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Abstract

This paper is the first to provide evidence of a direct causal impact of iodine fortification in early life on cognitive skills in childhood. I apply a differences-in-differences strategy using exogenous variation from a nationwide iodine fortification policy in India, comparing test scores of school aged children in naturally iodine sufficient and deficient districts over time. I find that the policy increased the probability of attaining basic numeracy and literacy skills by 2.67 - 5.83%. Previous papers find a larger effect on longer term human capital for women. I do not find a gender differential for basic skills but I observe a positive effect on more difficult literacy tasks for girls but not for boys. Additionally, I find that the male treatment effect on basic numeracy vary with district level son preference.

Key words: early life, iodine, cognitive ability.

JEL Classification: I15, I18, I21, J13.

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1 Introduction

Mass fortification of food with micronutrients constitutes a very cost-effective way to improve overall health, reduce mortality and increase productivity (Black et al., 2008, 2013). The WHO has established that iodine deficiency in early life is the most common predictor of permanent and irreversible brain damage in the world (Aburto et al., 2014). More than 140 countries have implemented Universal Salt Iodisation (USI) programmes since the 1990s where the goal is to reach at least 90% of households with adequately iodised salt (UNICEF, 2015). USI programmes are regarded as largely successful as almost 70% of the global population now consume iodised salt Zimmermann and Andersson (2012) .

This study is the first to analyse the effects of USI on human capital by evaluating its impact on children's cognitive test scores in rural India. Evaluating such a legislation is of large policy relevance as the WHO recommends all countries with iodine deficiency to mandate salt iodisation. The existing literature studies the historical provision of fortified salt. Adhvaryu et al. (2017); Politi (2010*b*,*a*) observe that access to iodised salt in the US and Switzerland during the 1920s improved schooling attainment and labour market outcomes. However, historical salt iodisation differs from current government led USI programmes initiated by the WHO. For instance, the spread of iodised salt in the US occurred in the private sector, without any regulation, standardisation or controls. It relied on the demand from health conscious consumers which might have led to selection in the take-up. It is further difficult to assess whether the historical experiences of salt iodisation are comparable to the policy aims and effects of current USI programmes. Previous papers do not observe nationwide consumption of iodised salt throughout time, nor the iodine content of the salt at the level of consumption. Therefore, it is also difficult to rule out that selection is an issue.

Secondly, this paper contributes to the limited causal evidence of the impact of iodine intake in early life on cognition by exploiting the introduction of USI across naturally iodine deficient and sufficient areas as a natural experiment.[1] Feyrer et al. (2017) show that the availability of iodised salt in the US increased the probability of men from previously deficient areas being selected into cognitively more demanding military sections during World War II. By estimating the impact on cognitive skills in childhood, this paper yields more robust evidence of an effect of iodine availability in early life on cognitive endowment. Cognition in adulthood is more likely to be affected by dynamic complementarities, where capabilities produced at one stage in life raise the productivity of investment at subsequent stages (Cunha and Heckman, 2007).

Moreover, Adhvaryu et al. (2017); Politi (2010*b*,*a*); Field et al. (2009) suggest that women

[1] Despite an abundance of observational epidemiological studies in this area, causal evidence of iodine intake in early life on human cognition is limited.

benefit more from added iodine in early life in terms of schooling attainment and labour market outcomes. However, these studies do not observe cognitive skills. By analysing the effect on cognition for both genders, my findings point towards increased cognitive skills as the main driver of the previously observed improvement in long term human capital outcomes, rather than through improved health or increased school attendance, particularly for women.

Thirdly, this study contributes to understanding the gains from such a policy in middle- and low income countries where iodine deficiency is more prevalent by evaluating a current USI programme in India (Hetzel, 2002). The existing research in Economics on the effect of iodine on human capital in developing countries is inconclusive and limited, see Field et al. (2009) and Bengtsson et al. (2017). It focuses on the evaluation of iodine supplementation programmes which are less common than USI and viewed as short term policies (Bougma et al., 2013; UNICEF, 2015). The experience and efficacy of USI in India has greater external validity for currently developing nations, compared to the historical provision of iodised salt in high income countries, due to common supply and demand factors. For example, mandating salt iodisation in India did not result in reaching USI immediately. This is due to the the general population being unaware of the benefits of iodine and because salt iodisation is costly for the many small and medium scale producers (Kumar et al., 2013; Vir, 2003).[2]

I apply a differences-in-differences (DD) strategy to analyse the effect of being exposed to a ban on non-iodised salt during early life on children's cognitive test scores, across naturally iodine deficient and sufficient districts over time. The nationwide mandate was implemented in 2006 and available data shows that it increased the consumption of adequately iodised salt by at least 20 percentage points over 2002-2004 to 2005-2006. The most recent data from 2015-2016 reveals that more than 90% of Indian households consumed salt with some iodine. As the risk for iodine deficiency is mainly determined by the geography (Hetzel, 2002), I use spatial historical information on the pre-fortification endemicity of iodine deficiency to identify districts that are likely to benefit from mandatory salt iodisation.[3]

The results suggest that being exposed to mandatory USI in utero until at least age 2, increases the probability of recognising at minimum simple numbers or letters by 1.9 - 4 percentage points among primary school aged children in rural India. Somewhat larger estimates are found on basic skills for girls, but the gender differences are not

[2]The spread of iodised salt in the US relied on a high degree of health consciousness among the consumers and on profit motives of relatively few and large salt manufacturers to distribute a product endorsed by medical experts (Adhvaryu et al., 2017; Bishai and Nalubola, 2002).

[3]Unlike other micronutrients, iodine does not occur naturally in specific foods. Rather, it is present in the soil and is ingested through foods grown on either iodine rich or poor soils. Soils from mountain ranges, areas with high rainfall and frequent flooding are particularly likely to be deficient (Hetzel, 2002).

statistically significant in most specifications. I also observe that girls improved their overall reading ability, which takes more difficult reading tasks into account, while no effects are found for boys. Children who reside in states which experienced larger (smaller) relative increases in iodised salt consumption also gained more (less) in terms of learning outcomes. The main results are not driven by compositional changes across the cohorts in naturally iodine deficient and sufficient areas, nor by coinciding improvements in health endowments or health investments in early life. The analysis in this paper further benefits from data on test scores of both in- and out of school children. Thus, the results are not driven by changes in the composition of children attending school. Furthermore, the treatment effects hold when using geographical predictors as Instrumental Variables (IV) for naturally occurring iodine deficiency or using an alternative dataset for pre-existing iodine deficiency. Additionally, I show that an earlier mandatory fortification policy which was in place only during two years, also had a positive, albeit smaller, impact on test scores.

The findings regarding women experiencing a larger improvement in their overall literacy ability compared to boys, help in explaining the mechanism by which women and girls experienced larger improvements in schooling attainment and labour market outcomes following iodine supplementation in utero compared to men, see; Adhvaryu et al. (2017); Politi (2010*b*,*a*); Field et al. (2009). Additionally, this paper adds to the extant knowledge by showing that USI improves basic cognitive skills for both genders. I also show that lower son-preference decreases the treatment effect of iodine fortification on basic numeracy skills for boys. This might be suggestive of gender differences in parental reinforcement of observable cognitive endowments.

Additionally, investigating the determinants of learning outcomes in developing countries is by itself of large importance for policy. It is cognitive skills rather than schooling attainment which drive individual earnings and economic growth (Hanushek and Woessmann, 2008). Although school enrolment and attainment have risen in a large part of the developing world, learning outcomes have remained poor in many countries. The findings from this study highlight the relevance of intersectoral action to improve academic skills.

The remainder of this paper is organised as follows. In Section 2, I discuss the biological role played by iodine in the human body and review the previous literature on its impact on human capital. I subsequently describe the iodine fortification policy I evaluate in Section 3, followed by the data in Section 4. The empirical strategy and the results are presented in Section 5. The robustness of the main results is tested and discussed in Section 6 and concluding remarks are reported in Section 7.

2 Iodine Deficiency and its Effects on Human Capital Outcomes

Iodine is needed to regulate thyroid hormone availability. The thyroid gland secretes 80μg of iodine per day in the form of thyroid hormones. Thyroid hormones are released into the blood stream to control the metabolism (conversion of oxygen and calories to energy) of all cells in the human body. The WHO recommends the following daily iodine intake: 90μg for children of 0-59 months, 120μg for ages 6-12 and 150 μg for older children and adults. Two teaspoons of adequately iodised salt provides 150μg of iodine. Pregnant and lactating women have a greater need for iodine and require 250μg iodine per day (Andersson et al., 2010).[4] When the thyroid does not receive sufficient amounts of iodine, it becomes enlarged such that it can produce more thyroid hormones for a given level of iodine (Zimmermann, 2009). This condition is called goitre and has by itself no ill effects on health.[5]

More important, normal concentrations of thyroid hormones are required for the development of the central nervous system during early life. The most critical time for overall brain development is during the feotal stage. Thyroid hormones influence the myelination, neuronal migration (the process by which neurons migrate from their place of origin to their final location in the brain), glial differentiation and density of neural networks established in the developing brain. Extreme iodine deficiency in utero can also lead to physical defects such as cretinism, deaf-mutism, abortions, stillbirths, congenital anomalies and increased perinatal and infant mortality (Zimmerman, 2012).

There is abundant evidence of the association between iodine deficiency and cognition (Zimmermann, 2012). A recent systematic review of 89 studies on the effects of iodised salt provision recorded a reduction of 72–76% in the risk for low intelligence (defined as IQ $\leq$70) and an overall increase of 8.2–10.5 IQ points (Aburto et al., 2014). Another systematic review of high quality randomised controlled trials show that iodine supplementation in utero increased IQ with an average of 7.4 points (Bougma et al., 2013). There is also convincing clinical and epidemiological evidence that mild iodine deficiency in early life reduces cognitive skills, see Lavado-Autric et al. (2003); Zimmermann (2012).[6]

[4]The human body cannot store iodine as it is excreted in the urine. However, we can store thyroid hormones which can meet the body's requirements for up to three months (Ahad and Ganie, 2010).

[5]Some vegetables such as; cassava, some species of millet and crucieferous vegetables can lead to goitre by blocking thyroidal uptake of iodine. However, they are not of clinical importance unless they are consumed in large amounts or there is coexisting iodine deficiency (Zimmermann, 2009).

[6]Some studies also show that mild iodine deficiency in childhood have concurrent effects on cognitive functioning. For example, results from a randomised trial in New Zeeland showed that iodine supplementation of young children improves perceptual reasoning in mildly iodine deficient children (Gordon et al., 2009).

The evidence of particularly critical time periods in utero is mixed.[7] A review conducted by Zoeller and Rovet (2004) concludes that thyroid hormones affect the developmental process in all areas of the brain which makes it difficult to identify specific critical time periods. Because different areas of the brain develop at different times, critical periods of iodine intake are temporally shifted. In addition, postnatal thyroid hormone insufficiency is associated with poorer language, auditory processing, attention, memory and fine motor skills.

Field et al. (2009) is the first paper in economics to study the effects of congenital iodine deficiency on human capital attainment. The authors use the roll-out of a maternal supplementation programme of iodine capsules, in Tanzania to estimate the causal effect of iodine supplementation during the first trimester in utero on schooling outcomes. They find that iodine supplementation increased educational attainment by 0.35 years on average, and that the effect was larger for girls. Bengtsson et al. (2017) argue that the treatment effects in Field et al. (2009), which stem exclusively from supplementation during the first trimester, are large given the effect sizes found in medical research. Bengtsson et al. (2017) replicate the previous study and improve the model with; a more precise calculation of treatment probability, up to date medical and institutional insights and increase the sample size with additional data. Their estimates are close to zero and statistically insignificant.

More recent papers such as; Feyrer et al. (2017); Adhvaryu et al. (2017); Politi (2010*b*,*a*) have studied the effects of iodine fortification of table salt on human capital outcomes in the US and Switzerland.[8] These studies identify the effect of iodine deficiency on human capital attainment using the introduction of iodised salt, in conjunction with geographic variation in pre-existing levels of naturally occurring iodine deficiency. The idea is that if added iodine in early life improves human cognition, one should see a relative increase in human capital among populations in previously deficient areas, compared to populations living in always iodine sufficient areas, after the introduction of iodised salt.

Feyrer et al. (2017) estimate the impact of iodine fortification of salt in the US on the probability of being accepted to the cognitively more demanding Air Forces. They identify treatment status by the interaction of pre-existing goitre prevalence per military section, with year of birth dummies indicating whether one experienced fortification in early life or not. The authors find that individuals from high goitre areas are 3.8-10 percentage points more likely to enter the Air Forces compared to earlier cohorts. This corresponds

[7]Older medical evidence points to that cognition is sensitive to iodine deficiency exclusively prior to mid gestation (Cao et al., 1994). Later clinical research finds that if pregnant women were previously deficient in iodine during early gestation but became sufficient later in pregnancy, infant development was not affected (Pop et al., 2003).

[8]The empirical methodology from this strand of literature originates from papers studying the effect of the eradication of other diseases, see Bleakley (2007); Cutler et al. (2010); Bleakley (2010); Lucas (2010).

to an increase of approximately 15 IQ points. The effect is larger than what is found in epidemiological research using observational data. Further, we are unable to compare the estimates to the medical literature as we do not know the proportion of households consuming iodised salt nor the iodine content in the fortified salt.

Adhvaryu et al. (2017) employ the same natural experiment as Feyrer et al. (2017) but analyse the effects on labour market outcomes using US census data.[9] The authors find that cohorts who benefited from access to iodised salt experienced an increase in; wages, labour force participation and the probability of working more than 50 weeks per year. These impacts were driven by females who also married at later ages and experienced a small increase in educational attainment. Politi (2010*b*,*b*) applies a similar identification strategy to evaluate the human capital effects of salt iodisation in Switzerland. The author shows that salt iodisation increased secondary and tertiary schooling as well as the probability of entering top-tier occupations with higher cognitive demands and wages. In similarity with the other studies in economics which use data on both genders, the effects are larger for women. It is important to note that the majority of medical studies involving humans do not show gender differences in iodine sensitivity.[10] [11]

3 Iodine Fortification Policies in India

Iodine fortification of salt in India dates back to the 1950's in the most goitre endemic areas. In 1962, the National Goitre Control Programme was launched with the attempt to provide iodised salt to districts with a high prevalence of goitre. The programme was considered a low priority due to the perception of goitre being a cosmetic concern. Research providing evidence of adverse health effects of the micronutrient deficiency, led to a higher priority of iodine deficiency eradication (Pandav et al., 2003). Nationwide iodisation of salt started in a phased manner in 1986 as surveys showed that all states were prone to iodine deficiency (Pandav et al., 2003; Pandav, 2013). The proportion of households consuming iodised salt has been increasing since the 1980s causing a decline in goitre prevalence in previously endemic areas (Toteja et al., 2004).

[9] The census respondents are assigned to the goitre rate in their state of birth.

[10] A review on gender differences in goitre show that the condition is more common among females in long-standing iodine deficient areas, especially in age groups after puberty. Evidence suggest that higher testosterone levels reduce the probability of thyroid enlargement. The review does not find gender differences in areas of long standing iodine sufficiency (Malboosbaf et al., 2013).

[11] A few lab and epidemiological studies find feotal gender differences in iodine sensitivity. Friedhoff et al. (2000) study the effect of severe prenatal iodine deficiency on rats and find that female rats appeared to be more vulnerable to the effects on learning than male rats. Nonetheless, it is questionable how well these results translate to humans with mild iodine deficiency. Murcia et al. (2011) study the correlation between a diet low in iodine, proxied by self-reported fish consumption and mineral supplement intake, among pregnant mothers and infant neurodevelopment. The study finds a gender difference but does not account for omitted variable bias.

On 27 November 1997, the Government of India notified a national ban on the sale and storage of non-iodised salt for direct human consumption, under the 1954 Prevention of Food Adulteration Act. The ban came into effect on 27 May 1998 and stipulated the minimum iodine content of salt at the production and consumption levels at 30 and 15 μg/g salt, respectively (Pandav, 2013).[12] Any shopkeeper who stocked non-iodised salt would be penalised (Kapil et al., 2005). However, this ban did not increase the consumption or production of iodised salt due to natural disasters striking salt producing areas and de-licensing of the salt industry (see Salt Department (2004)).[13]

Even though the effect of the ban of 1997/1998 was muted, salt legislation continues to be a controversial topic in India. Opponents argue that mandatory salt iodisation diminish individuals' freedom and choice (Pandav, 2005). By appearing to force the population to pay higher prices for salt, the legislation also resembled the unfair colonial taxes and monopolies on salt. These grievances remain visible in Indian politics today. Many dissenting voices, especially from groups with roots in the independence movement were raised, and the ban was lifted only after two years. On the 13th September 2000, the Government of India withdrew the central ban on non-iodised salt with the motivation that "..matters of public health should be left to informed choice and not enforced." (Rah et al., 2015). While the majority of the states maintained the ban, the state governments of Gujarat and Arunachal Pradesh revoked it.[14] As medium and small producers and traders operate within narrow profit margins, iodisation was viewed as an additional cost burden (Vir, 2003). The removal of the central ban increased the production of non-iodised salt in Gujarat and as the majority of all salt in India is produced in Gujarat, non-iodised salt became freely available across the country. National production of iodised salt decreased from 4.1 million tonnes in 1999, to 1.69 million tonnes during the absence of the federal mandate (Vir, 2003).

Lacking mechanisms to control the iodine content of salt and the difficulty for both intermediate suppliers and consumers to distinguish iodised from non-iodised salt, led to a significant reduction in the consumption of adequately fortified salt.[15] The proportion of households consuming adequately iodised salt dropped from 70.3% in 1997, to 29.6% in the period of 2000-2004 (Rah et al., 2015). Evaluations of state programmes aiming to

[12]Prior to the implementation of the nationwide ban, all states except Kerala, Andhra Pradesh and Maharashtra had a state-level ban on the sale of non-iodised salt.

[13]The salt producing areas of Gujarat, a state which produces more than 80% of all salt in India, were devastated by a cyclone in 1997 and later by an earthquake. Moreover, the salt industry was de-licensed a year earlier, in 1996, making it difficult for the Salt Department to regulate production (Pandav et al., 2003).

[14]The state of Orissa lifted the ban initially but reimposed it after six months.

[15]Salt is procured by wholesalers, who often purchase the salt in bulk, and subsequently repackage it. Salt procured in bulk is often non-iodised, but the wholesalers and retailers are not able to recognise it. Non-, or inadequately iodised salt is sold in packages with similar design, brands and logos to those of iodised salt, but at a lower price. They are often falsely labelled as adequately iodised and the consumer has no ability to distinguish the non-iodised salt from iodised salt (Vir, 2003).

increase iodised salt consumption conclude that "..even if the public is made aware of the significance of iodized salt and convinced to consume only adequately iodized salt, the consumers are not in a position to distinguish adequately iodized salt from non-iodized or inadequately iodized salt due to the misleading practice for incorrect labelling regarding iodine content." (Vir, 2011, pp. 596).

A nationwide study by Kumar et al. (2013) finds that even though the majority of the Indian population are aware of iodised salt, only a quarter of individuals have knowledge about it. Few know about other ill-effects of iodine deficiency than goitre. 17.1% of the sample studied know about mental retardation as an outcome of iodine deficiency and the percentage is likely to be lower among rural households (Kumar et al., 2013). The logo of the "Smiling Sun" used to mark that the salt is adequately iodised, is known to only 4% of respondents and the printing of the iodine content on packets is known to 15% (Kumar et al., 2013).

The drop in iodised salt consumption following the removal of the ban spurred advocacy among public health authorities and NGOs for a re-introduction of mandatory USI. Academic institutes, civil society, international agencies, the Ministry of Health and Family Welfare and the Ministry of Industry lobbied for a re-implementation of the previous ban. On 27 May 2005, a notification about re-issuing of the national prohibition of the sale of non-iodised salt was announced. The ban was in place on 17 May 2006. Food inspectors in each state are responsible to monitor the implementation of the ban, which includes testing of salt samples from producers and traders. If the samples are not found to be adequately iodised at the retail level, all responsible persons will be fined and subject to non-bail warrants or imprisonment (Vir, 2011).

The policy is still in place today and increased the production of salt to 5.1 million tonnes in 2007 (Vir, 2003).[16] It has led to an increased consumption of fortified salt with time. The national rural coverage of adequately iodised salt at the household level reached 51% in 2005–2006 and 71% in 2009 (UNICEF, 2011). The 2015-2016 National Family Health Survey (NFHS)-4 indicate that 92% of the rural population now consume iodised salt (salt with any iodine), see Figure 3 for the trends in iodised salt consumption across different nationwide surveys spanning from 1998/2000 to 2015/2016.

I will evaluate the impact of being exposed to the ban implemented in 2006, compared to being in early life during the absence of a mandatory USI in 2000-2005. I will not focus on the earlier policy of 1998-2000, due to its short time span. Children who were in very early life during the first ban, were still in a critical postnatal time period for brain development when it was abolished.

[16]Moreover, potassium iodate, which is used for iodine fortification of salt, has been supplied for free to selected iodisation units by some donors since 2005 (Pandav, 2013).

4 Data

4.1 District Level Goitre Endemicity

Most iodine in soils is derived from the atmosphere where, in turn, it has been derived from the oceans which contain the highest concentration of iodide (Fuge, 2007). Coastal soils are therefore likely to be richer in iodine compared to more inland soils. In many parts of India, deficiency of iodine in the soil-water ecosystem is due to heavy rainfall, steep gradient and poor vegetation cover resulting in quick run-off and little time for transfer of iodine. For instance, the soils in the Himalayan foothills contain low levels of iodine due to ground erosion by glaciation during the last ice age, which stripped the soil of iodine. Because it takes thousands of years for rain water to replenish the soil with iodine, the iodine-content of the soil and water of mountainous regions remain low (Fuge, 2007).

Due to heterogeneity in iodine availability in the soil accessible to humans and because of the lack of nationally representative data on iodine content in soil and groundwater, the best measure of inadequate local iodine availability is the prevalence of pre-fortification goitre.[17] The "Himalayan goitre belt" is the world's largest and most intense goitre endemic area, spanning over 2,400 km. It runs along the southern slopes, foothills and adjacent plains of the Himalayas and the level of iodide in the drinking water is extremely low (Pandav, 1982). Other areas, such as for example pockets of the Indian west coast also have a high prevalence of iodine deficiency due to heavy rainfalls, alluvial soils and less saline ground waters (Smedley, 2004).

Following Feyrer et al. (2017); Adhvaryu et al. (2017); Politi (2010*b*,*a*), I define naturally iodine deficient areas by the spatial prevalence of goitre endemicity prior to any availability of iodine supplementation. Individuals who reside in previously endemic areas are thus more likely to benefit from iodine fortification in comparison to individuals who live in non-endemic areas which have always been naturally sufficient in iodine. I use the only available nationwide information on the location of goitre endemicity prior to fortification compiled by the British physician Sir Robert McCarrisson. Sir McCarrisson was provided data on goitre incidence by administrative medical officers and civil surgeons in British India (McCarrison, 1915).[18] The original map of goitre endemicity in McCarrison (1915) is shown in Figure A.9. McCarrison (1915) writes;

[17]Various characteristics of a soil can lead to different iodine-fixation points where the iodine from the soil is fixed in the soil and not taken up by the roots of plants and thus not transferred to humans (Johnson, 2003).

[18]McCarrison (1915) writes: "Through the kindness of Administrative Medical Officers, and with the generous assistance of Civil Surgeons, I have been enabled to collect detailed information regarding the prevalence and distribution of goitre in almost every part of British India."

> In the accompanying map I have indicated by means of red dots those localities where goitre has been reported to prevail. It is of course impossible, in a map of these dimensions to indicate every area with the accuracy of detail that is desirable. The map, therefore is to be regarded only as affording an approximately accurate indication of the general distribution of the disease over India.

For the analysis, I use the geographic information system (GIS) software QGIS, to digitise the location of the dots as of Figure A.9 into a GIS file. I define a district to be goitre endemic if it contains at least one dot by merging the information on the location of the dots using a boundary GIS file of the district as of the 2001 Indian Census. Districts containing no dots are defined as non-endemic.[19] The constructed map of endemic districts in India prior to 1915 is shown in Figure 1. The dark yellow districts represent goitre endemic districts and the light yellow districts represent non-endemic districts.

While other micronutrient deficiencies are likely to be resolved with rising caloric intake, the risk of iodine deficiency is likely to persist locally due to its geographical determinants. Therefore, the population residing in the goitre endemic localities shown in McCarrison (1915) should have a higher risk of iodine deficiency today without supplementation of iodine. The validity of the spatial goitre prevalence in McCarrison (1915) is confirmed both by state level thyroid prevalence in 2005-2006 and previous studies. I use the 2005-2006 National Family Health Survey (NFHS) III to check the relationship between historical pre-fortification goitre endemicity as of McCarrison (1915) per state and more recent thyroid related illness prevalence. I regress the proportion of adults, 35 years and older, who report having thyroid related illnesses on the number of historically goitrous areas per state population. The results show a positive and statistical significant association, see Table A.21.

Furthermore, there is no evidence of the consumption of iodine rich foods to have risen more in historically endemic areas compared to iodine sufficient areas over time. Fish has the highest iodine content of all foods but fish consumption is low in India as the majority of the population is vegetarian. Individuals living in coastal areas consume relatively more fish compared to their inland counterpart. The share of food expenditure on fish does not appear to have increased disproportionally in areas identified as goitre endemic compared to non-endemic.[20]

Sub-national surveys on goitre from the 1940's and onward, such as Pandav (1982),

[19] There is no information about the size of the area each dot represents, nor the intensity of goitre per dot.

[20] Data from the National Sample Study Organization, show that the percentage of food expenditure on fish increased from 2.03% in 1983-1984, to 2.42% in 1999-2000 for all of India. The corresponding change over time for maritime states have been 2.77% to 3.51% and the increase in fish consumption has been lower for non-maritime states have been 1.43% to 1.55% (Mruthyunjaya, 2004).

corroborate the location of areas prone to iodine deficiency. Despite later public health efforts to supplement deficient populations with iodine, the spatial occurrence of iodine deficiency in McCarrison (1915) appears to have understated the historical goitre rate, as more districts have been found to be goitre endemic (Pandav, 2013). Therefore, using the spatial information provided in McCarrison (1915) to identify areas that will benefit from iodised salt will at most underestimate the true effect of iodine fortification on human capital.

4.1.1 District Level Total Goitre Rate Surveys

In order to confirm the validity of the spatial information of goitre endemicity in McCarrison (1915), I use additional data on the total goitre rate. The IDD and Nutrition Cell, Directorate of Health Services, Ministry of Health and Family Welfare India report district level averages of the goitre rate among primary school aged children measured in 1940-2010.[21] The data is not representative on state or country level and does not include all districts. Areas with previously known goitre prevalence are likely to have been included in the survey and surveyed earlier. Furthermore, the data consists of surveys collected over a long period of time making it prone to measurement error.[22]

To obtain a measure of the underlying intensity of naturally occurring iodine deficiency, I restrict the analysis of the goitre rate data to the 263 districts as of the 2001 Indian Census that were surveyed prior to the implementation of any district, state or national iodine fortification policies.[23] The sample of surveyed districts have an average total goitre rate (TGR) of 25.94 with a SD of 15.74, the proportion of children with goitre ranges from 0.01 - 85.35%.

Even though this data is not nationally representable, we note that the historical goitre rate for India far exceeds the maximum prevalence of the historical goitre rate in previous papers, such as Feyrer et al. (2017). The estimates reported here are more in line with historical data from other currently low or middle income countries.[24] More important, this district level data validates the use of the endemicity indicator variable derived from McCarrison (1915). I estimate a linear probability model with the outcome being

[21] The report have been shared with me by the courtesy of Dr. Kapil Yadav, at the All Indian Institute of Medical Sciences (AIIMS).

