
Sugar-sweetened drinks	4.3
Full cream milks and yoghurts (>3g fats/100g) and cheese (>15g fat/100g)	3.6
Ice cream, iced confection, desserts	2.5
Sweet breads/cakes/muffins/buns/biscuit/cakes/pies	1.6
Meat, processed meat	1.2
Flavoured/fried instant rice and noodle products	1.0
Chocolate and candy	1.0
High sugar and/or low fibre breakfast cereals	0.5
Fruit juice/drinks (98% fruit)	0.4
Fast food	0.3
Sweet snack food (jelly, sugar-coated dried fruits or nuts, sweet rice bars, tinned fruit in syrup)	0.2
Savoury snacks foods (chips, crisps, popcorn, salted or coded nuts)	0.2
Core food	0.6
Water	0.4
Breads, rice, rice products without added fat	0.1
Other	0.1
Miscellaneous food/food-related	3.4
Baby milk	1.6
Recipe additions (soup cubes, oils, herbs)	1.2
Other	0.5
Total food and beverage advertisement	20.6

Note: Rate of advertisments (ads/h/channel) for channels Global TV, TPI, and RCTI in Yogyakarta in 2012. Data from Kelly et al. (2014).

Table XII: Channels

	Snacks & softdrinks		Employed		Income p.c. (IDR)	
	(1)	(2)	(3)	(4)	(5)	(6)
	Migrated	Did not migrate	All	Female	Levels	Log
TV channels childhood	34.562 (18.219)*	7.486 (2.916)**	0.015 (0.015)	0.001 (0.017)	16.528 (13.873)	0.043 (0.036)
YoB dummies and sex	X	X	X	X	X	X
Education of parents	X	X	X	X	X	X
Province FE	X	X	X	X	X	X
District controls I	X	X	X	X	X	X
Mean of dependent variable	33.64	23.72	0.58	0.44	411.76	5.95
N	745	4430	5174	3655	5048	5048
Number of clusters	133	138	147	145	147	147
Fstat	14.81	152.36	144.66	142.04	141.50	141.50
R-squared	0.17	0.14	0.24	0.07	0.07	0.08

* p < 0.1, ** p < 0.05 *** p < 0.01.

Note: For columns 1 & 2 the dependent variable is expenditures for snacks and soft drinks per capita during the previous month (IDR). For columns 5 & 6 income includes remittances and is measured in p.c. (IDR). The variable of interest is the number of TV channels available during childhood of the decision maker (age 14-18). *Education of parents* is measured by a categorical variable indicating whether none, one, or both parents went to school.*District controls* include altitude in meters, dummy for coastal districts, three dummies for north-facing, south-facing, and east-facing districts. Robust standard error are clustered by district of residence at age 14.

Figures

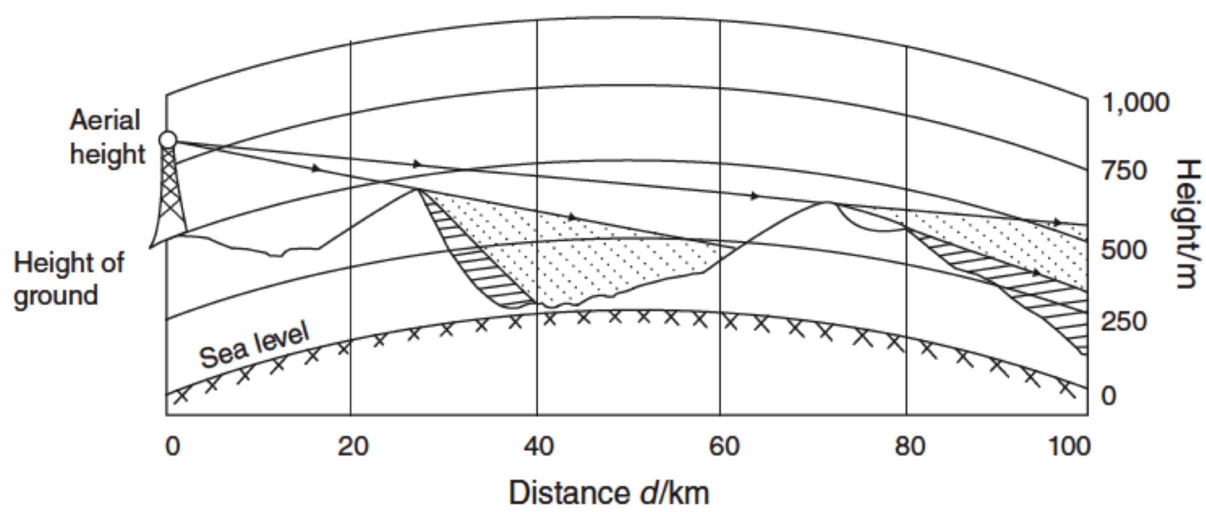

Figure 1: The physics of broadcasting (from Olken (2009), p. 26)

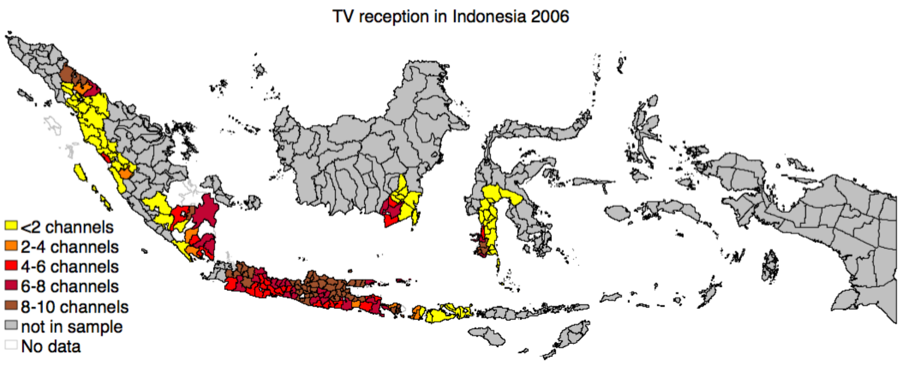

Figure 2: TV reception 2006 (Source: own elaboration)