[22] See further descriptions and discussion of the data in Appendix A.1.2

[23] Changes to district boundaries have resulted in an increased number of districts since partition. I match districts which were surveyed at a given year prior to 2001, to districts as of 2001 that were contained within the boundaries of the older districts. The matching of districts was made based on the division of districts throughout census years 1971-2001 reported by (Kumar and Somanathan, 2009). I also match districts of 2001 to the older districts if the old districts constitute at least 90% of the area of the new districts.

[24] In the mid 1950s many endemic regions in for instance Nicaragua, Colombia, Sierra Leone, Sudan, Malaysia and Indonesia had a goitre rate above 40% (Kelly and Snedden, 1960).

the probability that a district contains at least one goitre endemic area as of McCarrison (1915), on the proportion of children with goitre and different cut-offs of goitre prevalence. From Table A.22 in the Appendix one can observe a positive association between the spatial occurrence of goitre across both datasets.

4.2 Data on Cognitive Test Scores

I use the Annual Status of Education Report (ASER) to measure the effect of USI on cognitive test scores. ASER is a cross-sectional survey which tests around 500,000 children aged 5-16 in rural India each year in reading and mathematics.[25] Publicly available household surveys began in 2007, and have been conducted yearly between September-November. The survey is representative at the district level. ASER is unique in that it includes both in- and out of school children. No compositional changes in school enrolment will affect the test score outcomes in the data. I use all available surveys, for years 2007-2014. See a further explanation of the ASER data in Appendix A.1.1.

I construct a basic numeracy score which is a binary indicator variable taking value 1 if the child can recognise single-digit numbers or more (double-digit number recognition, two-digit subtraction with carry over, and three digit by one digit division), and 0 if the child cannot recognise single digit numbers. Similarly, I generate a basic literacy score which takes value 1 if the child recognises letters and above (words, a short paragraph - a grade 1 level text, and a short story -a grade 2 level text) and 0 if the child cannot recognise letters. Focusing on basic academic proficiency can help to reveal heterogeneous impacts of iodine fortification, with possibly greater effects on the children who are more likely to have low test scores to begin with. Moreover, I estimate the effect on the overall age standardised numeracy and literacy skills. The raw test score ranges 0-4, where the maximum score corresponds to the highest level of proficiency in the ASER tests.

The ASER data also includes other household and village level information. For instance, the material of the house which proxies for the wealth of the household, is reported. "Pucca" denotes a house made of durable materials such as brick, stones or cement, "Kutcha" denotes a house made of less durable materials such as mud, reeds, or bamboo, and "Semi-Pucca" denotes something in between. Hence, Pucca is a proxy for relatively high economic status. The survey also contains information on the existence of a government primary school, Anganwadi centre and a ration shop in the village and whether the village is connected to a road made of "pucca". An Anganwadi centre offers basic health care and services related to nutrition and schooling of young children. A ration shop provides food from the public distribution system.

[25] They also test children in English. Due to large regional differences in English proficiency, I am not studying the effects on English.

4.3 Descriptive Statistics

I begin with showing the effects of the iodisation mandate on the consumption of adequately iodised salt. Data from the National Family Health Survey (NFHS), II and III surveyed in 1998-2000 and 2005-2006, respectively, are used along the District Level Health Surveys (DLHS) II from 2002-2004. These surveys include information on objectively measured iodine levels of salt at the household level. Survey enumerators measure the level of iodine in table salt using a rapid-test kit (IIPS., 2007).[26] The salt is judged to be adequately iodised if it contains at least ≥ 15 μg iodine/g salt in line with government requirements.

I plot the changes in iodised salt consumption for the various rounds of NFHS and DLHS surveys for rural and urban households separately, as the main analysis will be carried out for rural children only, in Figure 2.[27] The proportion of rural households consuming adequately iodised salt is depicted by the red line and the trend for urban households is given by the blue line. One needs to keep in mind that the data collection for the 2005-2006 NFHS III mostly took place before the notification and the implementation of the 2006 mandate and thus the data understates the effect of the legislation on iodised salt consumption.

We observe a sharp drop in the proportion of Indian households consuming adequately iodised salt in the 2002-2004 DLHS II, compared to both the 1998-2000 NFHS II and the 2005-2006 NFHS III, in Figure 2. The removal of the ban reduced the proportion of rural households consuming adequately iodised salt from around 48% in 1998-2000, to 32% during no ban in 2002-2004. The coverage of adequately iodised salt consumption quickly increased to comparable levels to the initial ban when the policy was reinstated in 2006. Plotting the proportion of households who consume salt without any iodine reveals a similar trend.

WHO has established that urinary iodine excretion is the best measure of iodine deficiency. Unfortunately, consistent data on urinary iodine excretion across time does not exist for India. However, research show that there is a strong elasticity between iodised salt consumption and urinary iodine excretion. Horton and Miloff (2010) find that a 1% increase in iodised salt consumption is associated with a 0.73% increase in urinary iodine excretion for developing countries.

What is further important for the identification strategy is that the increase in iodised

[26]The test kit consists of a solution which will change colour, from light blue through dark violet, depending on the level of iodine in the salt. The interviewer then matches the colour of the salt as closely as possible to a colour chart provided and records the iodine levels. The surveys report a categorical measure of the iodine content in salt; no iodine, some iodine and whether the salt has an adequate amount of iodine (IIPS., 2007).

[27]Descriptive statistics of the surveys are given in Appendix A.1.3

salt availability following the ban of 2006 reduced iodine deficiency in areas identified as naturally prone to iodine deficiency by McCarrison (1915). I use the 2005-2006 NHFS III and the NFHS IV data to plot trends for the proportion of individuals with self reported thyroid problems, including goitre. I have merged the data with the number of goitre endemic areas from McCarrison (1915), by state as of the 2011 Indian Census. We observe that states at or above the 75$^{\text{th}}$ percentile, in comparison to those at, or below the 25$^{\text{th}}$ percentile of the distribution of the number of pre-fortification endemic goitre areas per state, experienced a larger decrease in thyroid related illnesses as iodised salt consumption have increased, see Figure 5.[28]

As for the dataset used in the main analysis, I merge the ASER data with information on the location of previously goitre endemic districts and present summary statistics for cohorts who did not benefit from iodine fortification in early life in order to present the ASER data prior to treatment. The means of learning outcomes, child, household and village characteristics are shown for 5-10 year olds, born in 2002-2004 in goitre endemic and non-endemic districts in Table 1. In addition, differences in means and accompanying t-statistics are provided.

We note that a higher proportion of children know some math and can do some reading in non-endemic districts compared to endemic districts. The same goes for the overall numeracy and literacy score, ranging from 0-4. Households in districts predisposed to iodine deficiency, tend to be bigger and there is a smaller fraction of villages with a primary school or Anganwadi in endemic districts. Assuming that the endemic and non-endemic groups have experienced similar trends in household and village characteristics, these baseline differences should not be a problem in a DD analysis.

The trends in the various test scores are plotted for children aged 5-16 using ASER in goitre endemic and non-endemic districts in Figure 6.[29] The probability of knowing any numeracy or literacy is given by the y-axis and year of birth is shown on the y-axis.

What is important for the DD identification strategy is that we observe parallel trends in test scores for children in endemic, and non-endemic districts, prior to the first policy

[28]It is important to keep in mind that an increased iodine intake above the recommended intake can be detrimental for health as well as it can cause hyperthyroidism. There is medical evidence that iodine-induced hyperthyroidism is also common among those in areas with chronic long-standing iodine deficiency. Therefore, more access to iodine might have increased thyroid issues for those with no previous iodine deficiency and also increased such problems for those with previous iodine deficiency (Zimmermann et al., 2008). These mechanisms might explain the overall upward trend in thyroid related problems in rural India during 2005/2006 - 2015/2016.

[29]I use data on all children from the ASER data to plot the trends in basic cognitive scores, as restricting it only to primary school children as in the analysis, will not adequately show the degree of parallel trends before the policy changes due to a shorter time span. The trends for children aged 5-10 are shown in Figure A.12. The trends in age standardised overall test scores for all ages are shown in Figure A.13.

mandating salt iodisation notified in 1997 and implemented in 1998 in Figure 6.[30] In line with the hypothesis, we observe diverging trends in the proportion of children mastering basic literacy and numeracy for cohorts born during no policy. The trends in test scores then converge after the ban was re-instated in 2006.

The overall drop in test scores is caused by a nationwide increase in school enrolment and a change in the composition of children who attend school. In 2009, India passed the Right of Children to Free and Compulsory Education Act (2009) (Kumar and Rustagi, 2016). Under this act, every child up to the age of 14 is guaranteed free and compulsory education, and no child can be held back or be expelled until grade 10. The increase in enrolment have not been met with a corresponding increase in other inputs, such as classrooms, teachers and learning materials. Moreover, teachers in India have not been able to change teaching according to the changed composition in school enrolment as teachers must cover the entire year's formal curriculum according to law. Repeated surveys have found that Indian students perform significantly below grade-level standards in both math and reading, with little or no improvements in any state over the past several years (ASER Centre, 2014).[31]

Additionally, I inspect the long-run trends in literacy and schooling for endemic and non-endemic districts prior to the time period shown in Figure 6. I use information on the respondents' mothers' reading ability and on both parents' highest grade attained in school from the 2009 ASER.[32] I graph the changes in reading and schooling attainment for cohorts born in 1955 to 1982 as national iodine fortification of salt started in 1983, for parents living in historically endemic and non-endemic districts. From Figures A.15, A.16 and A.17 we cannot distinguish differing trends in literacy or schooling attainment across previously endemic and non-endemic districts.

5 Empirical Analysis

I apply a DD strategy to investigate the impact of mandatory iodine fortification in early life, on cognitive test scores using the ASER data merged with the information on pre-fortification goitre endemicity. Cohorts who were in early life at the time of iodine fortification in historically goitre endemic districts, are likely to have experienced an improvement in cognition in comparison to cohorts in the same districts during no policy, relative to cohorts in districts with no prior goitre endemicity. I begin with presenting a flexible empirical specification where I do not constrain cohorts to be in a treatment or

[30] The total consumption of iodised salt did not increase despite the implementation of the first ban in 1998. This explains the lack of a discontinuity around the time when the first ban was implemented.

[31] Large surveys in other developing countries also find poor learning outcomes, see (Banerjee et al., 2016).

[32] Mother's literacy is only tested in the ASER survey of 2009.

control group depending on year of birth, but rather let the data tell the story. Next, I define treatment status by the presence of the mandatory iodine fortification of 2006 in early life.

5.1 Preliminary Analysis: Flexible Treatment Specification

I regress test scores on individual year of birth dummies interacted with the endemicity indicator variable. The model is specified in Equation 1;

$$\begin{aligned}\text{Test Scores}_{idt} = \alpha_0 + \sum_{t \neq 2000} \delta_t[Iodised(t = yob) \times Endemic] + \beta X_{idt} \\ + \phi_{district} + \phi_{yob} + \phi_{survey} + \phi_{survey*yob} + \mu_{idt}\end{aligned} \tag{1}$$

The outcome variable Test Scores, is a binary variable denoting basic literacy and numeracy skills for child i, in district d and born in year t. Linear probability models are estimated for basic numeracy and literacy skills separately. yob denotes year of birth dummies where the omitted reference year is 2000, consisting of children who were in utero during the first policy.[33] I choose birth year 2000 to be the reference group in order to show parallel trends prior to the exogenous changes in iodised salt consumption. Even though a ban was implemented in 1998, it did not change the consumption of iodised salt compared to previous years. Therefore, in comparison to birth year of 2000, one would not expect any diverging trends in test scores for children born prior to 2000 in endemic and non-endemic districts.

Endemic is a binary variable which takes value 1 if child i resides in a pre-fortification goitre endemic district, and 0 if the child resides in a non-endemic district. The coefficient of interest is δ which captures the interaction effect of year of birth and goitre endemicity, in comparison to those born during the first mandatory salt iodisation policy in 2000. I include district fixed effects, ϕ_{d}, and year of birth fixed effects ϕ_{yob}. Interactions between birth years and survey years $\phi_{\text{survey*yob}}$, are added to control for changes in education for different years, and this also controls for the age of the child taking the ASER test.

Household level covariates such as; housing material (semi-pucca and pucca compared to the omitted category kutcha), years of maternal education and household size, are added. I include the following dummy variables on whether the respondent's village of residence has: a government primary school, an Anganwadi centre and a rationshop. Moreover, I control for whether the village is connected to a road made of pucca. μ_{idt} is the error term. I cluster the standard errors at the district level to control for within-district

[33] The ASER data does not provide exact date of birth, only age at the time of the survey. I generate year of birth = survey year - current age; but this measure of iodine fortification policy at each age will be somewhat noisy.

serial correlation. I include children of all ages, 5-16 years old, as it allows for a better understanding of the trends prior to mandatory USI.

The graph in Figure 7 plots the coefficients on δ from Equation 1 for the pooled sample.[34] The probability of mastering any skill is given by the y-axis and year of birth is displayed on the x-axis. The dots represent the coefficients on basic numeracy and literacy for a child born in a given year, with reference birth year 2000, in an endemic district compared to a non-endemic district.

We observe no statistically significant differences in test scores for children born prior to 2000 in endemic, compared to non-endemic districts. We do not notice any direct or lagged positive effects from the implementation of the first ban in 1998 in comparison to older cohorts. This is in line with there not being a spike in iodised salt consumption following its implementation. What is more important, is that one clearly sees that children in endemic areas performed significantly worse on basic numeracy and literacy scores if they were were born during no policy in 2001-2006, thus conceived in 2000-2005. Learning outcomes improved for cohorts in endemic districts as they benefited from increased iodised salt availability after 2005. We note that cohorts born in 2007-2008, thus being in utero at, or after, the time of implementation of the second ban in 2006, experienced an increase in cognitive outcomes.

We also observe an increasing positive trend in test scores after 2006 for children in previously endemic districts. This might be due to that an extended duration of mandatory iodine fortification before birth allows the mother to replete previously depleted iodine stores. Alternatively, this is driven by an increasing coverage of iodised salt with time following the policy. This finding is in line with Qian et al. (2005) who show that a positive impact of iodine supplementation on IQ is mainly observed in children born 3.5 years after such a programme was introduced.

5.2 Main Analysis: Effects of the 2006 Ban on Non-Iodised Salt

In the following analysis, I will focus on the impact of the central prohibition of non-iodised salt notified in 2005 and implemented in 2006, compared to the absence of the ban, 2000-2005. The ban of 2006 led to a large increase in the coverage of iodised salt which increased with time and the ban is still in place today. I present the DD model in Equation 2:

$$\begin{aligned}\text{Human Capital}_{idt} &= \alpha_0 + \delta \text{Iodised}_t + \gamma \text{Endemic}_d + \theta(\text{Iodised}_t * \text{Endemic}_d) \\ &+ \beta X_{idt} + \phi_{district} + \phi_{yob} + \phi_{district*yob} + \phi_{survey} + \phi_{survey*yob} + \mu_{idt}\end{aligned} \tag{2}$$

[34] The graphs in Figure 8 graphs the coefficients for boys and girls separately.

The outcome variables are jointly denoted Human Capital. I estimate the probability of mastering basic numeracy and literacy and the effects on overall learning scores, for child i, in district d, born in year t. The regressions are estimated for 5-10 year old children to reflect the Indian primary school age.

Iodised is a binary treatment variable taking value 1 if the respondent was born in 2007-2008 and thus benefited from the fortification policy in utero and and throughout his/her life. Iodised takes value 0 if the child was in early life during no federal policy, thus born in 2002-2004. The choice of control cohorts allows for a one year lag after the change in policy in 2000, and thus constitute of children who were in utero 2001-2004. As the first 1000 days (feotal life up to age 2) are critical for overall brain development, the control cohorts must not have been exposed to the policy from one year prior to birth up to age 2.[35]

Endemic is a binary variable denoting whether child i resides in a pre-fortification goitre endemic district. The coefficient of interest is the interaction term θ capturing the DD effect of being in early life during the nationwide mandatory iodine fortification policy implemented in 2006, compared to no policy, in naturally iodine deficient districts compared to sufficient districts, on cognitive test scores over time. The regressions are estimated for the pooled sample and for girls and boys separately.

As in Equation 1, the following fixed effects are included; district fixed effects, ϕ_{d}, year of birth fixed effects ϕ_{yob}, interactions between birth year fixed effects and survey years $\phi_{\text{survey*yob}}$. I account for district level specific trends, $\phi_{\text{d*yob}}$ so that θ is estimated from the variation around linear district time trends. Partialling out district trend variation is required due the large size and population of Indian districts. Moreover, districts are the key administrative units administering all major programmes in the Indian education system (Department of Education, 1993). When the regressions are estimated for the pooled sample of girls and boys, I include gender specific district linear time trends.

I further control for housing material, years of maternal education, household size and village characteristics. μ_{idt} is the error term and the standard errors are clustered at the district level. I present regression estimates with and without village level controls as the ASER surveys from 2007 and 2008 do not contain information on village characteristics.

The regression results for basic numeracy and literacy, i.e. the likelihood of recognising simple numbers and letters or better, are shown in Table 2. From column (2) we observe that children who benefited from the prohibition of non-iodised salt in early life experienced an increased probability of recognising single digit numbers or more, with 2.6 percentage points, after the inclusion of all covariates. Splitting the sample by gender

[35]The econometric specification possibly underestimates the true effect of mandatory USI on cognition. The cohorts in the control group were in early life between two iodine fortification policies and therefore their control status might be confounded due to the storage and depletion of iodine.

reveals that girls benefited somewhat more. From column (6) we see that girls who were in early life after the implementation of the mandate were more likely to have obtained basic numeracy skills by 3.4 percentage points. The corresponding DD coefficient for boys is nearly half the effect size and indicates that boys improved their probability of mastering basic numeracy skills by 1.9 percentage points, see column (10). The gender differences are not statistically significant. The proportion of girls aged 5-7 with some numeracy skills is 70.07% and the corresponding proportion is 71.11% for boys. Exposure to a higher availability of iodised salt in early life improved basic numeracy skills by 4.81% for girls and with 2.67% for boys.

The effect of iodine fortification in early life is slightly larger for the probability of being able to recognise letters or more, compared to the previously discussed effects on basic numeracy skills. The fortification policy increased the probability of having some literacy skills with 3 percentage points for the pooled sample after the inclusion of all covariates, see column (4) in Table 2. The DD coefficients are 0.04 for girls (see column (8)) and 0.022 for boys (see column (12)). The gender differences are not statistically significant. The estimates correspond to an increase of 5.83% in the likelihood of having basic literacy skills for girls (mean 68.66%) and 3.21% for boys (mean 69.24%).

I investigate the effects of iodine fortification on the overall numeracy and literacy score, ranging 0-4. 0 corresponds to failing to recognise any letters or numbers. A score of 4 is given to children who can read a paragraph or do division and corresponds to what is required from a second or third grader in Indian primary education. Due to the relatively young sample of children who benefited from the policy (5-7 year olds), one might not expect a large effect on the total learning score. I estimate the effect on age standardised numeracy and literacy scores. While no effects are found for boys, a positive and statistically significant improvement of 6.6% of a standard deviation increase in girls' overall age standardised literacy score, see column (8) in Table 3.[36] The larger effects of an increased access to iodine on literacy compared to numeracy, corroborate the findings in Huda et al. (1999). The authors argue that reading skills are more likely to reflect a long-term cumulative process of the children's learning rather than current functioning.

The results also largely hold when using the standardised number of historically goitrous areas as defined in (McCarrison, 1915) per 2001 districts, in place of the previous binary measure. One standard deviation more pre-fortification goitre endemic locations per district increases basic numeracy and literacy with 1.6 and 2.2 percentage points, respectively, for girls. The new measure leads to an increase of having mastered basic literacy with 0.9 percentage points for boys, while no effects are observed on basic numeracy, see Table A.19 in the Appendix. Consistent with the main results, girls also

[36]The effects on the raw score ranging from 0-4 is consistent with the impact on the age standardised scores, see Table 4.

improved their overall age standardised test scores, see Table A.20 in the Appendix.

The observed improvements in cognitive test scores are not driven by increased school enrolment (see Table A.10 in the Appendix). This is not surprising as primary school enrolment have become near universal in India in recent years. We note that iodine fortification is associated with a reduction in the likelihood of dropping out of school of 0.2 percentage points for the pooled sample, see column (4) in Table A.10 in the Appendix. However, no significant effects are found on dropping out for either gender separately.[37]

Children in private schools have, on average, better test scores (Muralidharan and Kremer, 2009). Differential trends in private school enrolment in areas more or less prone to iodine deficiency might pose a threat to the identification strategy. I investigate this by regressing the probability of being enrolled in a private school compared to a government or Madrasa (islamic) school, on the right hand side variables in Equation 2. I do not find that the increased basic cognitive test scores for children in endemic areas are caused by coincidental increases in private school enrolment, see Table A.11 in the Appendix. Neither do I find any effect on the probability of taking private tuition (tutoring outside of school), see Table A.12 in the Appendix. These findings further strengthen our confidence that the improved numeracy and literacy skills are driven by increased cognitive skills.

5.2.1 Heterogeneous Treatment Effects: Control of Iodine in Salt Rakes

I analyse whether the differences in basic cognitive test scores vary with the changes in the availability of iodised salt across policy regimes. Gujarat, was the only major salt producing state which revoked its state ban in 2000 following the removal of the first national mandate.[38] The mode of salt transport from Gujarat is determined by distance as it is more cost effective to use road transportation for shorter distances and rail transportation for longer distances (Vir, 2011, p.586).

Salt transported by rail is subject to monitoring and registration of the producer. Moreover, the controls of iodine content of salt are only obligatory in transport by rail but not by road by federal policy. These rules applied before and after the implementation of the federal bans. This created less incentive for the salt producers and distributors to adequately iodise salt which was going to be transported by road (Vir, 2011, p.586).

[37] There is some evidence of a positive impact on grade progression for both genders. However the effect size decreases significantly and the estimates are no longer statistically significant when village level covariates are included, see Table A.9.

[38] Besides meeting its own requirement, Gujarat caters to the North Eastern States, West Bengal, Bihar, Uttar Pradesh, Madhya Pradesh, Maharashtra, Goa, Rajasthan, Delhi, Jammu and Kashmir and Orissa.

The north eastern states; Sikkim, Mizoram, Meghalaya, Nagaland, Tripura, Arunachal Pradesh, Manipur, Assam and West Bengal import their salt by rail due to their far off location. These states also use a nominee system which consists of appointed traders who procure salt for the states. This system is biased in favour of large and registered salt producers who are more likely to produce adequately iodised salt and have their salt undergo inspections (Vir, 2011, p.586).

Therefore, during the absence of central mandatory salt fortification, states within 500 km of Gujarat imported salt which was less likely to have been checked compared to salt transported by rail. States with rail transportation always had a higher proportion of households consuming iodised salt and were less affected by changes in the federal ban (Vir, 2011).[39]

I plot the trends in iodised salt consumption for rural households in the north eastern states of India which import their salt by rail. I also plot separate trends for Gujarat and states within 500 km of Gujarat; Rajasthan, Uttar Pradesh, Madhya Pradesh and Maharahstra, which use predominantly road transportation by salt, see Figure A.14. The graphs confirm the differential coverage of iodised salt over time. "Rail states" experienced an increase of around 11% of iodise salt consumption following the implementation of the ban in 2006. States relying on road transport from Gujarat experienced an improvement of over 25% following the legislation.[40]

I run separate regressions for children in states depending on their transportation mode of salt. Children in, and near Gujarat experienced stronger improvements in cognition if they were in early life during the ban on non-iodised salt. Mandatory fortification of salt during early life is associated with an increase in the probability of knowing some numeracy with 7.5 percentage points for girls and 4.6 percentage points for boys, see Table A.17 in the Appendix. The ban also improved basic literacy scores. Girls and boys are 6.8 and 3.6 percentage points more likely to know some literacy, respectively. I do not find any positive effects on test scores for children residing in "rail states", see Table A.18 in the Appendix.

[39]Other policies might additionally have affected the changes in the availability of iodised salt. For instance, in April 2001, the freight for transporting salt by rail experienced a price hike which led to an increase in transportation by road. Most states offer subsidised salt through the public distribution system (PDS) but there is no support for PDS having affected the supply and consumption of iodised salt. Consumption of salt from PDS have remained low after the re-introduction of the ban as an average 3.9% of households in 2012 reported purchasing salt from PDS shops. Moreover, quality assurance of adequate iodine levels in salt sold through PDS have been heavily criticised (Pandav, 2012).

[40]We also note a larger discrepancy between "rail states" and "road states" is found in the proportion of households consuming salt without any iodine.

5.2.2 Heterogeneous Treatment Effects: Son Preference

Previous studies in economics which evaluate the impact of iodine in early life on human capital have found larger effects on female human capital outcomes in childhood and adulthood. Field et al. (2009) explain this finding by female feotal brain development being more sensitive to iodine compared to male brain development. However, no such consensus exists in the medical literature. Moreover, previous papers in economics which study the impact of iodine, do not actually observe cognitive skills for both genders which makes such an interpretation even more difficult. It should also be noted that many papers (see for instance; Bobonis et al. (2006); Maccini and Yang (2009); Maluccio et al. (2009); Hoynes et al. (2016); Bleakley (2007)) which study the impact of various shocks in early life on schooling outcomes find larger effects for girls compared to boys.

The coefficients in this study are marginally larger on girls' basic skills, but the gender differences are not statistically significant across the baseline estimations. However, we observe that girls experienced a positive effect on the overall literacy score while no effects were found for the subsample of boys. Therefore I shed light on whether the somewhat stronger effects on female learning outcomes are solely driven by biology, as proposed in the previous literature, by investigating if boys' or girls' test scores vary with social gender institutions.

It is difficult to disentangle the effect of nature versus nurture as I do not observe parental behaviour, such as reinforcement or compensation with regards to observed cognitive endowments and gender. A question which arises is whether the treatment effects in this study vary with differences in son bias. Preference for sons is a well known fact in many parts of India. This has led to unbalanced sex ratios and adverse human capital outcomes for girls and women. This phenomenon is driven either by prenatal sex selection or lower investments in early life of girls leading to higher female mortality rates in infancy and childhood.[41]

I interact the DD variables with district level standardised sex ratios of the number of girls to 1000 boys aged 0-6 years from the 2001 Census. A larger sex ratio indicates that a district is more balanced with regards to gender and suffers less from observed son bias. The regression results are presented in Table A.8. In column (10) we note that a more balanced sex ratio have a negative impact of mandatory iodine fortification on boys' cognitive test scores. No effects of the ban with respect to son preference is found on test scores for girls.

These findings can be explained by parental reinforcement of observed cognitive endowments of children. Adhvaryu and Nyshadham (2014) build upon the study by Field et al.

[41] On the other hand, there is evidence that sex selection could lead to a reduction in the prevalence of malnutrition among girls, see Hu and Schlosser (2015).

(2009) and observe that postnatal investments such as vaccinations and breastfeeding responded to the positive shock to cognition and thus reinforced the positive effect on human capital. Additionally, previous research finds that parents in India do not notice higher abilities of their daughters while they do so for their sons, see (Chari and Maertens, 2014). The paper also finds a significant gender gap in the perceived returns to education. Given this evidence, parents in districts with a higher son preference might be more likely to reinforce observed cognitive abilities of their sons and not their daughters in comparison to parents in districts with less son preference.

6 Robustness

6.1 Validity tests

The DD estimates are only valid if the variation in iodised salt policies in early life did not coincide with other policies affecting malnutrition, cognition and future schooling. Therefore, I conduct several robustness checks to test for other potential drivers of the main results.

I begin with testing whether the treatment is systematically correlated with changes at the household or village level. A correlation between the treatment and the changes in these observable characteristics would make us worried that the same could apply to unobservable variables. I stepwise regress the change in one household or village level covariate which was previously used as a control variable in Equation 2 while all the other control variables remain unchanged. I then estimate similar regressions but without including the other covariates, see Tables A.40 and A.41 for the regression results.

There are no statistically significant differences in years of maternal education, the likelihood that a child's village of residence has a government primary school, ration shop or is connected to a pucca road. I do find a negative effect on the probability of living in a house made of pucca and the village having an Anganwadi centre. However, these small and negative effects rule out the possibility that any improvement in either household wealth or accessibility to an Anganwadi are causing the improvement in cognitive skills.

Additionally, I investigate whether the DD estimates are driven by differential health care investments, varying disease or sanitation environments of children during early life. A potential threat to internal validity is the roll out of the National Rural Health Mission. The programme was implemented in 2005 and has decentralised and improved the quality of the health delivery system in deprived rural areas. It has for instance improved immunisation coverage and quality. I estimate placebo regressions using the econometric strategy set out as in Equation 2. Data from the DLHS II and DLHS III on the last, and second to last born child to a surveyed woman is used for the analysis. The outcome variables are the probability of being vaccinated against BCG and Measles. In addition, I analyse whether newborn children born after the implementation of a ban on non-iodised salt were more likely to receive another micronutrient supplement - Vitamin A. Lastly, I estimate the effects on the incidence of diarrhoea two weeks prior to the survey. Diarrhoea incidence is an overall proxy for the health and sanitation environment. The regression results are presented in Table A.42. All estimates but one are statistically insignificant. We notice that the probability of receiving vaccination against BCG is 5.7 percentage points lower for birth cohorts who were in early life during the 2006 ban on non-iodied salt in historically goitre endemic districts. These findings cancel out potential worry about improved health care services and health in early life causing the observed improvements in cognitive test scores.[42]

6.2 Effects of the 1998-2000 Ban

In order to prove that the DD effects are not driven by coincidental improvements in cognition of children born after 2006, I show that children who were in early life during the first ban of 1998 also experienced increases in learning outcomes. Given, the previously discussed caveats regarding the short duration of the first ban and the importance of iodine for postnatal brain development, one would not expect the treatment effects to be as large as from the later ban. I estimate the same regression specification as in Equation 2 with the exception that the treatment cohorts now capture children who were in early life during the 1998-2000 ban on non-iodised salt. Treatment is defined as; Iodised (1st ban) = 1 if a child was born in 1999-2000, corresponding to children who were in utero in 1998-2000, and 0 if the child was born in 2002-2004. In addition, I investigate the treatment effect of both bans together by pooling the cohorts from the first and second ban together. Iodised (Both Bans) = 1 if the child is born in 1999, 2000, 2007 and 2008 and equals 0 if the child is born in 2002-2004.

The first ban has a positive and statistically significant effect on the probability of knowing basic literacy for both boys and girls, see Table A.13. Only boys appear to have experienced improved basic numeracy skills following the ban of 1998. The effect sizes are smaller compared to the later ban. We observe rather similar findings on age-standardised overall test scores. No effects are found on girls' test scores but boys experienced an improved age standardised overall literacy and numeracy scores across all specifications, see Table A.15. Pooling the treatment durations from both bans result in positive and

[42]In a separate paper I investigate the effect of the fortification policy on child mortality. I find that girls experienced a reduction in the risk of dying within the first month of birth. The higher survival rate following the policy suggests that the estimated effects on cognitive test scores shown in this study are likely to be underestimated for the sample of girls following the survival of "marginal" children.

significant effects on basic skills and for age standardised overall test scores for all sub samples, see Table A.14 and A.16 in the Appendix.

6.3 Total goitre rate as an alternative measure of goitre endemicity

In this subsection, I present regression results using data on the pre-iodisation total goitre rate of school aged children per district. I estimate Equation 2 with the exception that I substitute the former goitre endemicity dummy variable with a dummy variable taking value 1 if a district has an above median goitre rate, and 0 otherwise. When interpreting these DD estimates we need to keep in mind that they are showing the difference for for children residing in districts with a high risk for naturally occurring iodine deficiency compared to those at risk for mild to moderate iodine deficiency.

The results are presented in Table A.24. The findings largely support the main estimates. Children residing in districts with a previously high goitre rate who were in early life during the ban on non-iodised salt of 2006 are 1.9-4.5 percentage points more likely to know basic numeracy or literacy. However, the effects are only significant at a conventional level of statistical significance when village level covariates are excluded. The lack of statistical significance is potentially driven by the fact that the control group in terms of predisposition to iodine deficiency, does not consist of districts without any goitre. It can also be explained by the heavily reduced sample size. The corresponding effects on basic numeracy are improvements by 1.7 and 1.9 percentage points respectively. Using this measure of pre-fortification iodine deficiency results in positive effects on overall age standardised numeracy and literacy for both boys and girls. However, the estimates do not reach statistical significance when I include village level controls, see Table A.25 in the Appendix.

6.4 Instrumental Variable Analysis

The data on goitre endemicity per district might potentially suffer from measurement error. As previously discussed, there is not sufficient information about the sampling methods, nor the collection of data in McCarrison (1915) and in the district level TGR surveys. In order to circumvent measurement error in the propensity to benefit from iodine fortification, I instrument for pre-fortification prevalence of the disease environment using topological and hydro-geological determinants.[43] This is a valid strategy provided that the measurement error in the geographical data is uncorrelated with the measurement error in either goitre dataset. This is a reasonable assumption given the different

[43]This is in similarity with Cutler et al. (2010) who instrument for malaria endemicity.

contexts and methods of data collection.

The iodine content in soils is determined mainly by soil type and locality. Most iodine in soils is derived from the atmosphere where, in turn, it has been derived from the oceans. Iodine deficiency in the soil-water ecosystem is due to; heavy rainfall, steep gradient and poor vegetation cover resulting in quick run-off and little time for transfer of iodine (Fuge, 2007). Soil erosion and leaching leads to iodine deficient soils and hilly topography encourages natural erosion of the surface layers (Brady, 1996, pp.48-49). Iodine deficient soils are therefore common in mountainous areas (Zimmermann, 2009). Drinking water accounts for 10-20% of total iodine intake (Rasmussen et al., 2002). High concentrations of iodine in ground waters can be found in saline waters (Smedley, 2004). The majority of the iodine in the groundwater stems from organic matter decomposition in the marine strata with sea water influence (Wen et al., 2013).

I instrument goitre endemicity per district with maximum elevation and ground water salinity per district. The elevation data comes from the Shuttle Radar Topography Mission from FAO Harmonized World Soil Database v 1.2. I have geo-traced the location of the degree of saline ground waters from a map on groundwater quality in shallow aquifers from the Central Ground Water Board in India (Central Ground Water Board, 2010) using QGIS. I estimate the following first stage regressions:

$$\text{Goitre Endemicity}_d = \alpha_0 + \delta \text{ Elevation}_D + \gamma(1/\text{Groundwater Salinity})_d + \phi_d + \mu_d \tag{3}$$

$$\text{TGR}_d = \alpha_0 + \delta \text{ Elevation}_D + \gamma(1/\text{Groundwater Salinity})_d + \phi_d + \phi TGRsurveyyear + \mu_d \tag{4}$$

The first stage regression results are presented in Table A.26. The inverse of ground water salinity per district and the maximum elevation per district are relevant predictors of district level goitre endemicity based on McCarrison (1915), prior to the introduction of iodised salt. The first stage F-statistic is 61.31. The variables are also relevant predictors of above median TGR where the F-statistic is 18.19. I control for the timing of the various TGR surveys due to the possibility that more goitrous districts were sampled first. Controlling for the survey year reduces the predictive power of the instruments, but the F-statistic on the instruments are just barely under the rule of thumb cut off - 9.33.

Instrumenting for the goitre endemicity variable, the DD coefficients show that the fortification policy implemented in 2006 increased the probability of having basic numeracy skills with 7.6 percentage points for the sample of boys and girls. The TSLS coefficients show that girls experienced an increase in their probability of knowing basic numeracy by 10.5 percentage points. The corresponding increase for boys is half the effect size as for girls, 5.2 percentage points, see Table A.27. The coefficients for boys and girls are statistically significantly different from each other. Girls and boys experienced an increase of 15% and 7.3%, respectively, in the probability of knowing any math at their respective group means.[44]

Girls who benefited from prohibition of non-iodised salt during early life are 14.3 percentage points more likely to have attained basic literacy skills. The corresponding increase is 9.3 percentage points for boys, see Table A.28. The gender differences in the treatment effects now also are statistically significant. The coefficients correspond to an improvement of 20.8% for girls and 13.4% for boys. IV analysis also increases the coefficients on overall age-standardised test scores for girls. Girls improved their standardised score in literacy by 26.7% of a standard deviation and by 17.4% of a standard deviation for numeracy, see Table A.29. Applying IV estimation also results in positive and significant effects on grade progression, especially for girls, see Table A.30.

Similarly, the coefficients increase greatly when an IV analysis is applied to the TGR data. Being in early life during a fortification policy increases the probability of knowing any numeracy with 12.8-17.00 percentage points for the pooled sample after the full subset of controls is included. The corresponding increase is 13.2-19.4 percentage points for basic literacy. In addition, the DD estimates are now statistically significant for all sub samples and we observe larger estimates for girls in comparison to boys after using TSLS.

These results suggest that the measurement error in the goitre datasets have led to an underestimation of the true effect of mandatory iodine fortification on test scores using OLS. Moreover, larger gender differences are found using TSLS. A potential explanation for this difference might be that McCarrison (1915) oversampled areas that were part of British India which also have lower levels of gender bias. Roy and Tam (2016) show that states which were a part of British India benefited from better legislation against female discrimination. The authors find that these historical institutions have persisted until today where girls fare better in areas that were part of British India, compared to areas that were independent princely states.

As an additional check using geographical predictors, I use variation in natural iodine availability stemming from the fact that coastal areas are less likely to be deficient as most iodine is derived from the oceans. Therefore, the few districts bordering the sea which have been deemed goitre endemic by McCarrison (1915) are likely to have a lower rate of goitre, compared to endemic districts in more inland regions. Following this logic, children who live in sea bordering goitre endemic districts should have experienced a

[44]No effects are found on the probability of having enrolled in school.

smaller increase in cognition following iodine fortification in early life compared to more inland endemic districts. Consistent with this, insignificant and smaller estimates are found on test scores when restricting the analysis to districts bordering the sea (see Tables A.33 and A.34 in the Appendix).

6.5 Inter-District Trade in Agricultural Products

A subsequent threat to internal validity stems from the fact that districts might not be representative of agricultural markets. Therefore, district boundaries might not be the correct spatial area to define the district population's current underlying risk of iodine deficiency. India is still dominated by smaller rural agricultural primary markets meeting local demand (FAO, 2005). Despite trade liberalisation, internal trade remains low. Interstate tariffs, extensive trade regulations, and high transport costs constitute large barriers and affect rural households in particular (Atkin, 2013).[45] In order to rule out the main results are confounded by differences in road connectivity in early life and thus differential market access, I begin with conducting a falsification test. I regress the probability of one's village of residence being connected to an all weather road applying the DD model specified in Equation 2 using data from the DLHS II and III. I do not find that road connectivity is associated with the treatment of interest (See Table A.35 in the Appendix).

Atkin (2013) proves that Indian agricultural markets consist of small segmented markets within states. He defines these markets using the regions from the National Sample Survey (NSS). The NSS regions are drawn along agro-climatic boundaries within states. As to allow for intra-district trade in agricultural produce, I now define goitre endemicity per NSS region by standardising the number of goitre points as of McCarrison (1915) per NSS region. I control for NSS region specific time trends and cluster the standard errors on NSS regions. Otherwise, I estimate an identical DD model as specified in Equation 2.

After, controlling for all covariates, the DD estimates point to an increase in basic skills of 1.4 - 2.3 percentage points for the samples of boys and girls, see Table A.36 in the Appendix. As when using district goitre variation, we note that girls experienced an increase in their overall numeracy and literacy, see Table A.37. Moreover, these positive and significant effects remain when I change the level of analysis to standardised goitre areas per state, see Tables A.38 and A.39.

[45] External imports in Agriculture are low. In 2007/2008 agricultural imports were 4.32% of Indian GDP, see (Chand et al., 2010)

7 Conclusion

This study estimates the causal impact of mandatory iodine fortification of salt on cognitive test scores in rural India. I use a differences-in-differences strategy comparing cohorts who were in early life after the implementation of the policy to earlier cohorts, across districts with and without a geographical predisposition to iodine deficiency. As iodine deficiency is largely determined by the geography, I use historical information on the location of deficient areas to identify districts which are likely to benefit from the policy. This information is merged with annual cross-sectional data on both in and out of school children's test scores for 2007-2014 from the Annual Status of Education Report, and is used for the analysis.

Exposure to mandatory salt iodisation in early life increases the likelihood of children recognising simple numbers and letters or better, by 1.9 - 4 percentage points at ages 5-7. Girls also improved their overall literacy score which includes more difficult levels of mastery by 6.6% of a standard deviation. In comparison with studies on other inputs in early life using the same data on test scores, mandatory salt iodisation raises cognitive skills at least as much as avoiding drought in utero and more than being exposed to a sanitation campaign in early life, see Shah and Steinberg (2017) and Spears and Lamba (2016).

The results pass several robustness tests such as using an event study model, ruling out that other health improvements in early life or compositional changes are driving the findings and showing that a previous, although shorter, fortification policy also improved test scores. Taking account of trade in agricultural products across districts does not change the findings. Furthermore, I deal with the potential measurement error in the historical data on the spatial risk of iodine deficiency. I apply an IV analysis using geographical predictors of iodine content in soil and groundwater as IVs for the risk of the deficiency. The results from the IV analysis point to larger effects of salt iodisation on cognitive test scores. The main results also hold when using an alternative dataset on the rate of pre-existing iodine deficiency.

This is the first paper to use non-historical data on human capital to evaluate the cognitive returns from salt iodisation. As more than 140 countries have implemented USI legislation, these findings have global implications. Additionally, this study shows the mechanism by which historical salt iodisation has improved schooling attainment and labour market outcomes in Adhvaryu et al. (2017); Politi (2010*b*,*a*) by directly investigating the effects on cognition in childhood. Moreover, this study provides important evidence of the efficacy of USI in a developing country context given the mixed conclusions in the current literature on iodine supplementation from the developing world, see Field et al. (2009); Bengtsson et al. (2017).

Previous papers find large gender differences in the treatment effects, and in some instances only positive effects for women. This study adds to the literature by revealing heterogenous effects by gender depending on the level of difficulty of academic mastery. Additionally, I investigate whether the effects vary with district level son preference. I do not find that the coefficients on female skills vary with area level son preference which suggests that the policy has the potential to close gender gaps in learning outcomes in settings where women face discrimination. On the other hand, I find that the effect of salt iodisation on boys' numeracy skills are reduced in areas with more balanced gender ratios. This is suggestive of that parents are more likely to reinforce observable higher cognitive attainment for boys in areas with higher son preference. Further research is needed to understand how parental inputs vary with exogenous shocks to cognitive endowments and whether such inputs vary with the gender of the child.

India was deemed iodine sufficient in 2016 but many low income countries in Africa and Asia are still iodine deficient and have low coverage of iodised salt consumption (Iodine Global Network., 2017). Thus, there are still gains to be made for many countries by ensuring commitment to USI, as even moderate and short term variation in iodised salt consumption will have persistent effects on cognition. Large effects of reaching USI can be expected for countries which have a very low proportion of households consuming adequately iodised salt. A back of the envelope calculation using the lower bound effects found in this study, suggests that increasing the national coverage of iodised salt from 10% to 90% could increase the proportion of children attaining basic academic skills by at least 10%.

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8 Tables

Table 1: Descriptive statistics using ASER on children in early life during no nationwide iodine fortification policy in goitre endemic and non-endemic districts.

	Endemic		Non-Endemic		Difference	
	Mean	SD	Mean	SD	Difference	t-statistic
Enrolled	0.98	0.13	0.99	0.11	0.01***	(21.07)
Dropped out	0.01	0.07	0.00	0.07	-0.00***	(-5.52)
Recognises numbers one to nine or better	0.82	0.38	0.86	0.35	0.04***	(41.53)
Overall numeracy score	1.67	1.19	1.75	1.16	0.09***	(31.72)
Age standardised overall numeracy score	-0.02	1.05	0.07	0.94	0.09***	(38.98)
Reads letters or better	0.81	0.39	0.85	0.36	0.04***	(47.31)
Overall literacy score	1.81	1.36	1.94	1.33	0.13***	(41.43)
Age standardised literacy score	-0.02	1.08	0.09	0.95	0.11***	(45.98)
Grade	2.66	1.48	2.79	1.48	0.13***	(36.86)
In Private School	0.28	0.45	0.28	0.45	0.01***	(8.19)
Age	7.51	1.71	7.53	1.70	0.02***	(4.90)
Girl	0.46	0.50	0.46	0.50	-0.00	(-1.53)
Years of Maternal Education	3.76	4.41	4.09	4.48	0.33***	(32.83)
Kutcha House	0.41	0.49	0.33	0.47	-0.08***	(-75.02)
Pucca House	0.28	0.45	0.37	0.48	0.10***	(89.19)
Household Size	6.84	3.31	6.30	3.01	-0.53***	(-76.95)
Village has a government school	0.92	0.27	0.93	0.25	0.01***	(22.12)
Anganwadi in Village	0.90	0.29	0.95	0.21	0.05***	(78.04)
Access to Pucca Road in Village	0.70	0.46	0.82	0.39	0.12***	(123.62)
Ration Shop in Village	0.68	0.47	0.73	0.44	0.05***	(46.03)
Observations	534048		337490		871538	

Notes: This table reports the mean and standard deviations for children who were in early life during no nationwide iodisation policy, born in 2002-2004, in historically goitre endemic and non-endemic districts. The last two columns report the differences in the means for the endemic and non-endemic groups and corresponding t-statistics.

Table 2: Effect on basic skills

	Pooled				Girls				Boys			
Dependent variable is the probability of knowing basic:	(1) Numeracy	(2) Numeracy	(3) Literacy	(4) Literacy	(5) Numeracy	(6) Numeracy	(7) Literacy	(8) Literacy	(9) Numeracy	(10) Numeracy	(11) Literacy	(12) Literacy
Iodised * Endemic	0.014	0.026***	0.019**	0.030***	0.023**	0.034***	0.031***	0.040***	0.006	0.019*	0.009	0.022**
	(0.009)	(0.009)	(0.009)	(0.009)	(0.010)	(0.010)	(0.011)	(0.010)	(0.011)	(0.010)	(0.011)	(0.010)
Mother's education	0.010***	0.010***	0.011***	0.011***	0.010***	0.010***	0.012***	0.011***	0.010***	0.009***	0.011***	0.011***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Housing material: Semi-pucca	0.036***	0.034***	0.037***	0.034***	0.035***	0.033***	0.036***	0.033***	0.036***	0.035***	0.038***	0.035***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Housing material: Pucca	0.064***	0.062***	0.068***	0.064***	0.065***	0.063***	0.069***	0.065***	0.063***	0.061***	0.067***	0.063***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)	(0.003)	(0.003)	(0.002)	(0.002)	(0.002)	(0.002)
Household size	-0.000*	-0.000*	-0.001***	-0.001***	-0.000	-0.000	-0.001**	-0.001**	-0.000	-0.000*	-0.001***	-0.001**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Girl	2.814***	2.786***	-0.316	-0.828								
	(0.991)	(1.055)	(0.985)	(1.038)								
Gvt primary school in vlg		0.012***		0.018***		0.011***		0.017***		0.013***		0.020***
		(0.003)		(0.004)		(0.004)		(0.004)		(0.004)		(0.004)
Vlg has anganwadi		0.002		0.001		0.003		0.001		0.001		0.002
		(0.003)		(0.003)		(0.004)		(0.004)		(0.003)		(0.004)
Vlg is connected to a pucca road		0.011***		0.009***		0.011***		0.009***		0.010***		0.009***
		(0.002)		(0.002)		(0.002)		(0.002)		(0.002)		(0.002)
Vlg has ration shop		0.010***		0.011***		0.010***		0.010***		0.011***		0.011***
		(0.002)		(0.002)		(0.002)		(0.002)		(0.002)		(0.002)
Observations	824511	692890	828556	696175	384636	324064	386531	325576	439875	368826	442025	370599
R^2	0.843	0.855	0.832	0.842	0.841	0.852	0.831	0.841	0.846	0.857	0.833	0.843

Notes: This table reports the coefficients from Equation 2 using the ASER data merged with historical information on district level goitre endemicity. The outcome variables are the probability of knowing some numeracy (at least being able to recognise simple numbers) and literacy (at least being able to recognise letters) for children aged 5-10 for all states but Kerala. The subsample of analysis and the outcome variable is reported at the top of the table. The following fixed effects are included; year of birth, survey year, survey year*year of birth and linear district trends. Gender specific linear trends are included in the estimates for the pooled sample. Robust standard errors clustered on district are presented in parentheses. * $p < .10$, ** $p < .05$, *** $p < .01$

Table 3: Effect on age standardised overall test scores

Dependent variable is the Standard Deviation of the overall score in	Pooled (1) Numeracy	(2) Numeracy	(3) Literacy	(4) Literacy	Girls (5) Numeracy	(6) Numeracy	(7) Literacy	(8) Literacy	Boys (9) Numeracy	(10) Numeracy	(11) Literacy	(12) Literacy
Iodised * Endemic	0.009	0.013	0.041*	0.037*	0.026	0.019	0.078***	0.066**	-0.005	0.007	0.009	0.011
	(0.021)	(0.019)	(0.021)	(0.020)	(0.025)	(0.024)	(0.027)	(0.027)	(0.025)	(0.025)	(0.025)	(0.025)
Mother's education	0.043***	0.043***	0.043***	0.043***	0.044***	0.044***	0.044***	0.045***	0.042***	0.042***	0.041***	0.042***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Housing material: Semi-pucca	0.109***	0.107***	0.122***	0.120***	0.103***	0.101***	0.115***	0.114***	0.114***	0.113***	0.127***	0.124***
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.006)	(0.006)	(0.006)	(0.005)	(0.006)	(0.006)	(0.006)
Housing material: Pucca	0.242***	0.242***	0.245***	0.242***	0.238***	0.238***	0.248***	0.247***	0.245***	0.245***	0.242***	0.238***
	(0.006)	(0.006)	(0.006)	(0.006)	(0.007)	(0.007)	(0.007)	(0.007)	(0.006)	(0.006)	(0.006)	(0.007)
Household size	-0.001	-0.001*	-0.001	-0.001	-0.001*	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Girl	-5.667***	-8.500***	-4.038*	-4.601*								
	(2.105)	(2.332)	(2.217)	(2.470)								
Gvt primary school in vlg		0.045***		0.050***		0.050***		0.049***		0.041***		0.051***
		(0.010)		(0.011)		(0.012)		(0.012)		(0.012)		(0.012)
Vlg has anganwadi		0.004		0.006		0.006		0.006		0.003		0.007
		(0.009)		(0.009)		(0.009)		(0.010)		(0.010)		(0.010)
Vlg is connected to a pucca road		0.033***		0.032***		0.034***		0.031***		0.032***		0.034***
		(0.006)		(0.006)		(0.006)		(0.007)		(0.006)		(0.007)
Vlg has ration shop		0.041***		0.037***		0.039***		0.036***		0.043***		0.038***
		(0.005)		(0.005)		(0.006)		(0.006)		(0.006)		(0.006)
Observations	824511	692890	828556	696175	384636	324064	386531	325576	439875	368826	442025	370599
R^2	0.175	0.186	0.145	0.154	0.198	0.211	0.161	0.171	0.157	0.166	0.133	0.141

Notes: This table reports the coefficients from Equation 2 using the ASER data merged with historical information on district level goitre endemicity. The outcome variables are age-standardised overall numeracy and literacy scores for children aged 5-10 from all states but Kerala. The raw score is in the range of 0-4, where 0 denotes no numeracy or literacy ability and 4 denotes that the child can master reading a paragraph or do division, respectively. The subsample of analysis and the outcome variable is reported at the top of the table. The following fixed effects are included; year of birth, survey year, survey year*year of birth and linear district trends. Gender specific linear trends are included in the estimates for the pooled sample. Robust standard errors clustered on district are presented in parentheses. * $p < .10$, ** $p < .05$, *** $p < .01$

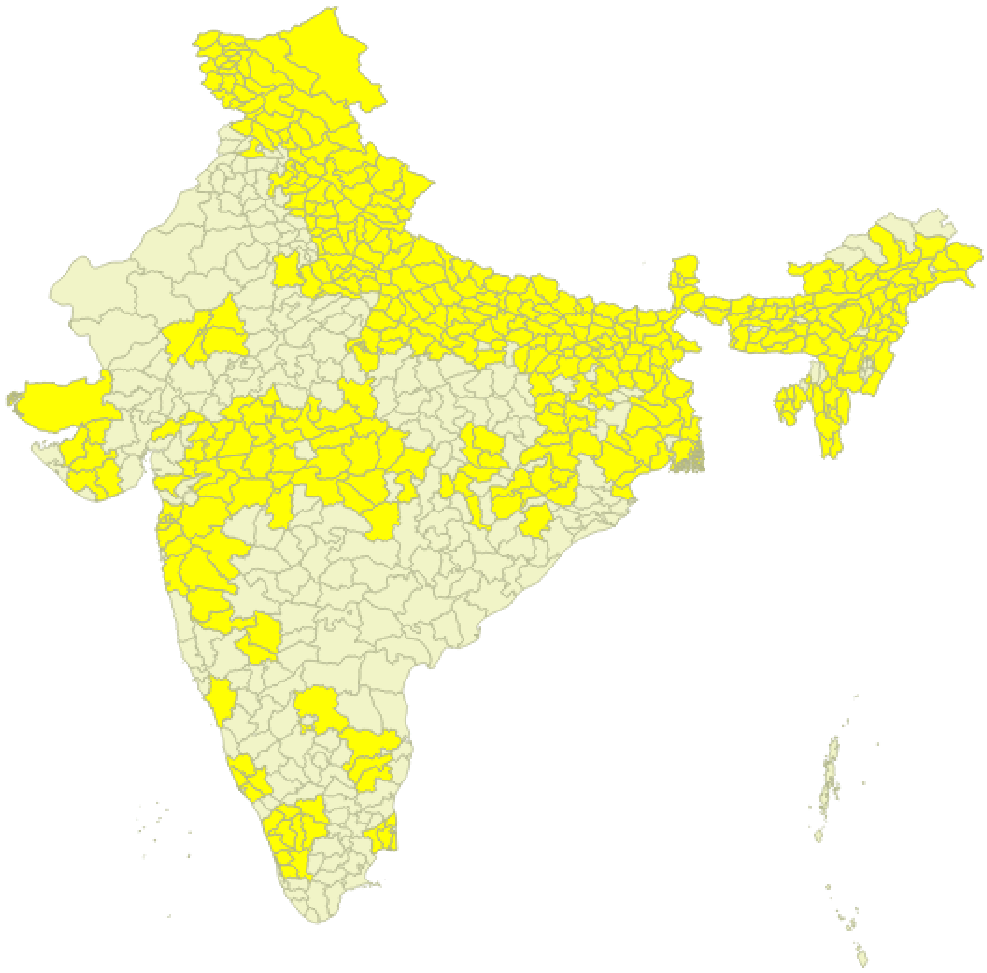
Table 4: Effect on raw overall test scores

	Pooled				Girls				Boys			
Dependent variable is the overall score in:	(1) Numeracy	(2) Numeracy	(3) Literacy	(4) Literacy	(5) Numeracy	(6) Numeracy	(7) Literacy	(8) Literacy	(9) Numeracy	(10) Numeracy	(11) Literacy	(12) Literacy
Iodised * Endemic	0.007	0.007	0.050*	0.038	0.028	0.017	0.094***	0.075**	-0.010	-0.003	0.010	0.006
	(0.022)	(0.021)	(0.026)	(0.025)	(0.027)	(0.026)	(0.033)	(0.032)	(0.027)	(0.026)	(0.029)	(0.030)
Mother's education	0.045***	0.046***	0.050***	0.051***	0.046***	0.047***	0.052***	0.053***	0.044***	0.044***	0.048***	0.049***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Housing material: Semi-pucca	0.114***	0.114***	0.142***	0.142***	0.109***	0.108***	0.135***	0.136***	0.118***	0.119***	0.148***	0.148***
	(0.005)	(0.005)	(0.006)	(0.006)	(0.006)	(0.006)	(0.007)	(0.008)	(0.006)	(0.006)	(0.006)	(0.007)
Housing material: Pucca	0.253***	0.256***	0.284***	0.285***	0.251***	0.253***	0.289***	0.291***	0.256***	0.258***	0.280***	0.279***
	(0.006)	(0.006)	(0.007)	(0.007)	(0.007)	(0.008)	(0.008)	(0.009)	(0.006)	(0.007)	(0.007)	(0.008)
Household size	-0.001*	-0.001*	-0.001*	-0.001	-0.001*	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Girl	-8.687***	-12.275***	-5.671**	-6.373**								
	(2.112)	(2.396)	(2.467)	(2.812)								
Gvt primary school in vlg		0.048***		0.057***		0.053***		0.056***		0.044***		0.058***
		(0.011)		(0.013)		(0.012)		(0.015)		(0.012)		(0.014)
Vlg has anganwadi		0.006		0.009		0.007		0.008		0.005		0.010
		(0.009)		(0.010)		(0.010)		(0.012)		(0.010)		(0.011)
Vlg is connected to a pucca road		0.034***		0.037***		0.035***		0.035***		0.033***		0.039***
		(0.006)		(0.007)		(0.007)		(0.008)		(0.007)		(0.008)
Vlg has ration shop		0.042***		0.043***		0.040***		0.042***		0.045***		0.044***
		(0.005)		(0.006)		(0.006)		(0.007)		(0.006)		(0.007)
Observations	824511	692890	828556	696175	384636	324064	386531	325576	439875	368826	442025	370599
R^2	0.773	0.782	0.755	0.763	0.771	0.781	0.756	0.764	0.774	0.784	0.754	0.762

Notes: This table reports the coefficients from Equation 2 using the ASER data merged with historical information on district level goitre endemicity. The outcome variables are the raw overall numeracy and literacy scores for children aged 5-10 from all states but Kerala. The score is in the range of 0-4, where 0 denotes no numeracy or literacy ability and 4 denotes that the child can master reading a paragraph or do division, respectively. The subsample of analysis and the outcome variable is reported at the top of the table. The following fixed effects are included; year of birth, survey year, survey year*year of birth and linear district trends. Gender specific linear trends are included in the estimates for the pooled sample. Robust standard errors clustered on district are presented in parentheses. * $p < .10$, ** $p < .05$, *** $p < .01$

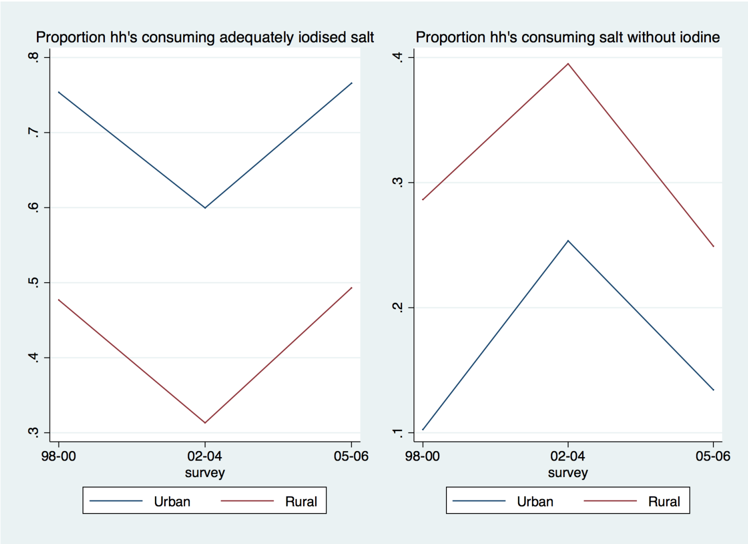
9 Figures

Figure 1: Pre-Fortification Goitre Endemic Districts



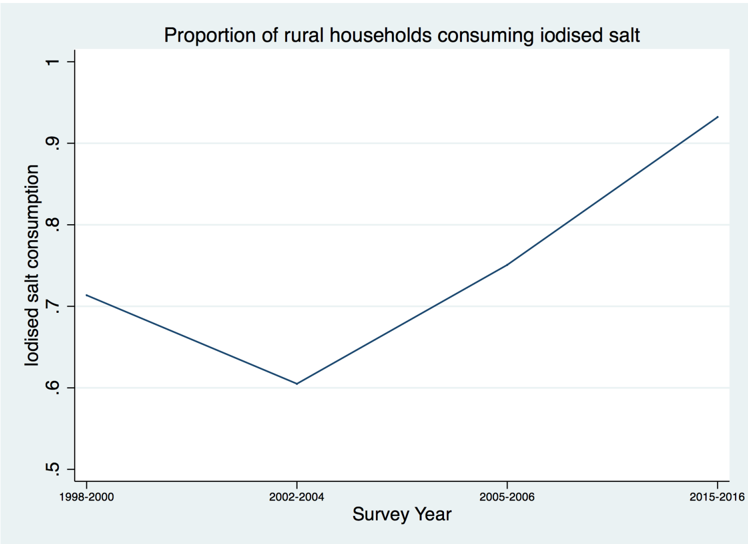
This figure shows the location of historical goitre endemicity of Indian districts as of 2001. The bright yellow areas represent districts that contained at least one area which was goitre endemic according to McCarrison (1915). These districts are deemed to be pre-fortification goitre endemic and the light yellow districts are non-endemic.

Figure 2: Nationwide consumption of adequately iodised salt and non-iodised salt over time



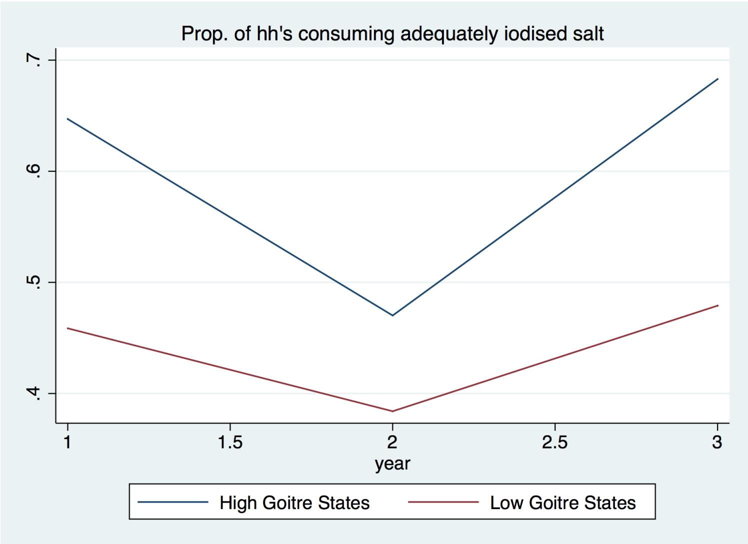
The figure depicts the trends in the proportion of urban and rural household who consume iodised and non-iodised salt. Survey 98-00 denotes the NFHS II which covers the years of 1998-2000. Survey 02-04 denotes the DLHS II of 2002-2004 and Survey 05-06 represents the NFHS III for years 2005-2006.

Figure 3: Nationwide consumption of iodised salt over time



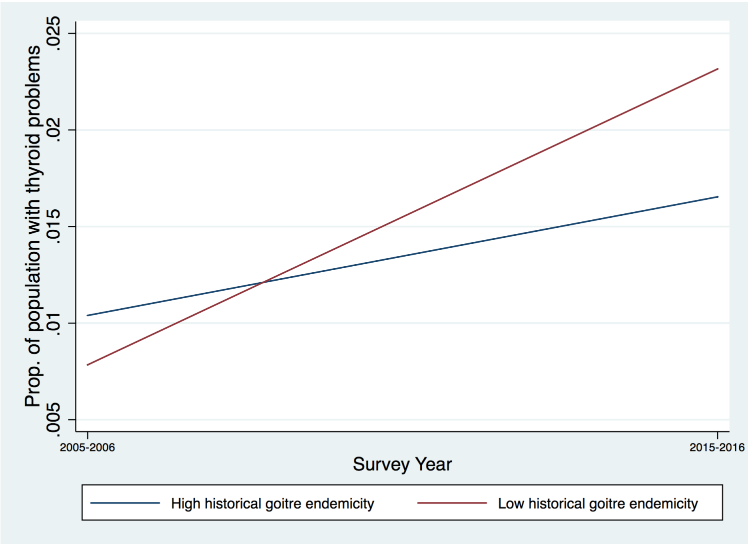
The figure depicts the trends in the proportion of rural household who consume iodised salt across all states. Survey 98-00 denotes the NFHS II which covers the years of 1998-2000. Survey 02-04 denotes the DLHS II of 2002-2004, Survey 05-06 represents the NFHS III for years 2005-2006 and the NFHS IV is used for 2015-2016.

Figure 4: Nationwide consumption of adequately iodised salt and non-iodised salt over time: Heterogeneous effects



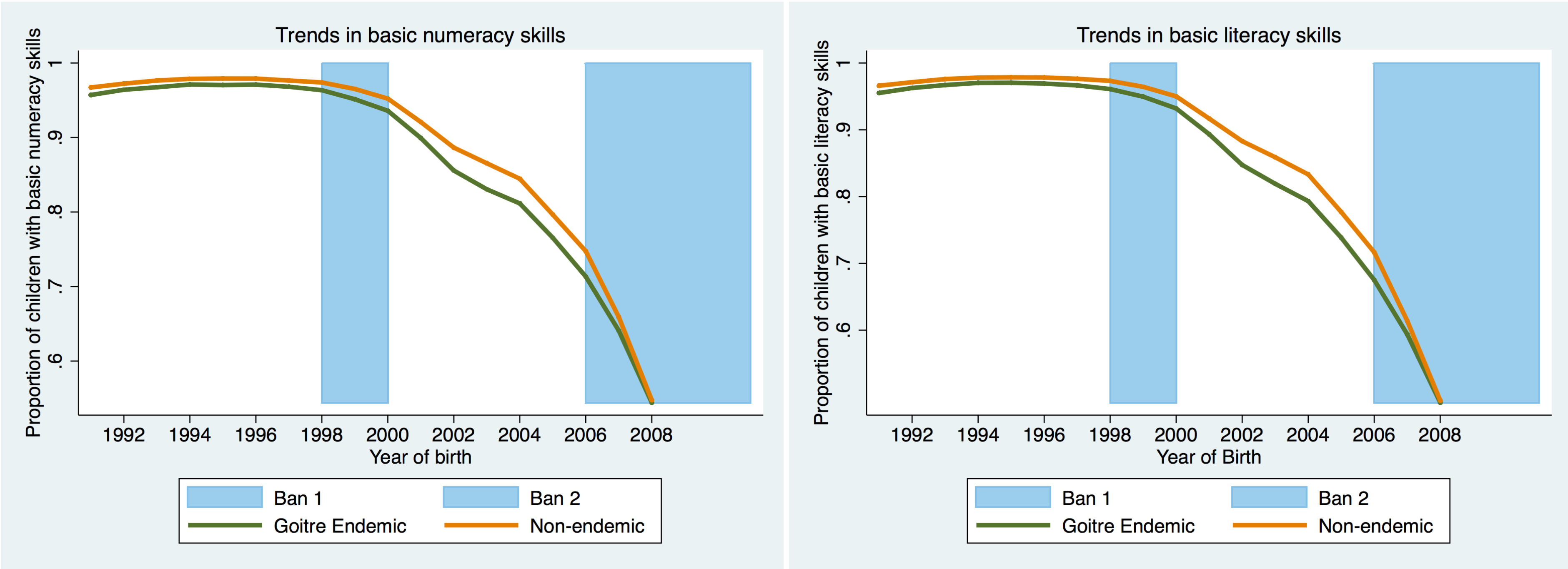
The figure depicts the trends in the proportion of rural household who consume iodised and non-iodised salt in; states near Gujarat and states with a nominee system and predominantly rail transportation of salt. Survey 98-00 denotes the NFHS II which covers the years of 1998-2000. Survey 02-04 denotes the DLHS II of 2002-2004 and Survey 05-06 represents the NFHS III for years 2005-2006.

Figure 5: Trends in thyroid related illnesses for states with high and low pre-fortification goitre



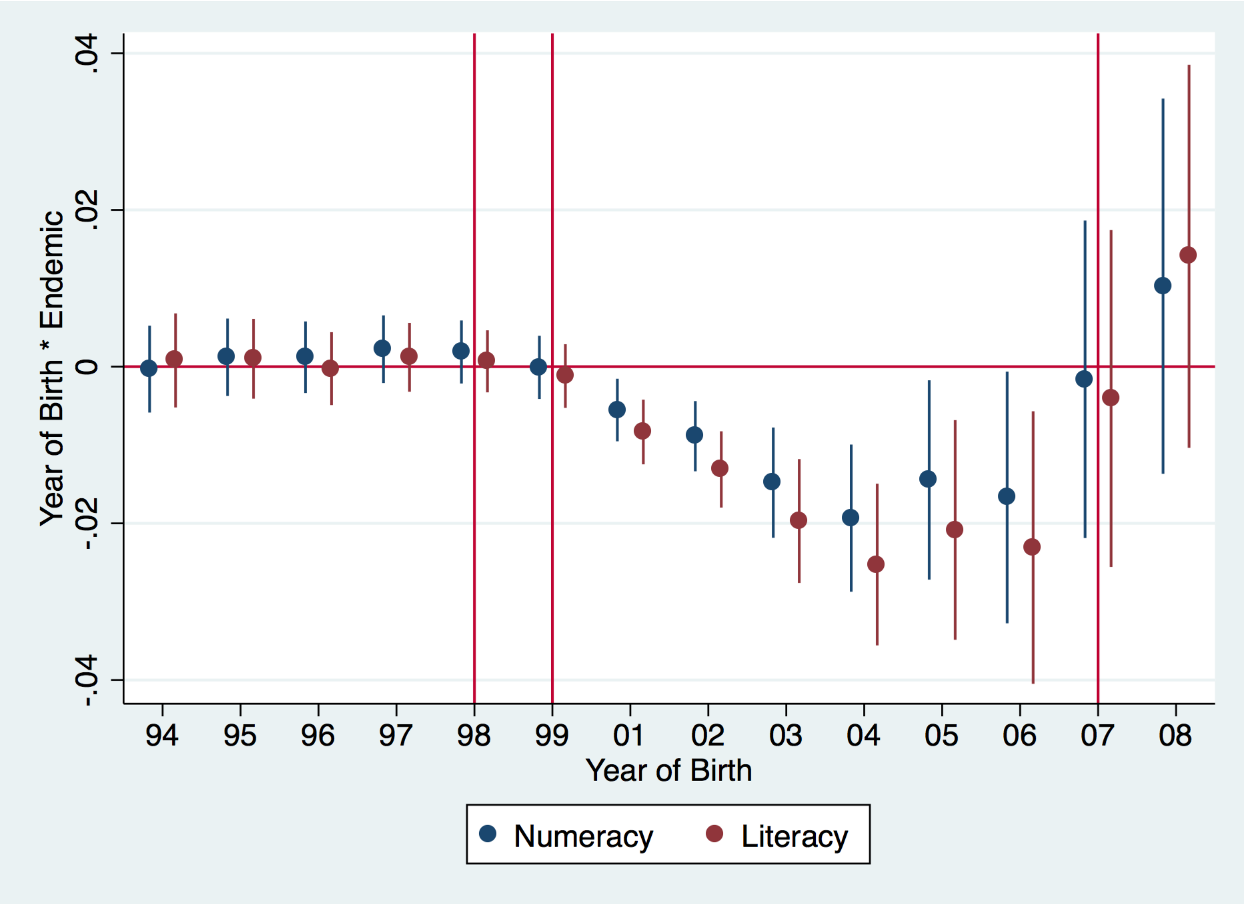
The figure depicts the trends in the proportion of rural household who have thyroid related health problems in states the number of areas with goitre endemicity being at or above the 75th percentile, compared to those at or below the 25th percentile. Survey year 2005-2006 denotes the NFHS III and Survey 2015-2016 denotes the NFHS IV.

Figure 6: Proportion of children with basic skills by birth year and goitre endemicity using the ASER data



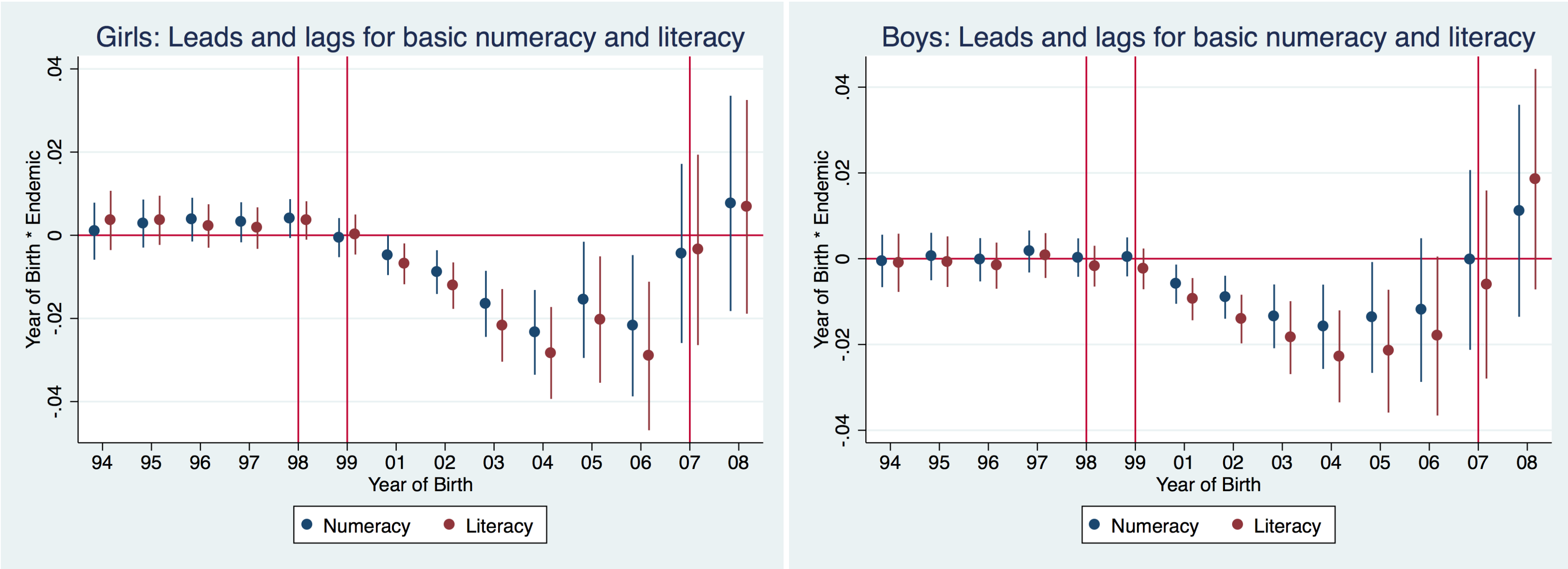
The figure depicts the proportion of children aged 5-16 in the ASER data who have mastered basic numeracy and literacy scores by birth year. The trends are given for children residing in pre-fortification goitre endemic and non-endemic districts. The blue areas represent the duration of a ban on non-iodised salt by birth year.

Figure 7: Leads and lags of birth year * endemicity



This graph plots the coefficients on birth year interacted with endemicity status of one's district of birth from Equation 1 omitting the inclusion of trends, using data from ASER. The reference category birth year is 2000. The y-axis shows the magnitude of the coefficients, the x-axis represents the birth year and the lines through the plotted coefficients are confidence intervals.

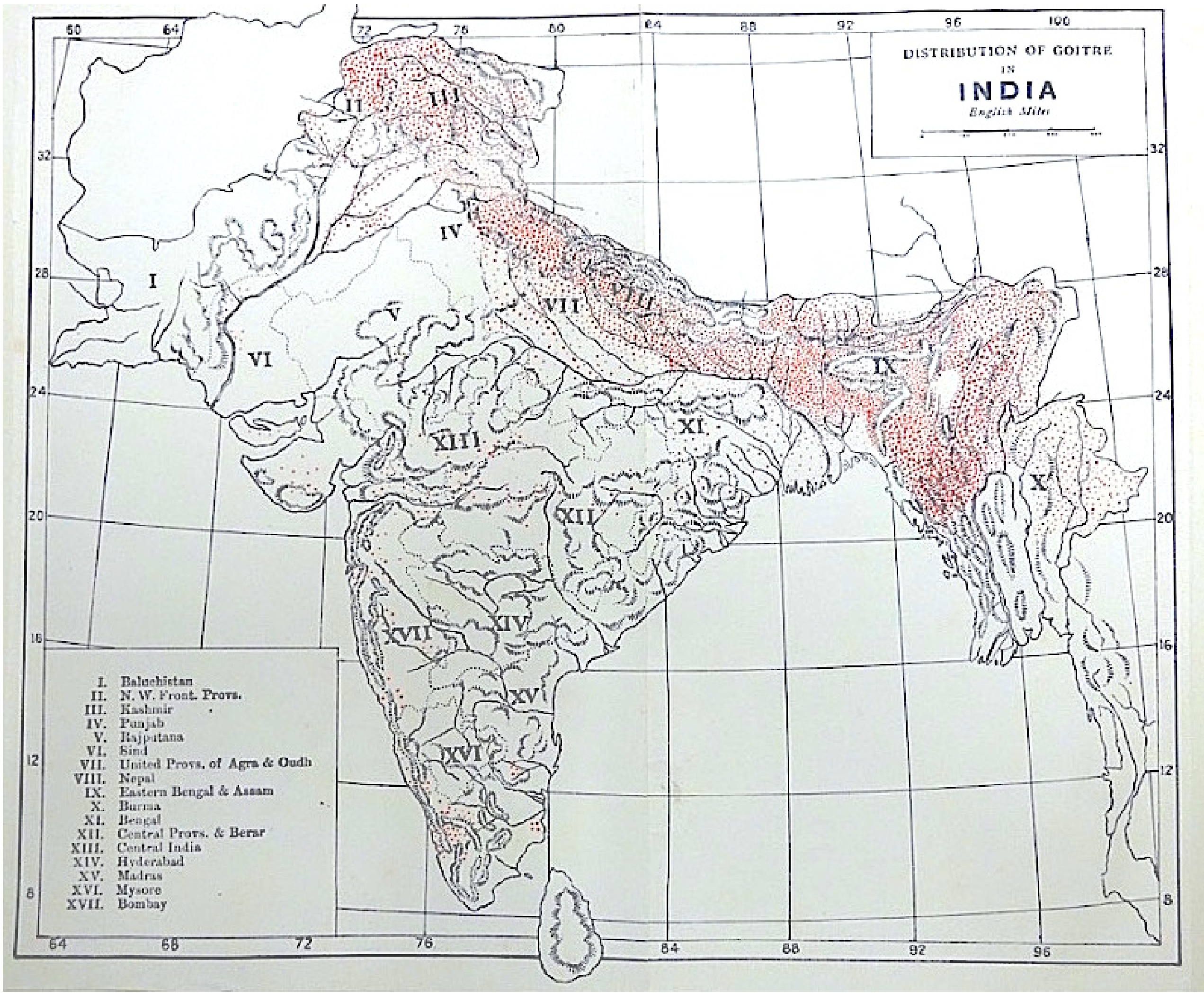
Figure 8: Leads and lags of birth year * endemicity



These graphs plot the coefficients on birth year interacted with endemicity status of one's district of birth from Equation 1 omitting the inclusion of trends, using data from ASER for boys and girls aged 5-16. The reference category birth year is 2000. The y-axis shows the magnitude of the coefficients, the x-axis represents the birth year and the lines through the plotted coefficients are confidence intervals.

A Appendix

Figure A.9: Location of Goitre Endemic Areas by McCarrisson (1915)



This figure shows the location of historical goitre endemicity as of McCarrison (1915). The dots represent areas which were found to be goitre endemic prior to 1915.

A.1 Data Appendix

A.1.1 ASER Data

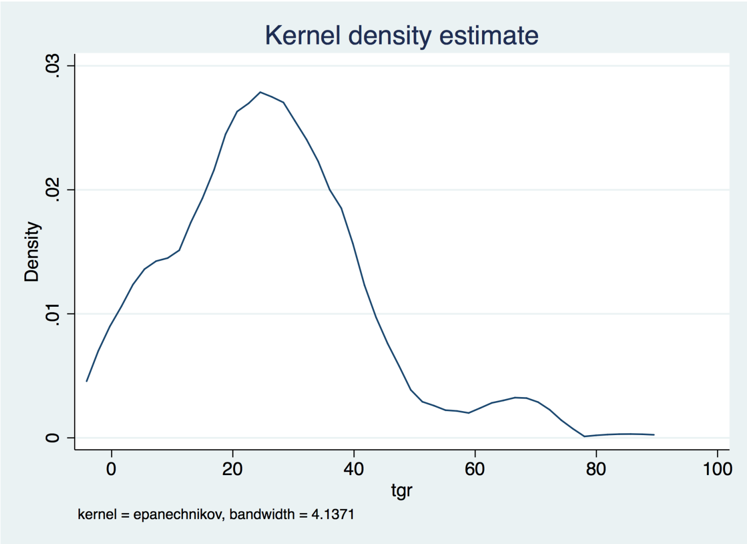
The enumerators conduct the survey on Sundays, when people generally do not work and children are not in school. The enumerators must return to households where children are not present at the time of the survey. The dataset consists of children who are currently enrolled in school, children who have dropped out and children who have never enrolled.

The reading assessment consists of 4 levels of mastery: letter recognition, word recognition, reading comprehension of a short paragraph (a class 1 level text), and a short story (a class 2 level text). Similarly, the math assessment consists of four levels: single-digit number recognition, double-digit number recognition, two-digit subtraction with carry over, and three digit by one digit division. For both tests separately, the child is marked at the highest level he or she can do with scores ranging from 0 to 4: a score of 0 means that the child can not do even the most basic level, a score of 4 means that he or she can do level 4 in the respective subject.

A.1.2 District Level Total Goitre Rate Data

Simple regressions of the probability of a district being surveyed, on McCarrisson's binary goitre endemicity indicator point to that severely goitrous districts were more likely to be sampled (see Table A.23 in the Appendix). Moreover, a negative and statistically significant relationship appears between the year of survey and the binary goitre. A similar association is found for survey year and TGR as well, see Table A.23. This indicates that more goitrous areas districts likely to be surveyed first and can potentially lead to an overestimation of goitre endemicity in severely endemic areas. 86.31% were goitre endemic according to the earlier definition of endemicity by the WHO used in the report of a cut-off of 10% (Aburto et al., 2014). The WHO revised the cut-offs for goitre endemicity in 1994. Mild endemicity corresponds to a prevalence of 5-19.9%, moderate to 20-29.90% and severe goitre endemicity to 30% or more (Aburto et al., 2014). Using the revised definitions, we observe that 24.33% of the surveyed school children in India prior to any policies on salt iodisation, had mild iodine deficiency, 27% were moderately iodine deficient and 36.50 % have severe iodine deficiency.

Figure A.10: Kernel density graph of goitre prevalence of school aged children per district prior to any bans on non-iodised salt.



A kernel density graph of TGR per district is shown in Figure A.10. One notes the high density of TGR in the range of 20-40%, indicating a high TGR in the sampled districts.

A.1.3 Descriptive Statistics of Surveys Containing Information on Iodised Salt

Summary statistics of household and village characteristics of non-iodised salt, salt with some iodine and adequately iodised salt are presented in Tables A.5, A.6 and A.7. We can observe a wealth gradient across all policy states in the consumption of adequately iodised salt. However some studies point to that wealth appear to influence the choice for a certain salt type in India rather than a conscious decision to buy iodised salt per (Wheeler and van der Haar, 2004).Unfortunately, only NFHS II includes information on the consumption of refined salt and not later surveys. However, we note that an important determinant of having adequately iodised salt at home in during the first ban is the purchasing of refined salt in comparison to coarse un-refined salt. What is further interesting is that household who consume salt with some iodine, are households who are worse off in terms of wealth, knowledge about aids (proxy for overall health knowledge), purifying water, haemoglobin levels and of bigger household size, during the bans. The unexpected effect of distance to nearest town or distance to nearest railway station might be due to the fact that there is more competition in salt suppliers in larger urban markets.

Table A.5: Descriptive Statistics NFHS II: First ban, 1998-2000

	Non-iodised	Inadequately Iodised	Adequately Iodised
Refined Salt	0.15	0.24	0.68
Quintiles of Wealth Index	2.44	2.36	3.06
Max. years of education in household	6.79	6.62	8.16
Number of children aged 5 and under in household	0.94	0.98	0.90
Has ever heard of AIDS	0.29	0.25	0.38
Female household head	0.11	0.09	0.10
Purify Water	0.26	0.22	0.35
Household Size	6.40	6.53	6.45
Kutcha	0.39	0.44	0.36
Semi-Pucca	0.42	0.40	0.40
Pucca	0.19	0.16	0.24
Owns Tv	0.17	0.17	0.33
Owns Radio	0.31	0.32	0.41
Owns Telephone	0.02	0.01	0.05
Currently Pregnant	0.08	0.08	0.08
Haemoglobin Level (g/dl - 1 decimal)	115.76	114.96	117.29
Eats meat/fish	0.65	0.74	0.66
Hindu	0.85	0.80	0.75
Muslim	0.08	0.12	0.10
Christian	0.04	0.06	0.07
Scheduled Caste	0.29	0.30	0.27
Scheduled Tribe	0.20	0.22	0.28
Other Backward Caste	0.51	0.48	0.44
Distance to nearest town (km)	15.04	15.82	15.03
Distance to nearest railway station (km)	28.11	31.81	34.47
Distance to transport service (km)	14.92	13.67	13.66
Observations	20951	17277	34576

Notes: This table uses the 1998-2000 NFHS II data to report the means of household characteristics by differences in iodised salt consumption; non-iodised salt, inadequately iodised salt ($\leq$15 μg iodine/g salt) and adequately iodised salt ($\geq$15μg iodine/g salt).

Table A.6: Descriptive Statistics DLHS II: Absence of ban 2002-2004

	Non-iodised	Inadequately Iodised	Adequately Iodised
Tertiles of Wealth Index	1.38	1.42	1.79
Max. years of education in household	8.40	8.68	9.85
Has ever heard of AIDS	0.35	0.37	0.59
Female household head	0.09	0.08	0.08
Household Size	6.17	6.24	6.05
Kutcha	0.46	0.49	0.38
Semi-Pucca	0.39	0.36	0.36
Pucca	0.25	0.24	0.41
Owns TV	0.22	0.25	0.46
Owns Radio	0.25	0.32	0.41
Owns Telephone	0.05	0.07	0.18
Hindu	0.87	0.77	0.70
Muslim	0.08	0.12	0.09
Christian	0.03	0.07	0.10
Scheduled Caste	0.21	0.19	0.15
Scheduled Tribe	0.16	0.19	0.22
Other Backward Caste	0.43	0.38	0.31
Distance to nearest town (km)	15.34	16.90	18.42
Distance to nearest railway station (km)	41.70	65.26	71.26
Observations	174869	128229	136708

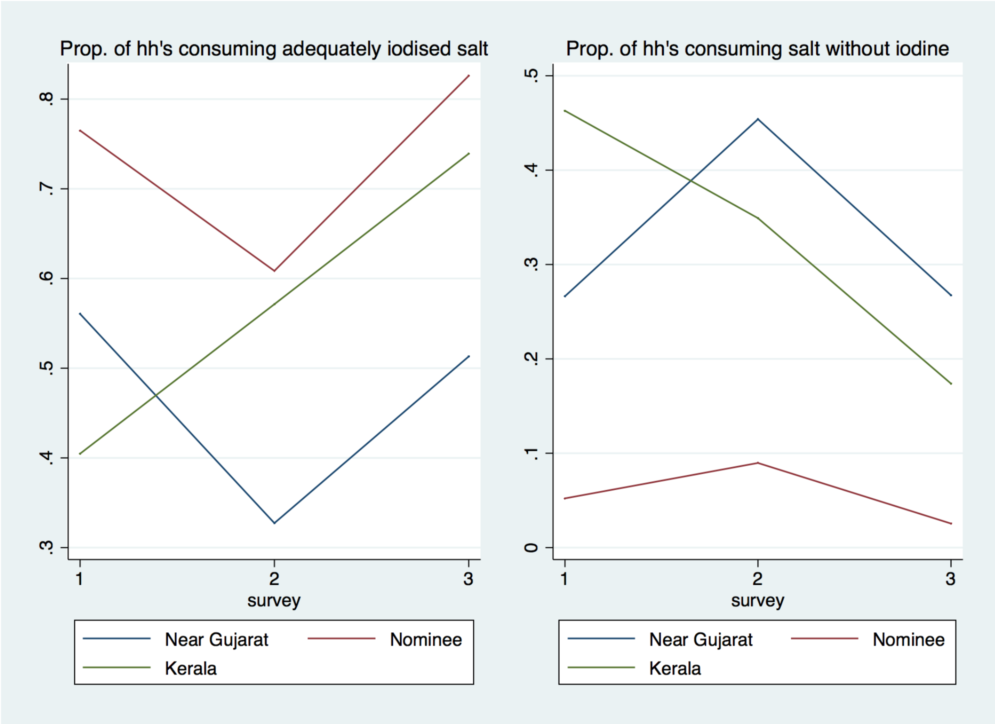
Notes: This table uses the 2002-2004 DLHS II data to report the means of household characteristics by differences in iodised salt consumption; non-iodised salt, inadequately iodised salt ($\leq$15 μg iodine/g salt) and adequately iodised salt ($\geq$15μg iodine/g salt).

Table A.7: Descriptive Statistics NFHS III: Second Ban 2005-2006

	Non-iodised	Inadequately Iodised	Adequately Iodised
Quintiles of Wealth index	2.41	2.39	3.18
Max. years of education in household	7.26	7.26	9.06
Number of children aged 5 and under in household	0.69	0.77	0.65
Has ever heard of AIDS	0.48	0.47	0.68
Female household head	0.13	0.14	0.15
Purify Water	0.30	0.27	0.45
Household Size	5.70	5.94	5.70
Kutcha	0.18	0.21	0.13
Semi-Pucca	0.54	0.55	0.49
Pucca	0.28	0.24	0.38
Owns TV	0.31	0.29	0.49
Owns Radio	0.26	0.28	0.39
Owns Telephone	0.07	0.06	0.18
Wealth Index	2.41	2.39	3.18
Currently Pregnant	0.06	0.06	0.05
Hemoglobin Level (g/dl - 1 decimal)	115.00	114.64	116.85
Eats meat/fish	0.54	0.64	0.65
Hindu	0.86	0.78	0.67
Muslim	0.08	0.11	0.12
Christian	0.03	0.07	0.14
Scheduled Caste	0.20	0.20	0.15
Scheduled Tribe	0.15	0.17	0.21
Other Backward Caste	0.42	0.39	0.30
Observations	19006	19837	38823

Notes: This table uses the 2005-2006 NFHS III data to report the means of household characteristics by differences in iodised salt consumption; non-iodised salt, inadequately iodised salt (≤ 15 μg iodine/g salt) and adequately iodised salt ($\geq 15 \mu$g iodine/g salt).

Figure A.11: Consumption of Iodised Salt Over Time



The figure depicts the trends in the proportion of rural household who consume iodised and non-iodised salt in; states near Gujarat, states with a nominee system and predominantly rail transportation of salt and in Kerala. Survey 1 denotes the NFHS II which covers the years of 1998-2000. Survey 2 denotes the DLHS II of 2002-2004 and Survey 3 represents the NFHS III for years 2005-2006.

Table A.8: Effect on basic skills by standardised son preference

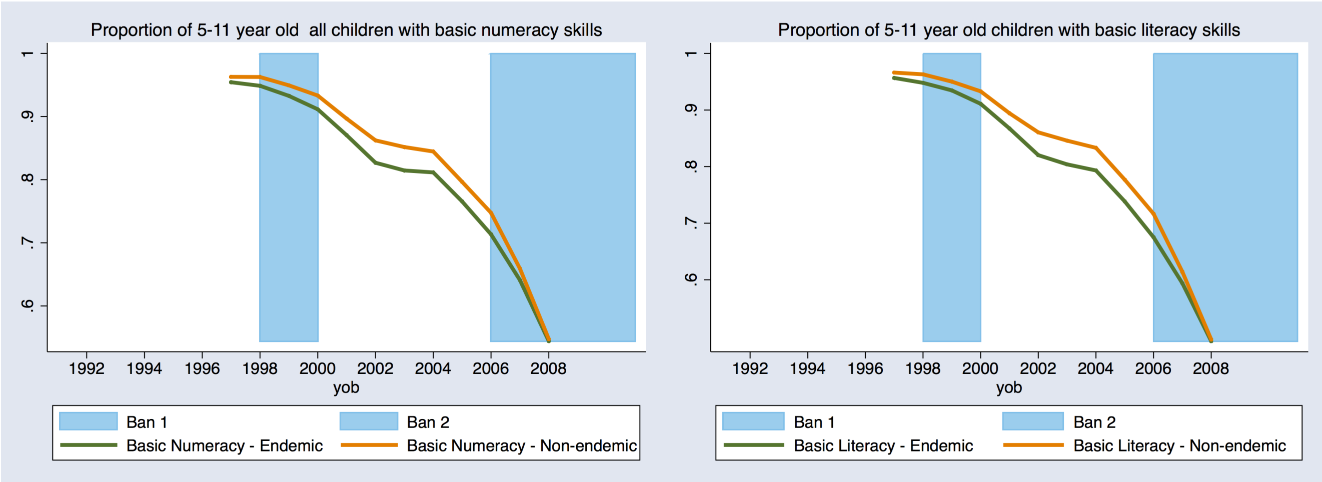
	Pooled				Girls				Boys			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Dependent variable is the probability of knowing basic:	Numeracy	Numeracy	Literacy	Literacy	Numeracy	Numeracy	Literacy	Literacy	Numeracy	Numeracy	Literacy	Literacy
Sex Ratio* Iodised * Endemic	-0.005	-0.012*	0.002	-0.006	-0.003	-0.008	0.004	0.001	-0.006	-0.015**	-0.000	-0.011
	(0.007)	(0.007)	(0.007)	(0.007)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)
Iodised * Endemic	0.016*	0.027***	0.019**	0.030***	0.023**	0.033***	0.030***	0.038***	0.009	0.021**	0.009	0.022**
	(0.009)	(0.009)	(0.009)	(0.009)	(0.010)	(0.010)	(0.011)	(0.010)	(0.011)	(0.010)	(0.011)	(0.010)
Mother's education	0.010***	0.010***	0.011***	0.011***	0.010***	0.010***	0.012***	0.011***	0.010***	0.009***	0.011***	0.011***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Housing material: Semi-pucca	0.036***	0.034***	0.037***	0.034***	0.036***	0.033***	0.036***	0.033***	0.036***	0.034***	0.038***	0.035***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Housing material: Pucca	0.064***	0.062***	0.068***	0.064***	0.065***	0.062***	0.069***	0.065***	0.063***	0.061***	0.067***	0.063***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)	(0.003)	(0.003)	(0.002)	(0.002)	(0.002)	(0.002)
Household size	-0.000*	-0.000*	-0.001***	-0.001***	-0.000	-0.000	-0.001**	-0.001**	-0.000	-0.000*	-0.001***	-0.001**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Girl	2.908***	2.820***	-0.190	-0.745								
	(0.997)	(1.063)	(0.995)	(1.049)								
Gvt primary school in vlg		0.012***		0.018***		0.011***		0.017***		0.012***		0.019***
		(0.004)		(0.004)		(0.004)		(0.004)		(0.004)		(0.004)
Vlg has anganwadi		0.003		0.002		0.004		0.002		0.002		0.002
		(0.003)		(0.003)		(0.004)		(0.004)		(0.003)		(0.004)
Vlg is connected to a pucca road		0.011***		0.009***		0.011***		0.009***		0.010***		0.009***
		(0.002)		(0.002)		(0.002)		(0.002)		(0.002)		(0.002)
Vlg has ration shop		0.010***		0.010***		0.010***		0.010***		0.010***		0.011***
		(0.002)		(0.002)		(0.002)		(0.002)		(0.002)		(0.002)
Observations	809296	680194	813246	683395	377336	317906	379174	319366	431960	362288	434072	364029
R^2	0.842	0.854	0.831	0.841	0.840	0.851	0.830	0.840	0.845	0.857	0.832	0.843

Notes: This table reports the coefficients from a similar specification as in Equation 2, but the treatment variable is now interacted with son preference per district. I use the ASER data merged with historical information on district level goitre endemicity and standardised sex-ratios per district. The sex ratio data stems from the Indian census of 2001 and represents the number of girls to 1000 boys aged 0-6 years. The independent variable of interest is the interaction term between benefiting from iodine fortification and one's sex ratio per district. The outcome variables are the probability of knowing some numeracy (at least being able to recognise simple numbers) and literacy (at least being able to recognise letters) for children aged 5-10 for all states but Kerala. The subsample of analysis and the outcome variable is reported at the top of the table. The following fixed effects are included; year of birth, survey year, survey year*year of birth and linear district trends. Gender specific linear trends are included in the estimates for the pooled sample. Robust standard errors clustered on district are presented in parentheses. * $p < .10$, ** $p < .05$, *** $p < .01$

Figure A.12: Test Scores for Pooled Sample of 5-10 year olds.

(a) Prop of children with basic numeracy skills

(b) Prop of children with basic literacy skills

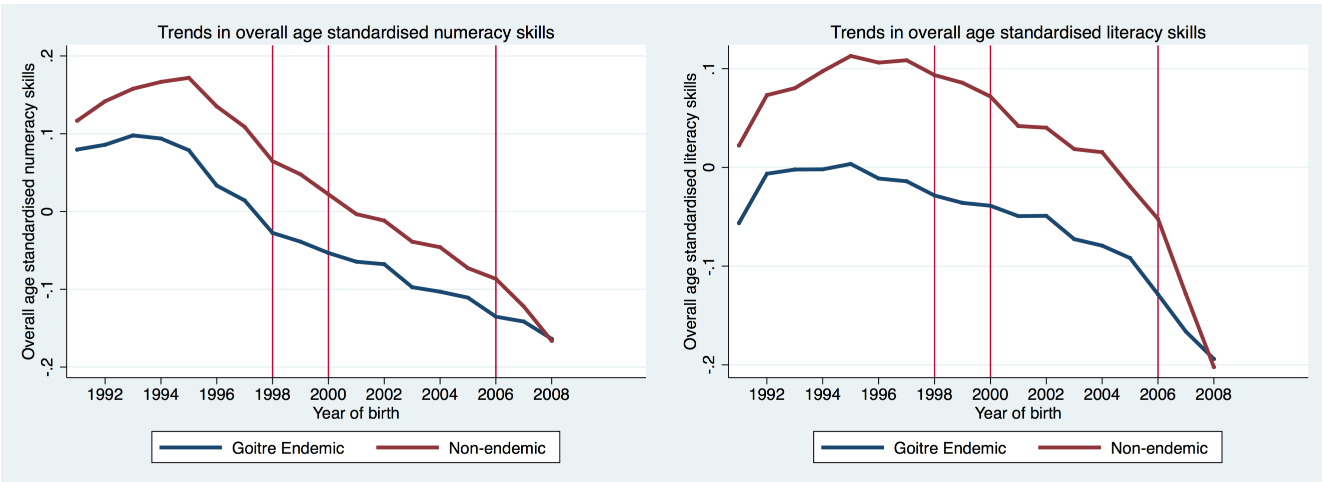


The figure depicts the proportion of children aged 5-10 in the ASER data who have mastered basic numeracy and literacy scores by birth year. The trends are given for children residing in pre-fortification goitre endemic and non-endemic districts. The blue areas represent the duration of a ban on non-iodised salt by birth year.

Figure A.13: Test Scores for Pooled Sample of 5-10 year olds.

(a) Prop of children with basic numeracy skills

(b) Prop of children with basic literacy skills



The figure depicts the proportion of children aged 5-10 in the ASER data who have mastered basic numeracy and literacy scores by birth year. The trends are given for children residing in pre-fortification goitre endemic and non-endemic districts. The blue areas represent the duration of a ban on non-iodised salt by birth year.

Table A.9: Effect on grade progression in primary school

	Pooled		Girls		Boys	
	(1)	(2)	(3)	(4)	(5)	(6)
Iodised * Endemic	0.042**	0.008	0.041*	0.010	0.042**	0.006
	(0.016)	(0.017)	(0.021)	(0.022)	(0.020)	(0.021)
Mother's education	0.005***	0.006***	0.006***	0.007***	0.004***	0.005***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Housing material: Semi-pucca	0.043***	0.044***	0.042***	0.043***	0.043***	0.045***
	(0.005)	(0.005)	(0.006)	(0.006)	(0.005)	(0.006)
Housing material: Pucca	0.043***	0.040***	0.048***	0.048***	0.037***	0.033***
	(0.005)	(0.006)	(0.006)	(0.007)	(0.006)	(0.006)
Household size	-0.003***	-0.003***	-0.002***	-0.002***	-0.004***	-0.004***
	(0.000)	(0.000)	(0.001)	(0.001)	(0.001)	(0.001)
Girl	8.011***	11.720***				
	(2.034)	(2.222)				
Gvt primary school in vlg		0.042***		0.046***		0.038***
		(0.011)		(0.012)		(0.012)
Vlg has anganwadi		-0.010		-0.010		-0.010
		(0.009)		(0.010)		(0.010)
Vlg is connected to a pucca road		0.006		0.010*		0.002
		(0.005)		(0.006)		(0.006)
Vlg has ration shop		0.008*		0.011*		0.005
		(0.005)		(0.006)		(0.005)
Observations	881444	762618	412454	357786	468990	404832
R^2	0.934	0.935	0.937	0.938	0.931	0.932

Notes: This table reports the coefficients from Equation 2 using the ASER data merged with historical information on district level goitre endemicity. The outcome variable is the primary school class attended by a child aged 5-10 from all states except Kerala, using the ASER data. The subsample of analysis and the outcome variable is reported at the top of the table. The following fixed effects are included; year of birth, survey year, survey year*year of birth and linear district trends. Gender specific linear trends are included in the estimates for the pooled sample. Robust standard errors clustered on district are presented in parentheses. * $p < .10$, ** $p < .05$, *** $p < .01$

Table A.10: Effect on enrolment and dropout

	Pooled				Girls				Boys			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	Enrolled	Enrolled	Dropped out	Dropped out	Enrolled	Enrolled	Dropped out	Dropped out	Enrolled	Enrolled	Dropped out	Dropped out
Iodised* Endemic	-0.001	0.002	-0.001	-0.002*	-0.003	0.000	-0.002	-0.002	0.000	0.003	-0.001	-0.001
	(0.002)	(0.002)	(0.001)	(0.001)	(0.002)	(0.002)	(0.001)	(0.002)	(0.002)	(0.002)	(0.001)	(0.001)
Mother's education	0.001***	0.001***	-0.000***	-0.000***	0.001***	0.001***	-0.000***	-0.000***	0.001***	0.001***	-0.000***	-0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Housing material: Semi-pucca	0.006***	0.006***	-0.002***	-0.002***	0.007***	0.006***	-0.002***	-0.002***	0.005***	0.005***	-0.002***	-0.002***
	(0.001)	(0.001)	(0.000)	(0.000)	(0.001)	(0.001)	(0.000)	(0.000)	(0.001)	(0.001)	(0.000)	(0.000)
Housing material: Pucca	0.008***	0.008***	-0.003***	-0.003***	0.009***	0.008***	-0.003***	-0.003***	0.007***	0.007***	-0.003***	-0.003***
	(0.001)	(0.001)	(0.000)	(0.000)	(0.001)	(0.001)	(0.000)	(0.000)	(0.001)	(0.001)	(0.000)	(0.000)
Household size	-0.000***	-0.000***	-0.000	-0.000	-0.000*	-0.000**	-0.000	-0.000*	-0.000**	-0.000***	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Girl	-1.088***	-1.252***	0.162	0.272**								
	(0.213)	(0.226)	(0.110)	(0.125)								
Gvt primary school in vlg		0.005***		-0.001*		0.005***		-0.000		0.005***		-0.001**
		(0.001)		(0.000)		(0.001)		(0.001)		(0.001)		(0.001)
Vlg has anganwadi		0.004***		-0.001*		0.005***		-0.002**		0.003***		-0.000
		(0.001)		(0.001)		(0.001)		(0.001)		(0.001)		(0.001)
Vlg is connected to a pucca road		0.001***		-0.000		0.001**		-0.000		0.001**		-0.000
		(0.000)		(0.000)		(0.001)		(0.000)		(0.001)		(0.000)
Vlg has ration shop		0.000		-0.001***		0.000		-0.001***		-0.000		-0.000*
		(0.000)		(0.000)		(0.001)		(0.000)		(0.001)		(0.000)
Observations	1045467	852979	1045467	852979	486657	397679	486657	397679	558810	455300	558810	455300
R^2	0.988	0.989	0.014	0.015	0.987	0.987	0.015	0.017	0.989	0.990	0.013	0.014

Notes: This table reports the coefficients from Equation 2 using the ASER data merged with historical information on district level goitre endemicity. The outcome variables are the probability of ever having enrolled in primary school and ever having dropped out of school, for children aged 5-10 for all states but Kerala. The subsample of analysis and the outcome variable is reported at the top of the table. The following fixed effects are included; year of birth, survey year, survey year*year of birth and linear district trends. Gender specific linear trends are included in the estimates for the pooled sample. Robust standard errors clustered on district are presented in parentheses. * $p < .10$, ** $p < .05$, *** $p < .01$

Table A.11: Effect on private school enrolment

	Pooled		Girls		Boys	
	(1)	(2)	(3)	(4)	(5)	(6)
Iodised * Endemic	-0.010	-0.005	-0.008	-0.002	-0.012	-0.007
	(0.007)	(0.007)	(0.009)	(0.009)	(0.009)	(0.009)
Mother's education	0.024***	0.024***	0.024***	0.024***	0.024***	0.023***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Housing material: Semi-pucca	0.048***	0.044***	0.042***	0.038***	0.053***	0.050***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Housing material: Pucca	0.160***	0.158***	0.151***	0.148***	0.167***	0.166***
	(0.004)	(0.004)	(0.005)	(0.005)	(0.004)	(0.004)
Household size	0.003***	0.003***	0.002***	0.002***	0.004***	0.004***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Girl	3.178***	2.194*				
	(1.074)	(1.138)				
Gvt primary school in vlg		-0.069***		-0.069***		-0.068***
		(0.007)		(0.007)		(0.007)
Vlg has anganwadi		0.007*		0.006		0.008*
		(0.004)		(0.004)		(0.005)
Vlg is connected to a pucca road		0.033***		0.033***		0.032***
		(0.003)		(0.003)		(0.003)
Vlg has ration shop		0.038***		0.034***		0.042***
		(0.003)		(0.003)		(0.003)
Observations	829887	707469	385724	329611	444163	377858
R^2	0.468	0.476	0.440	0.446	0.489	0.498

Notes: This table reports the coefficients from Equation 2 using the ASER data merged with historical information on district level goitre endemicity. The outcome variable is the probability of being enrolled in a private school, compared to a public school or a madrasa (islamic school), for children aged 5-10 for all states but Kerala. The subsample of analysis and the outcome variable is reported at the top of the table. The following fixed effects are included; year of birth, survey year, survey year*year of birth and linear district trends. Gender specific linear trends are included in the estimates for the pooled sample. Robust standard errors clustered on district are presented in parentheses. * $p < .10$, ** $p < .05$, *** $p < .01$

Table A.12: Effect on taking paid tuition

	Pooled		Girls		Boys	
	(1)	(2)	(3)	(4)	(5)	(6)
Iodised * Endemic	0.002	0.001	-0.005	-0.003	0.008	0.005
	(0.005)	(0.006)	(0.007)	(0.007)	(0.008)	(0.008)
Mother's education	0.011***	0.010***	0.011***	0.010***	0.011***	0.011***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Housing material: Semi-pucca	0.035***	0.033***	0.032***	0.030***	0.037***	0.036***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Housing material: Pucca	0.079***	0.076***	0.074***	0.071***	0.083***	0.080***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Household size	-0.000	-0.000	-0.000	-0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Girl	-1.246	-0.945				
	(0.894)	(0.920)				
Gvt primary school in vlg		0.001		0.001		0.001
		(0.004)		(0.004)		(0.004)
Vlg has anganwadi		0.006*		0.008*		0.005
		(0.004)		(0.004)		(0.004)
Vlg is connected to a pucca road		0.022***		0.021***		0.022***
		(0.002)		(0.002)		(0.002)
Vlg has ration shop		0.020***		0.018***		0.022***
		(0.002)		(0.002)		(0.002)
Observations	750195	694202	348375	322578	401820	371624
R^2	0.349	0.349	0.341	0.341	0.356	0.356

Notes: This table reports the coefficients from Equation 2 using the ASER data merged with historical information on district level goitre endemicity. The outcome variable is the probability of taking paid tuition (tutoring outside of school), for children aged 5-10 for all states but Kerala. The subsample of analysis and the outcome variable is reported at the top of the table. The following fixed effects are included; year of birth, survey year, survey year*year of birth and linear district trends. Gender specific linear trends are included in the estimates for the pooled sample. Robust standard errors clustered on district are presented in parentheses. * $p < .10$, ** $p < .05$, *** $p < .01$

Table A.13: Effect of being in early life during the ban of 1998 on basic numeracy skills.

	Pooled				Girls				Boys			
Dependent variable is the probability of knowing basic:	(1) Numeracy	(2) Numeracy	(3) Literacy	(4) Literacy	(5) Numeracy	(6) Numeracy	(7) Literacy	(8) Literacy	(9) Numeracy	(10) Numeracy	(11) Literacy	(12) Literacy
Iodised (First Ban) * Endemic	0.010*	0.004	0.012**	0.007	0.004	-0.002	0.004	0.016**	0.016**	0.010*	0.019***	0.012**
	(0.006)	(0.005)	(0.006)	(0.005)	(0.007)	(0.006)	(0.007)	(0.007)	(0.007)	(0.006)	(0.007)	(0.006)
Mother's education	0.007***	0.006***	0.008***	0.007***	0.007***	0.007***	0.008***	0.007***	0.007***	0.006***	0.007***	0.007***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Housing material: Semi-pucca	0.032***	0.030***	0.033***	0.031***	0.032***	0.030***	0.032***	0.032***	0.032***	0.030***	0.033***	0.031***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Housing material: Pucca	0.049***	0.047***	0.052***	0.050***	0.050***	0.049***	0.054***	0.047***	0.047***	0.046***	0.051***	0.048***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Household size	-0.001***	-0.001***	-0.001***	-0.001***	-0.001***	-0.001***	-0.001***	-0.001***	-0.001***	-0.001***	-0.001***	-0.001***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Girl	2.793***	4.182***	1.904***	2.566***								
	(0.706)	(0.826)	(0.725)	(0.847)								
Gvt primary school in vlg		0.010***		0.013***		0.009***				0.010***		0.013***
		(0.003)		(0.003)		(0.004)				(0.003)		(0.004)
Vlg has anganwadi		0.005*		0.005*		0.006*				0.005		0.005
		(0.003)		(0.003)		(0.003)				(0.003)		(0.004)
Vlg is connected to a pucca road		0.008***		0.006***		0.009***				0.008***		0.006***
		(0.002)		(0.002)		(0.002)				(0.002)		(0.002)
Vlg has rationshop		0.009***		0.009***		0.010***				0.009***		0.009***
		(0.002)		(0.002)		(0.002)				(0.002)		(0.002)
Observations	921536	684955	926392	688812	426196	317515	428460	495340	495340	367440	497932	369521
R^2	0.895	0.905	0.888	0.897	0.892	0.902	0.886	0.898	0.898	0.908	0.890	0.899

This table reports the coefficients from Equation 2 but now the treatment of interest is based on children who were exposed to the initial ban of 1998-2000. Iodised thus captures cohorts who were born in 1999 - 2000. The data used for the analysis is the ASER data merged with historical information on district level goitre endemicity. The outcome variables are the probability of knowing some numeracy (at least being able to recognise simple numbers) and literacy (at least being able to recognise letters) for children aged 5-10 for all states but Kerala. The subsample of analysis and the outcome variable is reported at the top of the table. The following fixed effects are included; year of birth, survey year, survey year*year of birth and linear district trends. Gender specific linear trends are included in the estimates for the pooled sample. Robust standard errors clustered on district are presented in parentheses. * $p < .10$, ** $p < .05$, *** $p < .01$

Table A.14: Effect of being in early life during the bans implemented in 1998 or 2006 on basic numeracy skills.

	Pooled				Girls				Boys			
Dependent variable is the probability of knowing basic:	(1) Numeracy	(2) Numeracy	(3) Literacy	(4) Literacy	(5) Numeracy	(6) Numeracy	(7) Literacy	(8) Literacy	(9) Numeracy	(10) Numeracy	(11) Literacy	(12) Literacy
Iodised (Both Bans) * Endemic	0.016***	0.017***	0.019***	0.021***	0.017***	0.018***	0.020***	0.022***	0.015***	0.017***	0.019***	0.021***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.005)	(0.004)	(0.004)	(0.004)	(0.004)
Mother's education	0.009***	0.009***	0.010***	0.010***	0.009***	0.009***	0.010***	0.010***	0.009***	0.008***	0.009***	0.009***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Housing material: Semi-pucca	0.032***	0.031***	0.032***	0.031***	0.031***	0.030***	0.031***	0.030***	0.033***	0.032***	0.033***	0.032***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Housing material: Pucca	0.056***	0.055***	0.059***	0.057***	0.056***	0.056***	0.059***	0.058***	0.055***	0.055***	0.058***	0.057***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Household size	-0.000**	-0.000*	-0.001***	-0.001***	-0.000*	-0.000	-0.001***	-0.001**	-0.000**	-0.000*	-0.001***	-0.001**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Girl	2.715***	3.342***	0.676	0.518								
	(0.585)	(0.685)	(0.575)	(0.680)								
Gvt primary school in vlg		0.010***		0.014***		0.010***		0.014***		0.010***		0.015***
		(0.003)		(0.003)		(0.003)		(0.004)		(0.003)		(0.003)
Vlg has anganwadi		0.003		0.002		0.003		0.002		0.003		0.002
		(0.003)		(0.003)		(0.003)		(0.003)		(0.003)		(0.003)
Vlg has pucca road		0.009***		0.008***		0.010***		0.007***		0.009***		0.008***
		(0.002)		(0.002)		(0.002)		(0.002)		(0.002)		(0.002)
Vlg has ration shop		0.009***		0.010***		0.009***		0.010***		0.009***		0.010***
		(0.002)		(0.002)		(0.002)		(0.002)		(0.002)		(0.002)
Observations	1080282	834744	1085367	838797	500852	388019	503224	389896	579430	446725	582143	448901
R^2	0.871	0.875	0.863	0.865	0.868	0.872	0.861	0.863	0.874	0.878	0.865	0.867

This table reports the coefficients from Equation 2 but now the treatment of interest is based on children who were exposed to the initial ban of 1998-2000 and the ban implemented in 2006. Iodised thus captures cohorts who were born in 1999, 2000, 2007 and 2008. The data used for the analysis is the ASER data merged with historical information on district level goitre endemicity. The outcome variables are the probability of knowing some numeracy (at least being able to recognise simple numbers) and literacy (at least being able to recognise letters) for children aged 5-10 for all states but Kerala. The subsample of analysis and the outcome variable is reported at the top of the table. The following fixed effects are included; year of birth, survey year, survey year*year of birth and linear district trends. Gender specific linear trends are included in the estimates for the pooled sample. Robust standard errors clustered on district are presented in parentheses. * $p < .10$, ** $p < .05$, *** $p < .01$

Table A.15: The effect of being in early life during the ban of 1998 on overall age standardised numeracy and literacy scores.

	Pooled				Girls				Boys			
Dependent variable is the Standard Deviation of the overall score in	(1) Numeracy	(2) Numeracy	(3) Literacy	(4) Literacy	(5) Numeracy	(6) Numeracy	(7) Literacy	(8) Literacy	(9) Numeracy	(10) Numeracy	(11) Literacy	(12) Literacy
Iodised (First Ban) * Endemic	0.012	0.016	0.022	0.031**	-0.009	-0.006	-0.003	0.013	0.031*	0.036*	0.044**	0.048**
	(0.014)	(0.015)	(0.015)	(0.015)	(0.019)	(0.020)	(0.019)	(0.020)	(0.017)	(0.019)	(0.018)	(0.019)
Mother's education	0.022***	0.021***	0.024***	0.023***	0.023***	0.022***	0.025***	0.025***	0.020***	0.019***	0.023***	0.022***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Housing material: Semi-pucca	0.102***	0.101***	0.101***	0.100***	0.103***	0.101***	0.101***	0.100***	0.101***	0.101***	0.102***	0.100***
	(0.005)	(0.006)	(0.005)	(0.006)	(0.006)	(0.007)	(0.006)	(0.007)	(0.006)	(0.006)	(0.006)	(0.006)
Housing material: Pucca	0.156***	0.156***	0.161***	0.159***	0.162***	0.163***	0.167***	0.167***	0.150***	0.149***	0.155***	0.152***
	(0.006)	(0.007)	(0.006)	(0.007)	(0.007)	(0.008)	(0.007)	(0.008)	(0.006)	(0.007)	(0.006)	(0.007)
Household size	-0.002***	-0.002***	-0.003***	-0.003***	-0.002***	-0.002***	-0.003***	-0.003***	-0.002***	-0.002***	-0.003***	-0.002***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Girl	5.527**	9.661***	3.546	4.996*								
	(2.472)	(3.021)	(2.357)	(2.933)								
Gvt primary school in vlg		0.033***		0.041***		0.034***		0.043***		0.033***		0.039***
		(0.009)		(0.010)		(0.011)		(0.012)		(0.010)		(0.010)
Vlg has anganwadi		0.023**		0.022**		0.025**		0.024**		0.022**		0.021*
		(0.010)		(0.010)		(0.011)		(0.011)		(0.011)		(0.011)
Vlg has pucca road		0.024***		0.016***		0.024***		0.013*		0.024***		0.018***
		(0.006)		(0.006)		(0.007)		(0.007)		(0.007)		(0.007)
Vlg has ration shop		0.027***		0.026***		0.029***		0.029***		0.025***		0.024***
		(0.006)		(0.006)		(0.007)		(0.007)		(0.006)		(0.006)
Observations	921536	684955	926392	688812	426196	317515	428460	319291	495340	367440	497932	369521
R^2	0.070	0.069	0.083	0.082	0.078	0.077	0.092	0.093	0.064	0.062	0.075	0.074

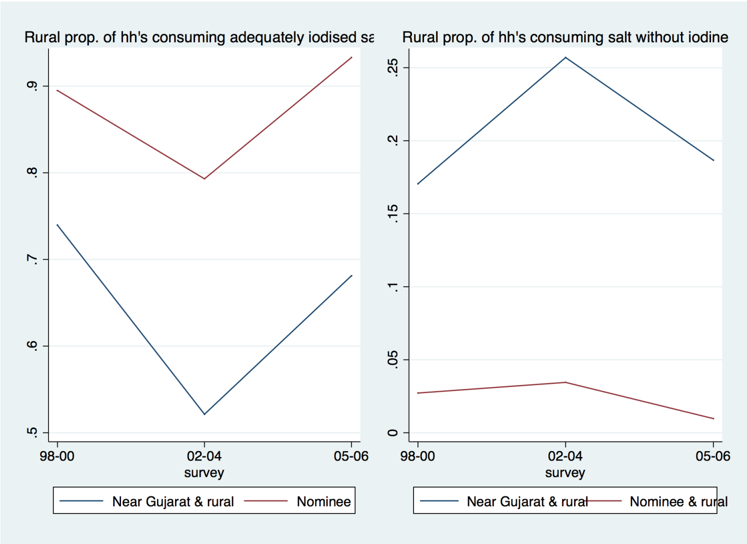
This table reports the coefficients from Equation 2 but now the treatment of interest is based on children who were exposed to the initial ban of 1998-2000. Iodised thus captures cohorts who were born in 1999-2000. The data used for the analysis is the ASER data merged with historical information on district level goitre endemicity. The outcome variables are age-standardised overall numeracy and literacy scores for children aged 5-10 from all states but Kerala. The raw score is in the range of 0-4, where 0 denotes no numeracy or literacy ability and 4 denotes that the child can master reading a paragraph or do division, respectively. The subsample of analysis and the outcome variable is reported at the top of the table. The following fixed effects are included; year of birth, survey year, survey year*year of birth and linear district trends. Gender specific linear trends are included in the estimates for the pooled sample. Robust standard errors clustered on district are presented in parentheses. * $p < .10$, ** $p < .05$, *** $p < .01$

Table A.16: Effect of being in early life during the bans implemented in 1998 or 2006 on age standardised overall test scores.

	Pooled				Girls				Boys			
Dependent variable is the Standard Deviation of the overall score in	(1) Numeracy	(2) Numeracy	(3) Literacy	(4) Literacy	(5) Numeracy	(6) Numeracy	(7) Literacy	(8) Literacy	(9) Numeracy	(10) Numeracy	(11) Literacy	(12) Literacy
Iodised (Both Bans) * Endemic	0.032***	0.041***	0.047***	0.058***	0.035***	0.043***	0.050***	0.063***	0.029***	0.039***	0.043***	0.054***
	(0.008)	(0.009)	(0.009)	(0.010)	(0.010)	(0.011)	(0.010)	(0.012)	(0.009)	(0.010)	(0.009)	(0.010)
Mother's education	0.025***	0.025***	0.027***	0.027***	0.026***	0.026***	0.028***	0.029***	0.024***	0.024***	0.026***	0.026***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Housing material: Semi-pucca	0.099***	0.098***	0.098***	0.096***	0.099***	0.097***	0.096***	0.094***	0.100***	0.099***	0.100***	0.097***
	(0.005)	(0.005)	(0.005)	(0.005)	(0.006)	(0.006)	(0.006)	(0.006)	(0.005)	(0.006)	(0.005)	(0.006)
Housing material: Pucca	0.165***	0.166***	0.169***	0.168***	0.169***	0.171***	0.173***	0.173***	0.161***	0.162***	0.165***	0.164***
	(0.006)	(0.006)	(0.006)	(0.006)	(0.007)	(0.008)	(0.007)	(0.008)	(0.006)	(0.007)	(0.006)	(0.007)
Household size	-0.002***	-0.001**	-0.002***	-0.002***	-0.002**	-0.001*	-0.002***	-0.002***	-0.002**	-0.002**	-0.002***	-0.002**
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Girl	2.647	3.639*	-1.386	-2.572								
	(1.607)	(1.881)	(1.490)	(1.795)								
Gvt primary school in vlg		0.033***		0.042***		0.033***		0.042***		0.033***		0.042***
		(0.009)		(0.009)		(0.010)		(0.011)		(0.010)		(0.010)
Vlg has anganwadi		0.016*		0.013		0.017*		0.013		0.016		0.014
		(0.008)		(0.008)		(0.010)		(0.010)		(0.009)		(0.010)
Vlg has pucca road		0.026***		0.018***		0.025***		0.015**		0.026***		0.020***
		(0.006)		(0.006)		(0.006)		(0.006)		(0.006)		(0.006)
Vlg has ration shop		0.026***		0.026***		0.027***		0.028***		0.025***		0.025***
		(0.005)		(0.005)		(0.006)		(0.006)		(0.005)		(0.005)
Observations	1080282	834744	1085367	838797	500852	388019	503224	389896	579430	446725	582143	448901
R^2	0.081	0.082	0.096	0.099	0.090	0.091	0.106	0.109	0.074	0.075	0.089	0.091

This table reports the coefficients from Equation 2 but now the treatment of interest is based on children who were exposed to the initial ban of 1998-2000 and the ban implemented in 2006. Iodised thus captures cohorts who were born in 1999, 2000, 2007 and 2008. The data used for the analysis is the ASER data merged with historical information on district level goitre endemicity. The outcome variables are age-standardised overall numeracy and literacy scores for children aged 5-10 from all states but Kerala. The raw score is in the range of 0-4, where 0 denotes no numeracy or literacy ability and 4 denotes that the child can master reading a paragraph or do division, respectively. The subsample of analysis and the outcome variable is reported at the top of the table. The following fixed effects are included; year of birth, survey year, survey year*year of birth and linear district trends. Gender specific linear trends are included in the estimates for the pooled sample. Robust standard errors clustered on district are presented in parentheses. * $p < .10$, ** $p < .05$, *** $p < .01$

Figure A.14: Nationwide consumption of adequately iodised salt and non-iodised salt over time: Heterogeneous effects



The figure depicts the trends in the proportion of rural household who consume iodised and non-iodised salt in; Gujarat and states near Gujarat with predominantly road transportation of salt and for north earstern states with a nominee system and predominantly rail transportation of salt. Survey 98-00 denotes the NFHS II which covers the years of 1998-2000. Survey 02-04 denotes the DLHS II of 2002-2004 and Survey 05-06 represents the NFHS III for years 2005-2006.

Table A.17: Effect on basic skills skills for children in Gujarat and in states near Gujarat

	Pooled				Girls				Boys			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Dependent variable is the probability of knowing basic:	Numeracy	Numeracy	Literacy	Literacy	Numeracy	Numeracy	Literacy	Literacy	Numeracy	Numeracy	Literacy	Literacy
Iodised * Endemic	0.032**	0.060***	0.026*	0.051***	0.046***	0.075***	0.045***	0.068***	0.020	0.046***	0.010	0.036**
	(0.014)	(0.014)	(0.014)	(0.014)	(0.016)	(0.017)	(0.016)	(0.016)	(0.016)	(0.017)	(0.016)	(0.017)
Mother's education	0.012***	0.011***	0.013***	0.012***	0.012***	0.012***	0.013***	0.013***	0.011***	0.011***	0.012***	0.012***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Housing material: Semi-pucca	0.044***	0.042***	0.044***	0.043***	0.043***	0.041***	0.044***	0.043***	0.045***	0.042***	0.045***	0.042***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.004)	(0.003)	(0.004)	(0.003)	(0.003)	(0.003)	(0.003)
Housing material: Pucca	0.077***	0.076***	0.079***	0.078***	0.078***	0.079***	0.080***	0.081***	0.075***	0.074***	0.078***	0.075***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.004)	(0.004)	(0.004)	(0.004)	(0.003)	(0.004)	(0.003)	(0.004)
Household size	-0.000	-0.000	-0.000	-0.000	-0.000	-0.000	-0.000	-0.000	-0.000	-0.000	-0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Girl	5.397***	5.129***	1.640	0.956								
	(1.668)	(1.847)	(1.631)	(1.753)								
Gvt primary school in vlg		0.019***		0.024***		0.023***		0.026***		0.016**		0.023***
		(0.006)		(0.006)		(0.007)		(0.007)		(0.007)		(0.007)
Vlg has anganwadi		0.003		0.008		0.004		0.009		0.001		0.008
		(0.005)		(0.005)		(0.006)		(0.006)		(0.005)		(0.006)
Vlg is connected to pucca road		0.006*		0.004		0.007		0.001		0.006		0.006
		(0.004)		(0.004)		(0.004)		(0.005)		(0.004)		(0.004)
Vlg has ration shop		0.010***		0.010***		0.012***		0.011***		0.008**		0.010***
		(0.003)		(0.003)		(0.003)		(0.003)		(0.003)		(0.003)
Observations	342979	289137	344167	290087	156614	132592	157155	133009	186365	156545	187012	157078
R^2	0.811	0.821	0.803	0.811	0.805	0.814	0.798	0.806	0.816	0.827	0.807	0.816

Notes: This table reports the coefficients from Equation 2 using the ASER data merged with historical information on district level goitre endemicity. The outcome variables are the probability of knowing some numeracy (at least being able to recognise simple numbers) and literacy (at least being able to recognise letters) for children aged 5-10 in Gujarat, Rajasthan, Uttar Pradesh, Madhya Pradesh and Maharahstra. The subsample of analysis and the outcome variable is reported at the top of the table. The following fixed effects are included; year of birth, survey year, survey year*year of birth and linear district trends. Gender specific linear trends are included in the estimates for the pooled sample. Robust standard errors clustered on district are presented in parentheses. * $p < .10$, ** $p < .05$, *** $p < .01$

Table A.18: Effect on basic skills skills for children in north eastern states and West Bengal

	Pooled				Girls				Boys			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Dependent variable is the probability of knowing basic:	Numeracy	Numeracy	Literacy	Literacy	Numeracy	Numeracy	Literacy	Literacy	Numeracy	Numeracy	Literacy	Literacy
Iodised * Endemic	-0.034	-0.022	-0.038**	-0.025	-0.033	-0.020	-0.049**	-0.038*	-0.036	-0.025	-0.029	-0.013
	(0.027)	(0.033)	(0.018)	(0.017)	(0.034)	(0.041)	(0.020)	(0.020)	(0.028)	(0.033)	(0.023)	(0.024)
Mother's education	0.009***	0.008***	0.010***	0.009***	0.009***	0.008***	0.010***	0.010***	0.009***	0.008***	0.010***	0.009***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Housing material: Semi-pucca	0.022***	0.020***	0.024***	0.022***	0.019***	0.016***	0.021***	0.018***	0.025***	0.023***	0.027***	0.025***
	(0.003)	(0.003)	(0.004)	(0.004)	(0.004)	(0.004)	(0.005)	(0.005)	(0.004)	(0.003)	(0.004)	(0.004)
Housing material:Pucca	0.044***	0.040***	0.050***	0.045***	0.036***	0.032***	0.045***	0.041***	0.053***	0.048***	0.054***	0.049***
	(0.005)	(0.005)	(0.005)	(0.005)	(0.006)	(0.006)	(0.006)	(0.006)	(0.005)	(0.005)	(0.005)	(0.005)
Household size	-0.001**	-0.001**	-0.002***	-0.002***	-0.001*	-0.001*	-0.001**	-0.001**	-0.001**	-0.001	-0.002***	-0.002***
	(0.001)	(0.001)	(0.000)	(0.000)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Girl	-1.881	-1.855	-0.394	-1.046								
	(2.170)	(2.193)	(2.149)	(2.192)								
Gvt primary school in vlg		0.004		0.012		0.003		0.005		0.006		0.018*
		(0.008)		(0.009)		(0.009)		(0.010)		(0.009)		(0.010)
Vlg has anganwadi		0.004		-0.000		0.004		0.002		0.003		-0.002
		(0.006)		(0.006)		(0.007)		(0.007)		(0.006)		(0.006)
Vlg is connected to a pucca road		0.013***		0.013***		0.015***		0.014***		0.011**		0.011**
		(0.004)		(0.005)		(0.005)		(0.005)		(0.004)		(0.005)
Vlg has ration shop		0.015***		0.015***		0.014***		0.016***		0.015***		0.014***
		(0.004)		(0.004)		(0.005)		(0.005)		(0.005)		(0.005)
Observations	121033	105045	121919	105786	57866	50158	58282	50516	63167	54887	63637	55270
R^2	0.900	0.906	0.888	0.895	0.899	0.906	0.889	0.895	0.900	0.907	0.888	0.894

Notes: This table reports the coefficients from Equation 2 using the ASER data merged with historical information on district level goitre endemicity. The outcome variables are the probability of knowing some numeracy (at least being able to recognise simple numbers) and literacy (at least being able to recognise letters) for children aged 5-10 in Sikkim, Mizoram, Meghalaya, Nagaland, Tripura, Arunachal Pradesh, Manipur, Assam and West Bengal. The subsample of analysis and the outcome variable is reported at the top of the table. The following fixed effects are included; year of birth, survey year, survey year*year of birth and linear district trends. Gender specific linear trends are included in the estimates for the pooled sample. Robust standard errors clustered on district are presented in parentheses. * $p < .10$, ** $p < .05$, *** $p < .01$

Table A.19: Effect on basic skills using SD of goitre points per district.

	Pooled				Girls				Boys			
Dependent variable is the probability of knowing basic:	(1) Numeracy	(2) Numeracy	(3) Literacy	(4) Literacy	(5) Numeracy	(6) Numeracy	(7) Literacy	(8) Literacy	(9) Numeracy	(10) Numeracy	(11) Literacy	(12) Literacy
Iodised * SD goitre points per district	0.011***	0.011***	0.014***	0.015***	0.015***	0.016***	0.021***	0.022***	0.007	0.007	0.008*	0.009**
	(0.004)	(0.004)	(0.004)	(0.004)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.004)	(0.005)	(0.005)
Mother's education	0.010***	0.010***	0.011***	0.011***	0.011***	0.010***	0.012***	0.011***	0.010***	0.010***	0.011***	0.011***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Housing material: Semi-pucca	0.036***	0.034***	0.037***	0.035***	0.036***	0.033***	0.036***	0.034***	0.037***	0.035***	0.038***	0.036***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Housing material: Pucca	0.064***	0.062***	0.068***	0.064***	0.065***	0.062***	0.068***	0.065***	0.063***	0.061***	0.067***	0.063***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)	(0.003)	(0.003)	(0.002)	(0.002)	(0.002)	(0.002)
Household size	-0.000*	-0.000*	-0.001***	-0.001**	-0.000	-0.000	-0.001**	-0.000*	-0.000	-0.000	-0.001***	-0.001**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Girl	2.916***	2.936***	-0.262	-0.716								
	(1.000)	(1.066)	(1.000)	(1.053)								
Gvt primary school in vlg		0.012***		0.018***		0.010**		0.016***		0.013***		0.020***
		(0.004)		(0.004)		(0.004)		(0.004)		(0.004)		(0.004)
Vlg has anganwadi		0.002		0.001		0.003		0.001		0.001		0.001
		(0.003)		(0.003)		(0.004)		(0.004)		(0.004)		(0.004)
Vlg is connected to a pucca road		0.010***		0.008***		0.011***		0.008***		0.010***		0.008***
		(0.002)		(0.002)		(0.002)		(0.002)		(0.002)		(0.002)
Vlg has ration shop		0.011***		0.011***		0.011***		0.010***		0.011***		0.011***
		(0.002)		(0.002)		(0.002)		(0.002)		(0.002)		(0.002)
Observations	809189	680318	813090	683500	377677	318356	379504	319824	431512	361962	433586	363676
R^2	0.842	0.854	0.831	0.841	0.840	0.851	0.830	0.840	0.845	0.857	0.832	0.842

Notes: This table reports the coefficients from Equation 2 using the ASER data merged with historical information on the standard deviation of pre-fortification goitre endemic areas per district. The outcome variables are the probability of knowing some numeracy (at least being able to recognise simple numbers) and literacy (at least being able to recognise letters) for children aged 5-10 for all states but Kerala. The subsample of analysis and the outcome variable is reported at the top of the table. The following fixed effects are included; year of birth, survey year, survey year*year of birth and linear district trends. Gender specific linear trends are included in the estimates for the pooled sample. Robust standard errors clustered on district are presented in parentheses. * $p < .10$, ** $p < .05$, *** $p < .01$

Table A.20: Effect on age standardised overall test scores using SD of goitre points per district.

	Pooled				Girls				Boys			
Dependent variable is the age standardised overall test scores in:	(1) Numeracy	(2) Numeracy	(3) Literacy	(4) Literacy	(5) Numeracy	(6) Numeracy	(7) Literacy	(8) Literacy	(9) Numeracy	(10) Numeracy	(11) Literacy	(12) Literacy
Iodised * SD goitre points per district	0.018*	0.017*	0.030***	0.029***	0.033***	0.033***	0.050***	0.049***	0.005	0.002	0.011	0.011
	(0.009)	(0.009)	(0.010)	(0.010)	(0.012)	(0.012)	(0.013)	(0.013)	(0.011)	(0.011)	(0.010)	(0.010)
Mother's education	0.027***	0.027***	0.030***	0.030***	0.028***	0.028***	0.031***	0.031***	0.026***	0.026***	0.029***	0.029***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Housing material: Semi-pucca	0.104***	0.103***	0.105***	0.103***	0.106***	0.104***	0.105***	0.104***	0.103***	0.102***	0.106***	0.103***
	(0.005)	(0.005)	(0.005)	(0.005)	(0.006)	(0.007)	(0.006)	(0.007)	(0.005)	(0.006)	(0.006)	(0.006)
Housing material:Pucca	0.178***	0.177***	0.184***	0.180***	0.185***	0.183***	0.189***	0.186***	0.173***	0.172***	0.180***	0.175***
	(0.006)	(0.007)	(0.006)	(0.007)	(0.007)	(0.008)	(0.008)	(0.008)	(0.006)	(0.007)	(0.006)	(0.007)
Household size	-0.001**	-0.001**	-0.002***	-0.002***	-0.001*	-0.001	-0.002**	-0.002**	-0.001*	-0.001*	-0.002***	-0.002**
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Girl	2.004	0.673	-4.782**	-7.004***								
	(2.406)	(2.668)	(2.385)	(2.623)								
Primary gvt school in vlg		0.036***		0.049***		0.032***		0.045***		0.039***		0.054***
		(0.009)		(0.010)		(0.011)		(0.012)		(0.011)		(0.011)
Vlg has anganwadi		0.012		0.009		0.016		0.009		0.008		0.008
		(0.008)		(0.009)		(0.010)		(0.010)		(0.010)		(0.010)
Vlg is connected to a pucca road		0.028***		0.020***		0.029***		0.018**		0.028***		0.021***
		(0.006)		(0.006)		(0.007)		(0.007)		(0.007)		(0.007)
Vlg has rationshop		0.027***		0.026***		0.028***		0.027***		0.026***		0.025***
		(0.005)		(0.005)		(0.006)		(0.007)		(0.006)		(0.006)
Observations	809189	680318	813090	683500	377677	318356	379504	319824	431512	361962	433586	363676
R^2	0.090	0.089	0.107	0.108	0.099	0.099	0.117	0.119	0.083	0.082	0.099	0.099

Notes: This table reports the coefficients from Equation 2 using the ASER data merged with historical information on the standard deviation of pre-fortification goitre endemic areas per district. The outcome variables are age-standardised overall numeracy and literacy scores for children aged 5-10 from all states but Kerala. The raw score is in the range of 0-4, where 0 denotes no numeracy or literacy ability and 4 denotes that the child can master reading a paragraph or do division, respectively. The subsample of analysis and the outcome variable is reported at the top of the table. The following fixed effects are included; year of birth, survey year, survey year*year of birth and linear district trends. Gender specific linear trends are included in the estimates for the pooled sample. Robust standard errors clustered on district are presented in parentheses. * $p < .10$, ** $p < .05$, *** $p < .01$

Table A.21: Relationship between historical goitre per state on current thyroid prevalence.

	(1) Current prevalence of thyroid problems	(2) Logarithm of current prevalence of thyroid problems	(3) Current prevalence of thyroid problems
Historical goitrous areas /10 000 population/state	0.021**	1.424***	
	(0.009)	(0.479)	
Logarithm of historical goitrous areas /10 000 population/state			0.003***
			(0.001)
Constant	0.012***	-4.805***	0.024***
	(0.003)	(0.175)	(0.005)
Observations	28	28	27
R^2	0.123	0.148	0.168

Notes: This table reports the coefficients from three separate OLS models estimating the prevalence of individuals with thyroid related problems per state on the number of historical goitre areas per state and population. Data from the 2015-2015 NFHS IV is used on state level averages individuals 35 years and older reporting having thyroid related problems, such as goitre. The data is merged with the number of goitre endemic areas per states as of 2011 is geocoded from the map by McCarrison (1915) and with the population per state as of census 2011. Robust standard errors are clustered on state. Standard errors are shown in parentheses. * $p < .10$, ** $p < .05$, *** $p < .01$

Table A.22: Relationship between district level goitre rate and historical goitre endemicity

	(1) Historical Endemicity	(2) Historical Endemicity	(3) Historical Endemicity
Goitre rate	0.006***		
	(0.002)		
Goitre rate $\geq$ 10%		0.251***	
		(0.085)	
Goitre rate $\geq$ 20%			0.062
			(0.057)
Constant	0.476***	0.333***	0.516***
	(0.057)	(0.082)	(0.052)
Observations	262	582	582
R^2	0.037	0.015	0.002

Notes: This table reports the coefficients from three separate linear probability models estimating the likelihood that a district has been identified as historically goitre (containing at least one goitre endemic area from the map by McCarrison (1915)) on later district level goitre rate among children. This data stems from district level averages of the goitre rate among primary school aged children measured during 1940-2010 by the IDD and Nutrition Cell, Directorate of Health Services, Ministry of Health and Family Welfare India. Robust standard errors are clustered on district. Rural district as of the 2001 Census and which are included in the ASER survey are included. Standard errors are shown in parentheses. * $p < .10$, ** $p < .05$, *** $p < .01$

Table A.23: Relationship between goitre prevalence per district and timing of goitre survey

	(1) Goitre survey year	(2) Goitre survey year	(3) District included in goitre survey
Historical Endemicity	-13.087***		0.103***
	(1.261)		(0.038)
Goitre rate per district		-0.141***	
		(0.045)	
Constant	1986.809***	1982.068***	0.342***
	(1.011)	(1.361)	(0.029)
Observations	263	263	666
R^2	0.292	0.037	0.011

Notes: This table reports the coefficients from three separate linear probability models estimating the effect of various measures of goitre per district on a the year of goitre rate survey and the probability of a district having been included in the goitre survey. The historical endemicity measure is a binary measure for whether a district as of census 2001 contains at least one goitre endemic area from the map by McCarrison (1915). Goitre rate per district stems from district level data on the goitre rate among primary school aged children measured during 1940-2010 by the IDD and Nutrition Cell, Directorate of Health Services, Ministry of Health and Family Welfare India. Robust standard errors are clustered on district. Rural district as of the 2001 Census and which are included in the ASER survey are included. Goitre survey year denotes the year the survey was carried out per district. District included in goitre survey denotes whether the district has been sampled to measure the rate of goitre among children. Standard errors are shown in parentheses. * $p < .10$, ** $p < .05$, *** $p < .01$

Table A.24: Effect on basic skills skills using district level total goitre rate

	Pooled				Girls				Boys			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Dependent variable is the probability of knowing basic:	Numeracy	Numeracy	Literacy	Literacy	Numeracy	Numeracy	Literacy	Literacy	Numeracy	Numeracy	Literacy	Literacy
Iodised * Median TGR	0.041***	0.019	0.040***	0.022	0.037**	0.019	0.039**	0.025	0.045***	0.020	0.042**	0.019
	(0.013)	(0.013)	(0.015)	(0.015)	(0.015)	(0.015)	(0.017)	(0.017)	(0.016)	(0.016)	(0.017)	(0.017)
Mother's Education	0.010***	0.009***	0.010***	0.010***	0.010***	0.009***	0.011***	0.011***	0.009***	0.009***	0.010***	0.010***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Semi-Pucca	0.033***	0.031***	0.032***	0.030***	0.034***	0.033***	0.032***	0.032***	0.032***	0.029***	0.031***	0.029***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.004)	(0.003)	(0.004)	(0.003)	(0.003)	(0.003)	(0.003)
Pucca	0.056***	0.053***	0.059***	0.056***	0.058***	0.055***	0.060***	0.057***	0.054***	0.052***	0.058***	0.054***
	(0.003)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
HH size	-0.001***	-0.001***	-0.002***	-0.002***	-0.001***	-0.001***	-0.002***	-0.001***	-0.001***	-0.001***	-0.002***	-0.002***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Girl	2.558	3.657**	-1.605	-1.203								
	(1.612)	(1.741)	(1.571)	(1.712)								
Gvt Primary School in Vlg		0.012**		0.020***		0.008		0.013**		0.017***		0.026***
		(0.005)		(0.005)		(0.006)		(0.007)		(0.006)		(0.006)
Vlg has Anganwadi		0.002		-0.001		0.001		-0.002		0.003		0.000
		(0.004)		(0.004)		(0.005)		(0.005)		(0.005)		(0.005)
Vlg is connected to a pucca road		0.010***		0.008**		0.011***		0.009***		0.008**		0.007*
		(0.003)		(0.003)		(0.003)		(0.003)		(0.004)		(0.004)
Vlg has ration shop		0.010***		0.009***		0.009***		0.007**		0.012***		0.011***
		(0.003)		(0.003)		(0.003)		(0.004)		(0.003)		(0.003)
Observations	349291	292773	350971	294168	164796	138409	165592	139068	184495	154364	185379	155100
R^2	0.860	0.870	0.849	0.858	0.859	0.869	0.849	0.858	0.860	0.871	0.848	0.858

The outcome variables are the probability of knowing some numeracy and literacy for children aged 5-10 using the ASER data. Robust standard errors clustered on district are presented in parentheses.Columns 1-6 are estimated for the pooled sample, columns 7-12 are estimated for the sub-sample of girls and columns 13-18 are estimated for the sub-sample of boys. The following fixed effects are included; year of birth, survey year, survey year*year of birth and linear district trends. Gender specific linear trends are included in the estimates for the pooled sample.* $p < .10$, ** $p < .05$, *** $p < .01$

Table A.25: Effect on age standardised overall numeracy and literacy scores using district level total goitre rate

	Pooled				Girls				Boys			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Dependent variable is the overall score in:	Numeracy	Numeracy	Literacy	Literacy	Numeracy	Numeracy	Literacy	Literacy	Numeracy	Numeracy	Literacy	Literacy
Iodised * Median TGR	0.095***	0.052	0.085**	0.052	0.091**	0.057	0.087**	0.065	0.101***	0.050	0.084**	0.041
	(0.032)	(0.032)	(0.035)	(0.036)	(0.038)	(0.040)	(0.043)	(0.044)	(0.037)	(0.039)	(0.039)	(0.040)
Mother's Educ	0.025***	0.024***	0.028***	0.027***	0.026***	0.025***	0.029***	0.029***	0.024***	0.024***	0.027***	0.026***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Housing material: Semi-pucca	0.093***	0.091***	0.089***	0.088***	0.100***	0.099***	0.092***	0.094***	0.088***	0.085***	0.086***	0.083***
	(0.007)	(0.008)	(0.007)	(0.008)	(0.009)	(0.010)	(0.009)	(0.010)	(0.008)	(0.008)	(0.008)	(0.009)
Housing material: Pucca	0.153***	0.151***	0.158***	0.154***	0.160***	0.158***	0.164***	0.161***	0.146***	0.145***	0.153***	0.148***
	(0.010)	(0.010)	(0.010)	(0.010)	(0.012)	(0.013)	(0.012)	(0.013)	(0.010)	(0.011)	(0.010)	(0.010)
HH size	-0.003***	-0.004***	-0.005***	-0.004***	-0.004***	-0.004***	-0.005***	-0.004***	-0.003***	-0.003***	-0.004***	-0.004***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Girl	3.469	5.179	-6.140	-6.024								
	(3.894)	(4.357)	(3.728)	(4.210)								
Gvt Primary School in Vlg		0.030**		0.043***		0.017		0.026		0.043***		0.059***
		(0.013)		(0.014)		(0.016)		(0.016)		(0.015)		(0.016)
Vlg has Anganwadi		0.013		0.005		0.011		0.003		0.015		0.007
		(0.012)		(0.012)		(0.013)		(0.013)		(0.015)		(0.015)
Vlg is connected to a pucca road		0.025***		0.017*		0.027***		0.015		0.023**		0.017
		(0.009)		(0.009)		(0.009)		(0.010)		(0.010)		(0.011)
Vlg has ration shop		0.025***		0.022**		0.024**		0.020*		0.026***		0.023***
		(0.008)		(0.008)		(0.009)		(0.011)		(0.008)		(0.008)
Observations	349291	292773	350971	294168	164796	138409	165592	139068	184495	154364	185379	155100
R^2	0.092	0.091	0.108	0.108	0.099	0.099	0.117	0.118	0.086	0.085	0.101	0.101

The outcome variables are the effect on overall numeracy and literacy scores for children aged 5-10 using the ASER data. Robust standard errors clustered on district are presented in parentheses. The following fixed effects are included; year of birth, survey year, survey year*year of birth and linear district trends. Gender specific linear trends are included in the estimates for the pooled sample.* $p < .10$, ** $p < .05$, *** $p < .01$

Table A.26: Ecological Determinants of Pre-Eradication Goitre Endemicity

	(1) Summary Stats	(2) Goitre Endemic District (McCarrisson)	(3) Above Median TGR	(4) Above Median TGR
Maximum Elevation (km)	0.811	0.047***	0.083***	0.074***
	(1.155)	(0.011)	(0.023)	(0.024)
1/Groundwater Salinity	0.752	0.555***	0.396***	0.263*
	(0.071)	(0.075)	(0.122)	(0.133)
Year TGR surveyed				-0.008***
				(0.003)
Constant		0.116**	0.120	16.207***
		(0.058)	(0.096)	(6.168)
Observations	585	579	253	253
R^2		0.119	0.105	0.134
F-stat		61.31	18.19	9.33
Prob $\geq$ F		0.000	0.000	0.000

Robust standard errors clustered on district are in parentheses. This table shows the descriptive statistics in column (1), and then the first stage regressions from Equation 3 in columns (2) - (4). The pre-fortification goitre indicator variables are regressed on maximum elevation and 1/groundwater salinity per district. * $p < .10$, ** $p < .05$, *** $p < .01$

Table A.27: TSLS results: Effect of iodine fortification on basic numeracy skills

	Pooled						Girls						Boys					
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
Iodised (2nd Ban) * Endemic	0.080***	0.076***					0.102***	0.105***					0.061*	0.052*				
	(0.029)	(0.027)					(0.033)	(0.032)					(0.033)	(0.031)				
Iodised (1st Ban) * Endemic			0.006	0.033**					-0.010	0.018					0.020	0.047***		
			(0.018)	(0.015)					(0.021)	(0.018)					(0.020)	(0.018)		
Iodised (Both Bans) * Endemic					0.047***	0.061***					0.050***	0.065***					0.045***	0.058***
					(0.013)	(0.014)					(0.014)	(0.015)					(0.013)	(0.014)
Mother's Education	0.010***	0.010***	0.007***	0.006***	0.009***	0.009***	0.011***	0.010***	0.007***	0.007***	0.009***	0.009***	0.010***	0.010***	0.007***	0.006***	0.009***	0.008***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Semi-Pucca	0.036***	0.034***	0.032***	0.030***	0.032***	0.031***	0.036***	0.033***	0.032***	0.030***	0.032***	0.030***	0.037***	0.035***	0.032***	0.031***	0.033***	0.032***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Pucca	0.064***	0.062***	0.049***	0.047***	0.055***	0.055***	0.065***	0.062***	0.050***	0.049***	0.056***	0.056***	0.063***	0.061***	0.047***	0.045***	0.055***	0.055***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
HH size	-0.000*	-0.000*	-0.001***	-0.001***	-0.000**	-0.000*	-0.000	-0.000	-0.001***	-0.001***	-0.000	-0.000	-0.000	-0.000*	-0.001***	-0.001***	-0.000**	-0.000*
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Girl	2.823***	2.781***	2.821***	4.239***	2.754***	3.386***												
	(1.002)	(1.065)	(0.707)	(0.831)	(0.591)	(0.695)												
	(1.230)	(1.149)	(0.902)	(0.865)	(2.414)	(2.174)	(4.592)	(3.266)	(2.094)	(0.732)	(2.182)	(3.870)	(4.072)	(4.605)	(3.905)	(2.400)	(2.136)	(4.857)
Gvt Primary School in Vlg		0.012***		0.009***		0.009***		0.011**		0.008**		0.009**		0.013***		0.009***		0.010***
		(0.004)		(0.003)		(0.003)		(0.004)		(0.004)		(0.003)		(0.004)		(0.003)		(0.003)
Vlg has Anganwadi		0.003		0.006*		0.004		0.004		0.006*		0.004		0.002		0.005		0.003
		(0.003)		(0.003)		(0.003)		(0.004)		(0.004)		(0.003)		(0.003)		(0.003)		(0.003)
Vlg is connected to a pucca road		0.011***		0.008***		0.009***		0.011***		0.009***		0.010***		0.010***		0.007***		0.009***
		(0.002)		(0.002)		(0.002)		(0.002)		(0.002)		(0.002)		(0.002)		(0.002)		(0.002)
Vlg has ration shop		0.011***		0.009***		0.010***		0.011***		0.010***		0.010***		0.011***		0.009***		0.009***
		(0.002)		(0.002)		(0.002)		(0.002)		(0.002)		(0.002)		(0.002)		(0.002)		(0.002)
Observations	805829	677364	900451	669670	1055743	816224	376108	316986	416666	310611	489690	379586	429721	360378	483785	359059	566053	436638
R^2	0.843	0.854	0.895	0.904	0.871	0.874	0.840	0.851	0.892	0.901	0.868	0.871	0.845	0.857	0.897	0.907	0.873	0.877

The table reports IV results on the probability of knowing some numeracy for children aged 5-10 using the ASER data. 1/salinity per district and maximum elevation per districts are used as instruments for the binary historical goitre indicator. Robust standard errors clustered on district are presented in parentheses. Columns 1-6 are estimated for the pooled sample, columns 7-12 are estimated for the sub-sample of girls and columns 13-18 are estimated for the sub-sample of boys. The following fixed effects are included; year of birth, survey year, survey year*year of birth and linear district trends. Gender specific linear trends are included in the estimates for the pooled sample.* $p < .10$, ** $p < .05$, *** $p < .01$

Table A.28: TSLS results: Effect of iodine fortification on basic literacy skills

	Pooled						Girls						Boys					
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
Iodised (2nd Ban) * Endemic	0.122***	0.116***					0.139***	0.144***					0.107***	0.093***				
	(0.031)	(0.030)					(0.035)	(0.035)					(0.035)	(0.033)				
Iodised (1st Ban) * Endemic			0.002	0.032**					-0.013	0.022					0.015	0.041**		
			(0.019)	(0.015)					(0.022)	(0.019)					(0.021)	(0.019)		
Iodised (Both Bans) * Endemic					0.061***	0.077***					0.062***	0.082***					0.059***	0.072***
					(0.014)	(0.015)					(0.015)	(0.016)					(0.014)	(0.016)
Mother's Education	0.011***	0.011***	0.008***	0.007***	0.010***	0.010***	0.012***	0.011***	0.008***	0.008***	0.010***	0.010***	0.011***	0.011***	0.007***	0.007***	0.010***	0.009***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Semi-Pucca	0.037***	0.035***	0.033***	0.031***	0.033***	0.031***	0.036***	0.034***	0.033***	0.031***	0.032***	0.030***	0.038***	0.035***	0.033***	0.031***	0.034***	0.032***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Pucca	0.068***	0.064***	0.052***	0.050***	0.058***	0.057***	0.068***	0.065***	0.054***	0.052***	0.059***	0.058***	0.067***	0.063***	0.051***	0.048***	0.058***	0.056***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
HH size	-0.001***	-0.001**	-0.001***	-0.001***	-0.001***	-0.001***	-0.001**	-0.000*	-0.001***	-0.001***	-0.001***	-0.001**	-0.001***	-0.001**	-0.001***	-0.001***	-0.001***	-0.001**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Girl	-0.308	-0.814	1.899***	2.512***	0.728	0.586												
	(1.004)	(1.056)	(0.732)	(0.858)	(0.585)	(0.694)												
	(1.287)	(1.149)	(0.894)	(0.868)	(2.590)	(2.393)	(2.479)	(4.174)	(1.958)	(0.751)	(2.323)	(5.529)	(4.139)	(3.913)	(3.092)	(2.633)	(2.346)	(4.464)
Gvt Primary School in Vlg		0.018***		0.013***		0.014***		0.016***		0.013***		0.013***		0.020***		0.012***		0.014***
		(0.004)		(0.003)		(0.003)		(0.004)		(0.004)		(0.004)		(0.004)		(0.004)		(0.003)
Vlg has Anganwadi		0.001		0.005		0.002		0.002		0.006*		0.002		0.001		0.005		0.002
		(0.003)		(0.003)		(0.003)		(0.004)		(0.004)		(0.003)		(0.004)		(0.004)		(0.003)
Vlg is connected to a pucca road		0.009***		0.006***		0.008***		0.009***		0.006**		0.007***		0.008***		0.006***		0.008***
		(0.002)		(0.002)		(0.002)		(0.002)		(0.002)		(0.002)		(0.002)		(0.002)		(0.002)
Vlg has ration shop		0.010***		0.009***		0.010***		0.010***		0.010***		0.010***		0.010***		0.009***		0.010***
		(0.002)		(0.002)		(0.002)		(0.002)		(0.002)		(0.002)		(0.002)		(0.002)		(0.002)
Observations	809727	680542	905116	673402	1060624	820141	377937	318455	418841	312331	491970	381404	431790	362087	486275	361071	568654	438737
R^2	0.831	0.841	0.888	0.896	0.862	0.864	0.830	0.840	0.886	0.894	0.861	0.862	0.832	0.842	0.890	0.898	0.864	0.866

The table reports IV results on the probability of knowing some literacy for children aged 5-10 using the ASER data. 1/salinity per district and maximum elevation per districts are used as instruments for the binary historical goitre indicator. Robust standard errors clustered on district are presented in parentheses. Columns 1-6 are estimated for the pooled sample, columns 7-12 are estimated for the sub-sample of girls and columns 13-18 are estimated for the sub-sample of boys. The following fixed effects are included; year of birth, survey year, survey year*year of birth and linear district trends. Gender specific linear trends are included in the estimates for the pooled sample.* $p < .10$, ** $p < .05$, *** $p < .01$

Table A.29: IV Results: Effect on age standardised overall numeracy and literacy scores using district level total goitre rate

	Pooled				Girls				Boys			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Dependent variable is the overall score in:	Numeracy	Numeracy	Literacy	Literacy	Numeracy	Numeracy	Literacy	Literacy	Numeracy	Numeracy	Literacy	Literacy
Iodised * Endemic	0.136**	0.068	0.168**	0.127**	0.198**	0.174**	0.257***	0.267***	0.086	-0.022	0.093	0.008
	(0.068)	(0.061)	(0.068)	(0.063)	(0.079)	(0.076)	(0.086)	(0.086)	(0.081)	(0.076)	(0.077)	(0.075)
Mother's Education	0.043***	0.044***	0.043***	0.044***	0.044***	0.045***	0.045***	0.045***	0.042***	0.043***	0.041***	0.042***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Housing material: Semi-pucca	0.110***	0.109***	0.122***	0.120***	0.105***	0.103***	0.116***	0.114***	0.115***	0.114***	0.128***	0.125***
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.006)	(0.006)	(0.007)	(0.005)	(0.006)	(0.006)	(0.006)
Housing material: Pucca	0.242***	0.242***	0.245***	0.242***	0.238***	0.239***	0.248***	0.247***	0.245***	0.244***	0.243***	0.238***
	(0.006)	(0.006)	(0.006)	(0.006)	(0.007)	(0.007)	(0.007)	(0.007)	(0.006)	(0.007)	(0.006)	(0.007)
HH size	-0.001	-0.001*	-0.001	-0.001	-0.001	-0.001	-0.001	-0.000	-0.001	-0.001	-0.001	-0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Girl	-5.455**	-8.485***	-4.129*	-4.658*								
	(2.134)	(2.366)	(2.255)	(2.511)								
Gvt Primary School in Vlg		0.045***		0.051***		0.050***		0.050***		0.041***		0.052***
		(0.011)		(0.011)		(0.012)		(0.012)		(0.012)		(0.012)
Vlg has Anganwadi		0.006		0.006		0.007		0.005		0.005		0.008
		(0.009)		(0.009)		(0.009)		(0.010)		(0.010)		(0.010)
Vlg is connected to a pucca road		0.031***		0.032***		0.033***		0.031***		0.029***		0.033***
		(0.006)		(0.006)		(0.006)		(0.007)		(0.006)		(0.007)
Vlg has ration shop		0.040***		0.036***		0.038***		0.035***		0.043***		0.037***
		(0.005)		(0.005)		(0.006)		(0.006)		(0.006)		(0.006)
Observations	805829	677364	809727	680542	376108	316986	377937	318455	429721	360378	431790	362087
R^2	0.175	0.186	0.146	0.155	0.197	0.210	0.161	0.172	0.157	0.165	0.133	0.141

This table reports the regression results from the TSLS estimation specified in Equation 4. Historical goitre endemicity is instrumented with inverse of a salinity score ranging 1-3 per district and the maximum elevation per district. The outcome variables are age standardised overall scores in numeracy and literacy for children aged 5-10 using the ASER data. The Robust standard errors clustered on district are presented in parentheses. Columns 1-6 are estimated for the pooled sample, columns 7-12 are estimated for the sub-sample of girls and columns 13-18 are estimated for the sub-sample of boys. The following fixed effects are included; year of birth, survey year, survey year*year of birth and linear district trends. Gender specific linear trends are included in the estimates for the pooled sample.* $p < .10$, ** $p < .05$, *** $p < .01$

Table A.30: IV results: Effect on grade progression.

	Pooled		Girls		Boys	
	(1) Grade	(2) Grade	(3) Grade	(4) Grade	(5) Grade	(6) Grade
Iodised * Endemic	0.203***	0.116*	0.283***	0.225***	0.137*	0.023
	(0.070)	(0.064)	(0.085)	(0.083)	(0.076)	(0.075)
Mother's Educ	0.003***	0.003***	0.004***	0.004***	0.002***	0.003***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Kutcha	0.040***	0.041***	0.040***	0.042***	0.040***	0.040***
	(0.005)	(0.005)	(0.006)	(0.006)	(0.005)	(0.006)
Pucca	0.037***	0.034***	0.041***	0.041***	0.033***	0.028***
	(0.005)	(0.005)	(0.006)	(0.007)	(0.006)	(0.006)
HH size	-0.002***	-0.002***	-0.001**	-0.002***	-0.003***	-0.003***
	(0.000)	(0.000)	(0.001)	(0.001)	(0.001)	(0.001)
Girl	1.936	5.484**				
	(1.933)	(2.147)				
Gvt Primary School in Vlg		0.044***		0.048***		0.041***
		(0.011)		(0.012)		(0.011)
Vlg has Anganwadi		-0.010		-0.009		-0.011
		(0.009)		(0.010)		(0.010)
Vlg is connected to a pucca road		0.001		0.005		-0.002
		(0.005)		(0.006)		(0.006)
Vlg has ration shop		0.005		0.009		0.002
		(0.005)		(0.006)		(0.005)
Observations	752552	642486	351386	300833	401166	341653
R^2	0.919	0.919	0.921	0.922	0.916	0.917

This table reports the regression results from the TSLS estimation specified in Equation 4. Historical goitre endemicity is instrumented with inverse of a salinity score ranging 1-3 per district and the maximum elevation per district. The outcome variable is current grade in primary school for children aged 5-10 using the ASER data. Robust standard errors clustered on district are presented in parentheses. Columns 1-2 are estimated for the pooled sample, columns 3-4 are estimated for the sub-sample of girls and columns 5-6 are estimated for the sub-sample of boys. The following fixed effects are included; year of birth, survey year, survey year*year of birth and linear district trends. Gender specific linear trends are included in the estimates for the pooled sample.* $p < .10$, ** $p < .05$, *** $p < .01$

Table A.31: TSLS results: Effect of iodine fortification on the probability of knowing basic numeracy using TGR data

	Pooled						Girls						Boys					
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
Iodised (2nd Ban) * Median TGR	0.222***	0.163***					0.232***	0.179***					0.214***	0.148***				
	(0.049)	(0.045)					(0.055)	(0.053)					(0.052)	(0.049)				
Iodised (1st Ban) * Median TGR			-0.049*	0.043*					-0.041	0.063*					-0.056*	0.026		
			(0.025)	(0.024)					(0.030)	(0.032)					(0.029)	(0.029)		
[1em] Iodised (Both Bans) * Median TGR					-0.049*	0.043*					-0.041	0.063*					-0.056*	0.026
					(0.025)	(0.024)					(0.030)	(0.032)					(0.029)	(0.029)
Mother's Education	0.010***	0.009***	0.006***	0.005***	0.006***	0.005***	0.010***	0.009***	0.006***	0.006***	0.006***	0.006***	0.009***	0.009***	0.006***	0.005***	0.006***	0.005***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Semi-Pucca	0.033***	0.031***	0.029***	0.029***	0.029***	0.029***	0.034***	0.033***	0.029***	0.029***	0.029***	0.029***	0.032***	0.029***	0.030***	0.029***	0.030***	0.029***
	(0.003)	(0.003)	(0.002)	(0.003)	(0.002)	(0.003)	(0.003)	(0.004)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Pucca	0.056***	0.053***	0.041***	0.041***	0.041***	0.041***	0.058***	0.055***	0.043***	0.042***	0.043***	0.042***	0.054***	0.051***	0.040***	0.039***	0.040***	0.039***
	(0.003)	(0.004)	(0.003)	(0.003)	(0.003)	(0.003)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.003)	(0.004)	(0.003)	(0.004)
HH size	-0.001***	-0.001***	-0.001***	-0.001***	-0.001***	-0.001***	-0.001***	-0.001***	-0.001***	-0.001***	-0.001***	-0.001***	-0.001***	-0.001***	-0.001***	-0.001***	-0.001***	-0.001***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Girl	2.601	3.685**	1.140	1.342	1.140	1.342												
	(1.615)	(1.744)	(0.998)	(1.209)	(0.998)	(1.209)												
[1em] Gvt Primary School in Vlg		0.013**		0.008*		0.008*		0.008		0.004		0.004		0.017***		0.011**		0.011**
		(0.005)		(0.004)		(0.004)		(0.006)		(0.005)		(0.005)		(0.006)		(0.005)		(0.005)
Vlg has Anganwadi		0.002		0.005		0.005		0.002		0.005		0.005		0.003		0.006		0.006
		(0.004)		(0.005)		(0.005)		(0.005)		(0.005)		(0.005)		(0.005)		(0.005)		(0.005)
Vlg is connected to a pucca road		0.009***		0.007**		0.007**		0.012***		0.008**		0.008**		0.008**		0.006**		0.006**
		(0.003)		(0.003)		(0.003)		(0.003)		(0.003)		(0.003)		(0.004)		(0.003)		(0.003)
Vlg has ration shop		0.010***		0.007***		0.007***		0.009***		0.008***		0.008***		0.012***		0.006**		0.006**
		(0.003)		(0.002)		(0.002)		(0.003)		(0.003)		(0.003)		(0.003)		(0.003)		(0.003)
Observations	349291	292773	388393	287226	388393	287226	164796	138409	181970	134714	181970	134714	184495	154364	206423	152512	206423	152512
R^2	0.859	0.870	0.909	0.917	0.909	0.917	0.859	0.869	0.907	0.916	0.907	0.916	0.860	0.871	0.910	0.919	0.910	0.919

This table reports the regression results from the TSLS estimation specified in Equation 4. The district level TGR is instrumented with inverse of a salinity score ranging 1-3 per district and the maximum elevation per district. The outcome is the probability of knowing basic numeracy for children aged 5-10 using the ASER data from a TSLS regression. Robust standard errors clustered on district are presented in parentheses. Columns 1-4 are estimated for the pooled sample, columns 5-8 are estimated for the sub-sample of girls and columns 9-12 are estimated for the sub-sample of boys. The following fixed effects are included; year of birth, survey year, survey year*year of birth and linear district trends. Gender specific linear trends are included in the estimates for the pooled sample. * $p < .10$, ** $p < .05$, *** $p < .01$

Table A.32: TSLS results: Effect of iodine fortification on the probability of knowing some literacy using TGR data

	Pooled						Girls						Boys					
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
Iodised (Second Ban) * Median TGR	0.040***	0.022					0.039**	0.025					0.042**	0.019				
	(0.015)	(0.015)					(0.017)	(0.017)					(0.017)	(0.017)				
Iodised (First Ban) * Median TGR			-0.013	0.011					-0.020*	0.003					-0.008	0.018*		
			(0.009)	(0.008)					(0.010)	(0.009)					(0.010)	(0.009)		
Iodised (Both Bans) * Median TGR					0.011*	0.018***					0.010	0.017**					0.012*	0.019***
					(0.007)	(0.007)					(0.007)	(0.007)					(0.007)	(0.007)
Mother's Education	0.010***	0.010***	0.007***	0.006***	0.009***	0.009***	0.011***	0.011***	0.007***	0.007***	0.009***	0.009***	0.010***	0.010***	0.007***	0.006***	0.009***	0.009***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Semi-Pucca	0.032***	0.030***	0.028***	0.028***	0.028***	0.028***	0.032***	0.032***	0.027***	0.029***	0.027***	0.029***	0.031***	0.029***	0.029***	0.028***	0.028***	0.027***
	(0.003)	(0.003)	(0.002)	(0.003)	(0.002)	(0.003)	(0.003)	(0.004)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Pucca	0.059***	0.056***	0.044***	0.043***	0.050***	0.049***	0.060***	0.057***	0.045***	0.045***	0.050***	0.050***	0.058***	0.054***	0.044***	0.041***	0.050***	0.048***
	(0.004)	(0.004)	(0.003)	(0.003)	(0.003)	(0.003)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.003)	(0.004)	(0.003)	(0.003)
HH size	-0.002***	-0.002***	-0.002***	-0.001***	-0.002***	-0.001***	-0.002***	-0.001***	-0.002***	-0.002***	-0.002***	-0.001***	-0.002***	-0.002***	-0.001***	-0.001***	-0.001***	-0.002***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Girl	-1.605	-1.203	0.905	0.598	-0.359	-0.696												
	(1.571)	(1.712)	(1.018)	(1.223)	(0.863)	(1.084)												
Gvt Primary School in Vlg		0.020***		0.013***		0.013***		0.013**		0.010*		0.009		0.026***		0.017***		0.016***
		(0.005)		(0.005)		(0.005)		(0.007)		(0.006)		(0.006)		(0.006)		(0.005)		(0.005)
Vlg has Anganwadi		-0.001		0.003		-0.001		-0.002		0.003		-0.001		0.000		0.003		0.000
		(0.004)		(0.004)		(0.004)		(0.005)		(0.005)		(0.004)		(0.005)		(0.005)		(0.005)
Vlg is connected to a pucca road		0.008**		0.005*		0.007**		0.009***		0.004		0.008**		0.007*		0.005*		0.007**
		(0.003)		(0.003)		(0.003)		(0.003)		(0.003)		(0.003)		(0.004)		(0.003)		(0.003)
Vlg has ration shop		0.009***		0.007***		0.008***		0.007**		0.007**		0.007**		0.011***		0.007***		0.010***
		(0.003)		(0.003)		(0.003)		(0.004)		(0.003)		(0.003)		(0.003)		(0.003)		(0.003)
Observations	350971	294168	390409	288888	460401	354291	165592	139068	182907	135492	216207	166649	185379	155100	207502	153396	244194	187642
R^2	0.849	0.858	0.902	0.910	0.877	0.878	0.849	0.858	0.902	0.909	0.877	0.878	0.848	0.858	0.903	0.911	0.877	0.879

The outcome is literacy score ranging from 0-4 for children aged 5-10 using the ASER data from a TSLS regression. The district level TGR has been instrumented with inverse of a salinity score ranging 1-3 and the maximum elevation per district. Robust standard errors clustered on district are presented in parentheses. Columns 1-4 are estimated for the pooled sample, columns 5-8 are estimated for the sub-sample of girls and columns 9-12 are estimated for the sub-sample of boys. The following fixed effects are included; year of birth, survey year, survey year*year of birth and linear district trends. Gender specific linear trends are included in the estimates for the pooled sample.* $p < .10$, ** $p < .05$, *** $p < .01$

Table A.33: For children in sea bordering districts: Probability of having basic numeracy skills

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Iodised * Endemic	0.008	0.008			0.030	0.009			-0.011	0.008		
	(0.028)	(0.032)			(0.032)	(0.039)			(0.034)	(0.036)		
Iodised (Both bans) * Endemic			0.006	0.011			0.004	0.010			0.008	0.012
			(0.015)	(0.014)			(0.015)	(0.014)			(0.017)	(0.016)
Mother's Education	0.007***	0.007***	0.006***	0.007***	0.007***	0.007***	0.006***	0.006***	0.008***	0.007***	0.006***	0.007***
	(0.001)	(0.001)	(0.000)	(0.000)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)	(0.001)
Semi-Pucca	0.024***	0.025***	0.021***	0.021***	0.022***	0.025***	0.019***	0.020***	0.026***	0.025***	0.023***	0.021***
	(0.005)	(0.005)	(0.004)	(0.004)	(0.006)	(0.006)	(0.005)	(0.005)	(0.006)	(0.006)	(0.005)	(0.005)
Pucca	0.042***	0.034***	0.034***	0.028***	0.041***	0.033***	0.033***	0.027***	0.042***	0.033***	0.036***	0.029***
	(0.005)	(0.006)	(0.005)	(0.005)	(0.006)	(0.007)	(0.005)	(0.006)	(0.007)	(0.007)	(0.005)	(0.006)
HH size	-0.001*	-0.001**	-0.001	-0.001	0.000	-0.000	-0.000	0.000	-0.002**	-0.002**	-0.001**	-0.001*
	(0.001)	(0.000)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Girl	0.002	0.002	0.001	0.002								
	(0.003)	(0.003)	(0.002)	(0.002)								
Gvt Primary School in Vlg		0.023**		0.017**		0.031***		0.022***		0.015		0.013
		(0.009)		(0.007)		(0.009)		(0.007)		(0.011)		(0.009)
Vlg has Anganwadi		-0.018		-0.014		-0.019		-0.012		-0.017		-0.016
		(0.011)		(0.010)		(0.012)		(0.011)		(0.015)		(0.012)
Vlg is connected to a pucca road		0.012**		0.010**		0.016**		0.014**		0.009		0.006
		(0.005)		(0.004)		(0.006)		(0.005)		(0.006)		(0.005)
Vlg has ration shop		0.015***		0.014***		0.017**		0.015**		0.012**		0.013**
		(0.005)		(0.004)		(0.007)		(0.006)		(0.006)		(0.005)
Observations	61873	50938	83070	62316	29666	24469	39647	29809	32207	26469	43423	32507
R^2	0.886	0.900	0.910	0.915	0.888	0.902	0.911	0.917	0.884	0.899	0.909	0.914

Standard errors in parentheses

Robust Standard Errors Clustered on District. Year of Birth, Survey year, survey year*year of birth linear district trends.

* $p < .10$, ** $p < .05$, *** $p < .01$

Table A.34: For children in sea bordering districts: Probability of having basic literacy skills

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Iodised * Endemic	-0.022	-0.018			0.009	0.006			-0.052*	-0.042		
	(0.024)	(0.027)			(0.030)	(0.035)			(0.028)	(0.033)		
Iodised (both bans) * Endemic			0.011	0.013			0.006	0.013			0.015	0.013
			(0.015)	(0.014)			(0.014)	(0.013)			(0.017)	(0.016)
Mother's Education	0.007***	0.007***	0.006***	0.006***	0.007***	0.007***	0.006***	0.006***	0.007***	0.007***	0.006***	0.006***
	(0.001)	(0.001)	(0.000)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)	(0.001)
Semi-Pucca	0.031***	0.028***	0.026***	0.023***	0.028***	0.024***	0.024***	0.019***	0.034***	0.030***	0.028***	0.025***
	(0.007)	(0.006)	(0.005)	(0.005)	(0.008)	(0.008)	(0.007)	(0.007)	(0.007)	(0.008)	(0.006)	(0.006)
Pucca	0.045***	0.033***	0.036***	0.028***	0.044***	0.031***	0.035***	0.025***	0.045***	0.035***	0.037***	0.030***
	(0.007)	(0.007)	(0.005)	(0.006)	(0.008)	(0.008)	(0.006)	(0.006)	(0.008)	(0.008)	(0.006)	(0.007)
HH size	-0.001*	-0.001**	-0.001*	-0.001**	-0.000	-0.001	-0.000	-0.000	-0.002**	-0.002**	-0.001*	-0.002*
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Girl	0.010***	0.011***	0.008***	0.010***								
	(0.003)	(0.003)	(0.002)	(0.003)								
Gvt Primary School in Vlg		0.014*		0.011		0.020***		0.015**		0.007		0.007
		(0.008)		(0.007)		(0.008)		(0.006)		(0.011)		(0.009)
Vlg has Anganwadi		-0.015		-0.012		-0.020*		-0.012		-0.011		-0.012
		(0.011)		(0.009)		(0.012)		(0.011)		(0.014)		(0.012)
Vlg is connected to a pucca road		0.012**		0.010**		0.017**		0.015**		0.007		0.006
		(0.006)		(0.005)		(0.007)		(0.006)		(0.007)		(0.005)
Vlg has ration shop		0.015***		0.014***		0.021***		0.019***		0.009		0.010*
		(0.005)		(0.005)		(0.007)		(0.007)		(0.006)		(0.006)
Observations	62173	51160	83411	62567	29791	24561	39797	29921	32382	26599	43614	32646
R^2	0.877	0.890	0.903	0.907	0.881	0.895	0.907	0.912	0.873	0.886	0.900	0.904

Standard errors in parentheses

Robust Standard Errors Clustered on District. Year of Birth, Survey year, survey year*year of birth linear district trends.

* $p < .10$, ** $p < .05$, *** $p < .01$

Table A.35: Placebo regression: Village connected to an all weather road.

	(1)	(2)
Iodised * Endemic	0.006	0.012
	(0.024)	(0.025)
Girl	2.552	2.812
	(2.763)	(2.761)
Mother's Education	0.004***	0.004***
	(0.001)	(0.001)
House: Semi-Pucca	0.029***	0.028***
	(0.005)	(0.005)
House: Pucca	0.045***	0.044***
	(0.006)	(0.006)
Household Size	-0.001**	-0.001**
	(0.001)	(0.001)
Gvt Primary School in Vlg.		0.028**
		(0.013)
Vlg has Anganwadi		0.080***
		(0.011)
Observations	63031	63022
R^2	0.863	0.864

Standard errors clustered on district in parentheses

Year of Birth, Survey year, survey year*year of birth linear district trends.

* $p < .10$, ** $p < .05$, *** $p < .01$

Table A.36: Probability of having basic skills using NSS regions.

	Pooled				Girls				Boys			
Dependent variable is the probability of knowing basic:	(1) Numeracy	(2) Numeracy	(3) Literacy	(4) Literacy	(5) Numeracy	(6) Numeracy	(7) Literacy	(8) Literacy	(9) Numeracy	(10) Numeracy	(11) Literacy	(12) Literacy
Iodised * Standard Deviation Goitrous areas per NSS region	0.017***	0.016***	0.019***	0.019***	0.019***	0.018***	0.022***	0.023***	0.015**	0.014**	0.016***	0.015**
	(0.005)	(0.005)	(0.004)	(0.006)	(0.005)	(0.005)	(0.005)	(0.006)	(0.006)	(0.007)	(0.005)	(0.006)
Mother's Education	0.011***	0.011***	0.012***	0.012***	0.012***	0.011***	0.013***	0.013***	0.011***	0.010***	0.012***	0.011***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Housing material: Semi-pucca	0.036***	0.034***	0.037***	0.034***	0.036***	0.033***	0.036***	0.033***	0.037***	0.034***	0.038***	0.034***
	(0.003)	(0.002)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Housing material: Pucca	0.065***	0.062***	0.068***	0.064***	0.066***	0.063***	0.069***	0.066***	0.064***	0.061***	0.067***	0.063***
	(0.004)	(0.005)	(0.004)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.004)	(0.004)	(0.004)	(0.005)
Household Size	-0.000	-0.000	-0.001	-0.001	-0.000	-0.000	-0.001	-0.000	-0.000	-0.000	-0.001	-0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)	(0.000)	(0.001)	(0.001)
Girl	2.654**	2.684**	-0.498	-0.993								
	(1.095)	(1.133)	(0.895)	(0.939)								
Gvt Primary School in Vlg		0.010**		0.017***		0.009*		0.015**		0.012*		0.018***
		(0.005)		(0.006)		(0.005)		(0.006)		(0.006)		(0.006)
Vlg has Anganwadi		0.005		0.004		0.005		0.004		0.004		0.004
		(0.003)		(0.004)		(0.004)		(0.004)		(0.003)		(0.004)
Vlg is connected to a pucca road		0.014***		0.012***		0.014***		0.012***		0.014***		0.012***
		(0.003)		(0.003)		(0.003)		(0.003)		(0.003)		(0.004)
Vlg has ration shop		0.013***		0.014***		0.013***		0.014***		0.012***		0.014***
		(0.002)		(0.002)		(0.003)		(0.003)		(0.002)		(0.002)
Observations	827547	695403	831614	698703	386104	325264	388003	326780	441443	370139	443611	371923
R^2	0.840	0.852	0.828	0.838	0.838	0.849	0.827	0.837	0.843	0.855	0.829	0.840

The outcome variable is the probability of mastering basic numeracy and literacy for children aged 5-10 using the ASER data. Robust standard errors clustered on National Sample Survey regions and are presented in parentheses. Columns 1-6 are estimated for the pooled sample, columns 7-12 are estimated for the sub-sample of girls and columns 13-18 are estimated for the sub-sample of boys. The following fixed effects are included; year of birth, survey year, survey year*year of birth and linear national sample survey trends. Gender specific linear trends are included in the estimates for the pooled sample.* $p < .10$, ** $p < .05$, *** $p < .01$

Table A.37: Effects on age standardised overall test scores using NSS regions.

	Pooled				Girls				Boys			
Dependent variable is the age standardised overall score in:	(1) Numeracy	(2) Numeracy	(3) Literacy	(4) Literacy	(5) Numeracy	(6) Numeracy	(7) Literacy	(8) Literacy	(9) Numeracy	(10) Numeracy	(11) Literacy	(12) Literacy
Iodised * Endemic (Std. goitre areas per NSS region)	0.023**	0.021*	0.029**	0.029**	0.029***	0.025**	0.038**	0.040**	0.019	0.016	0.019*	0.019
	(0.010)	(0.012)	(0.011)	(0.013)	(0.009)	(0.011)	(0.015)	(0.017)	(0.014)	(0.015)	(0.011)	(0.013)
Mother's Education	0.030***	0.029***	0.033***	0.033***	0.031***	0.031***	0.034***	0.035***	0.029***	0.028***	0.031***	0.031***
	(0.002)	(0.002)	(0.003)	(0.003)	(0.002)	(0.002)	(0.003)	(0.003)	(0.002)	(0.002)	(0.002)	(0.003)
House Material: Semi-Pucca	0.104***	0.100***	0.104***	0.100***	0.105***	0.102***	0.104***	0.101***	0.104***	0.099***	0.105***	0.099***
	(0.007)	(0.007)	(0.008)	(0.008)	(0.009)	(0.009)	(0.009)	(0.009)	(0.008)	(0.008)	(0.008)	(0.009)
House Material: Pucca	0.180***	0.176***	0.185***	0.179***	0.186***	0.183***	0.191***	0.187***	0.174***	0.170***	0.180***	0.173***
	(0.013)	(0.014)	(0.013)	(0.015)	(0.015)	(0.016)	(0.015)	(0.016)	(0.012)	(0.013)	(0.012)	(0.014)
Household Size	-0.001	-0.001	-0.002	-0.002	-0.001	-0.001	-0.002	-0.002	-0.001	-0.001	-0.002	-0.002
	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.001)	(0.001)	(0.002)	(0.002)
Girl	1.585	0.352	-5.115**	-7.296***								
	(2.582)	(2.880)	(2.296)	(2.641)								
Gvt Primary School in Vlg		0.031**		0.045***		0.026*		0.039**		0.035**		0.050***
		(0.013)		(0.015)		(0.013)		(0.015)		(0.016)		(0.016)
Vlg has Anganwadi		0.020**		0.019*		0.023**		0.020*		0.017*		0.018*
		(0.009)		(0.010)		(0.011)		(0.012)		(0.009)		(0.010)
Vlg is connected to pucca road		0.037***		0.028***		0.037***		0.026***		0.038***		0.030***
		(0.008)		(0.009)		(0.008)		(0.009)		(0.009)		(0.010)
Vlg has rationshop		0.033***		0.035***		0.035***		0.038***		0.031***		0.033***
		(0.006)		(0.006)		(0.007)		(0.008)		(0.006)		(0.006)
Observations	827547	695403	831614	698703	386104	325264	388003	326780	441443	370139	443611	371923
R^2	0.075	0.074	0.090	0.090	0.082	0.081	0.098	0.099	0.068	0.067	0.083	0.082

The outcome variables are age standardised overall numeracy and literacy scores for children aged 5-10 using the ASER data. Robust standard errors clustered on National Sample Survey regions and are presented in parentheses. Columns 1-6 are estimated for the pooled sample, columns 7-12 are estimated for the sub-sample of girls and columns 13-18 are estimated for the sub-sample of boys. The following fixed effects are included; year of birth, survey year, survey year*year of birth and linear national sample survey trends. Gender specific linear trends are included in the estimates for the pooled sample.* $p < .10$, ** $p < .05$, *** $p < .01$

Table A.38: Probability of having basic skills using standardised goitre areas/states.

	Pooled				Girls				Boys			
Dependent variable is the probability of knowing basic:	(1) Numeracy	(2) Numeracy	(3) Literacy	(4) Literacy	(5) Numeracy	(6) Numeracy	(7) Literacy	(8) Literacy	(9) Numeracy	(10) Numeracy	(11) Literacy	(12) Literacy
Iodised * Endemic (Std. goitre points per state)	0.022***	0.016***	0.022***	0.018***	0.022***	0.017***	0.024***	0.021***	0.021***	0.014**	0.021***	0.016***
	(0.005)	(0.005)	(0.004)	(0.006)	(0.005)	(0.005)	(0.005)	(0.006)	(0.006)	(0.006)	(0.005)	(0.006)
Mother's Education	0.011***	0.011***	0.012***	0.012***	0.012***	0.011***	0.013***	0.013***	0.011***	0.010***	0.012***	0.012***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)
Housing material: Semi-pucca	0.036***	0.033***	0.037***	0.034***	0.036***	0.033***	0.036***	0.033***	0.037***	0.034***	0.038***	0.034***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Housing material: Pucca	0.066***	0.062***	0.068***	0.064***	0.066***	0.063***	0.070***	0.066***	0.064***	0.061***	0.067***	0.063***
	(0.005)	(0.006)	(0.006)	(0.006)	(0.006)	(0.007)	(0.006)	(0.007)	(0.005)	(0.006)	(0.005)	(0.005)
Household Size	-0.000	-0.000	-0.001	-0.001	-0.000	-0.000	-0.001	-0.000	-0.000	-0.000	-0.001	-0.001
	(0.000)	(0.000)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)
Girl	2.761**	2.693**	-0.495	-0.956								
	(1.183)	(1.133)	(0.919)	(0.788)								
Government Primary School in Vlg		0.010*		0.017***		0.009		0.015**		0.012*		0.019***
		(0.006)		(0.005)		(0.006)		(0.006)		(0.006)		(0.006)
Vlg has Anganwadi		0.004		0.004		0.005		0.004		0.003		0.004
		(0.004)		(0.005)		(0.004)		(0.006)		(0.004)		(0.005)
Vlg is connected to pucca road		0.014***		0.012***		0.014***		0.011***		0.014***		0.012***
		(0.003)		(0.003)		(0.002)		(0.003)		(0.003)		(0.004)
Vlg has rationshop		0.013***		0.014***		0.013***		0.014***		0.012***		0.014***
		(0.002)		(0.002)		(0.003)		(0.002)		(0.002)		(0.003)
Observations	827547	695403	831614	698703	386104	325264	388003	326780	441443	370139	443611	371923
R^2	0.840	0.852	0.828	0.838	0.838	0.849	0.827	0.836	0.843	0.855	0.829	0.840

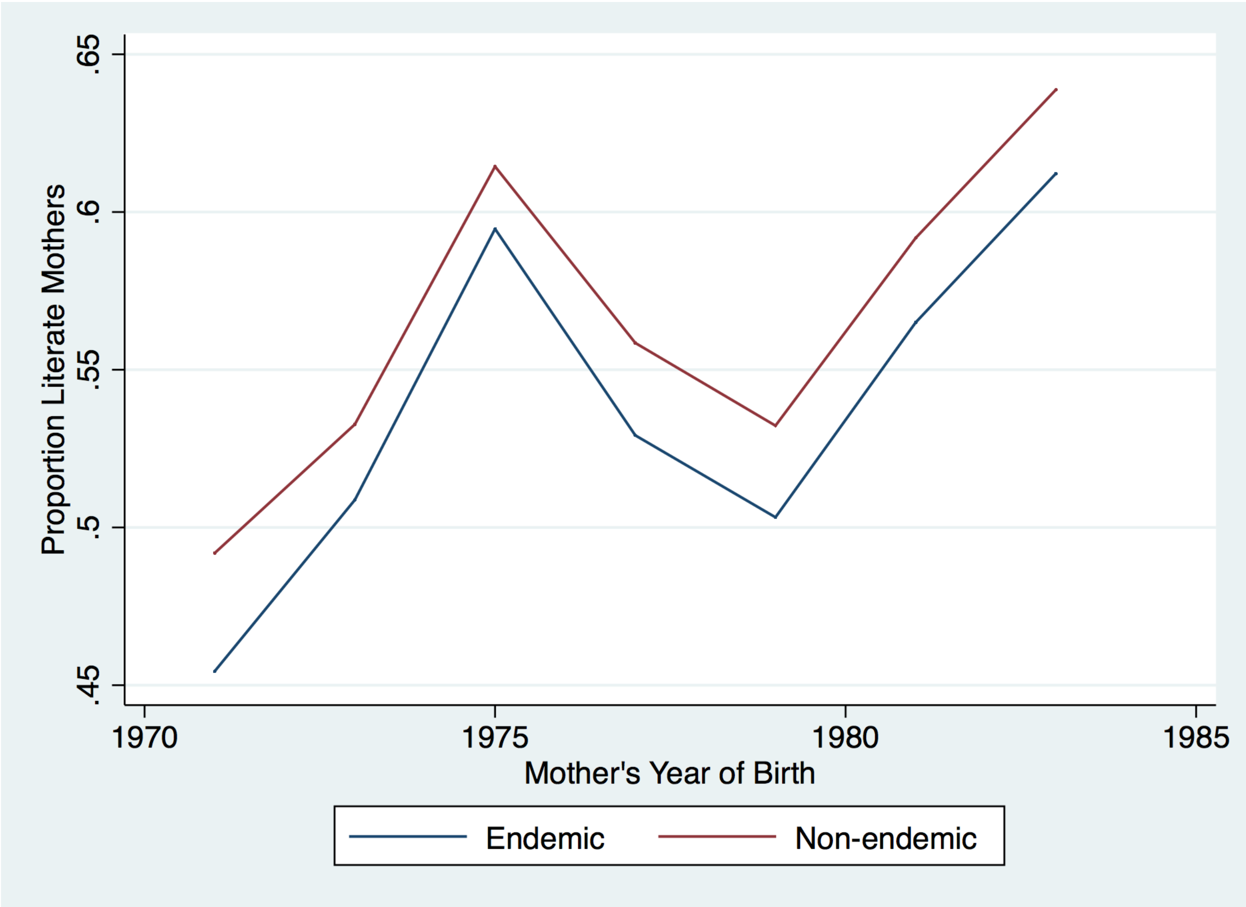
This tables shows the regression results from Equation 2 with the exception that I measure endemicity by the standardised number of goitre areas per state. The outcome variable is the probability of mastering basic numeracy and literacy for children aged 5-10 using the ASER data. Robust standard errors clustered on states and are presented in parentheses. Columns 1-6 are estimated for the pooled sample, columns 7-12 are estimated for the sub-sample of girls and columns 13-18 are estimated for the sub-sample of boys. The following fixed effects are included; year of birth, survey year, survey year*year of birth and linear state trends. Gender specific linear trends on state level are included in the estimates for the pooled sample.* $p < .10$, ** $p < .05$, *** $p < .01$

Table A.39: Effect on overall age standardised numeracy and literacy scores using standardised goitre areas/states.

	Pooled				Girls				Boys			
Dependent variable is the probability of knowing basic:	(1) Numeracy	(2) Numeracy	(3) Literacy	(4) Literacy	(5) Numeracy	(6) Numeracy	(7) Literacy	(8) Literacy	(9) Numeracy	(10) Numeracy	(11) Literacy	(12) Literacy
Iodised * Endemic (Std. goitre points per state)	0.003	-0.002	0.007	0.003	0.004	-0.000	0.015*	0.012**	0.002	-0.004	-0.001	-0.005
	(0.007)	(0.005)	(0.006)	(0.005)	(0.008)	(0.005)	(0.008)	(0.005)	(0.007)	(0.007)	(0.006)	(0.006)
Mother's Education	0.047***	0.046***	0.046***	0.047***	0.047***	0.048***	0.048***	0.049***	0.045***	0.045***	0.044***	0.045***
	(0.003)	(0.003)	(0.004)	(0.004)	(0.003)	(0.003)	(0.004)	(0.004)	(0.003)	(0.003)	(0.003)	(0.003)
Housing material: Semi-pucca	0.117***	0.109***	0.123***	0.118***	0.106***	0.103***	0.118***	0.113***	0.117***	0.114***	0.128***	0.122***
	(0.009)	(0.010)	(0.008)	(0.008)	(0.009)	(0.010)	(0.008)	(0.008)	(0.010)	(0.010)	(0.009)	(0.009)
Housing material: Pucca	0.264***	0.247***	0.250***	0.245***	0.245***	0.244***	0.255***	0.253***	0.251***	0.249***	0.246***	0.239***
	(0.013)	(0.014)	(0.013)	(0.014)	(0.014)	(0.014)	(0.014)	(0.015)	(0.013)	(0.014)	(0.013)	(0.013)
Household Size	-0.000	-0.001	-0.001	-0.000	-0.001	-0.001	-0.001	-0.000	-0.001	-0.001	-0.001	-0.001
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.001)	(0.001)	(0.002)	(0.002)
Girl	-5.363*	-8.335*	-3.713	-3.927								
	(3.102)	(4.360)	(3.747)	(4.642)								
Gvt Primary School in Vlg		0.040**		0.042**		0.042**		0.039*		0.038**		0.045***
		(0.016)		(0.017)		(0.018)		(0.020)		(0.016)		(0.016)
Vlg has Anganwadi		0.007		0.010		0.010		0.010		0.005		0.010
		(0.010)		(0.011)		(0.007)		(0.009)		(0.013)		(0.014)
Vlg is connected to a pucca road		0.044***		0.044***		0.044***		0.041***		0.044***		0.045***
		(0.010)		(0.012)		(0.010)		(0.012)		(0.012)		(0.013)
Vlg has ration shop		0.048***		0.046***		0.047***		0.046***		0.049***		0.046***
		(0.005)		(0.006)		(0.005)		(0.006)		(0.005)		(0.007)
Observations	827547	695403	831614	698703	386104	325264	388003	326780	441443	370139	443611	371923
R^2	0.149	0.163	0.123	0.131	0.175	0.187	0.137	0.146	0.136	0.143	0.111	0.117

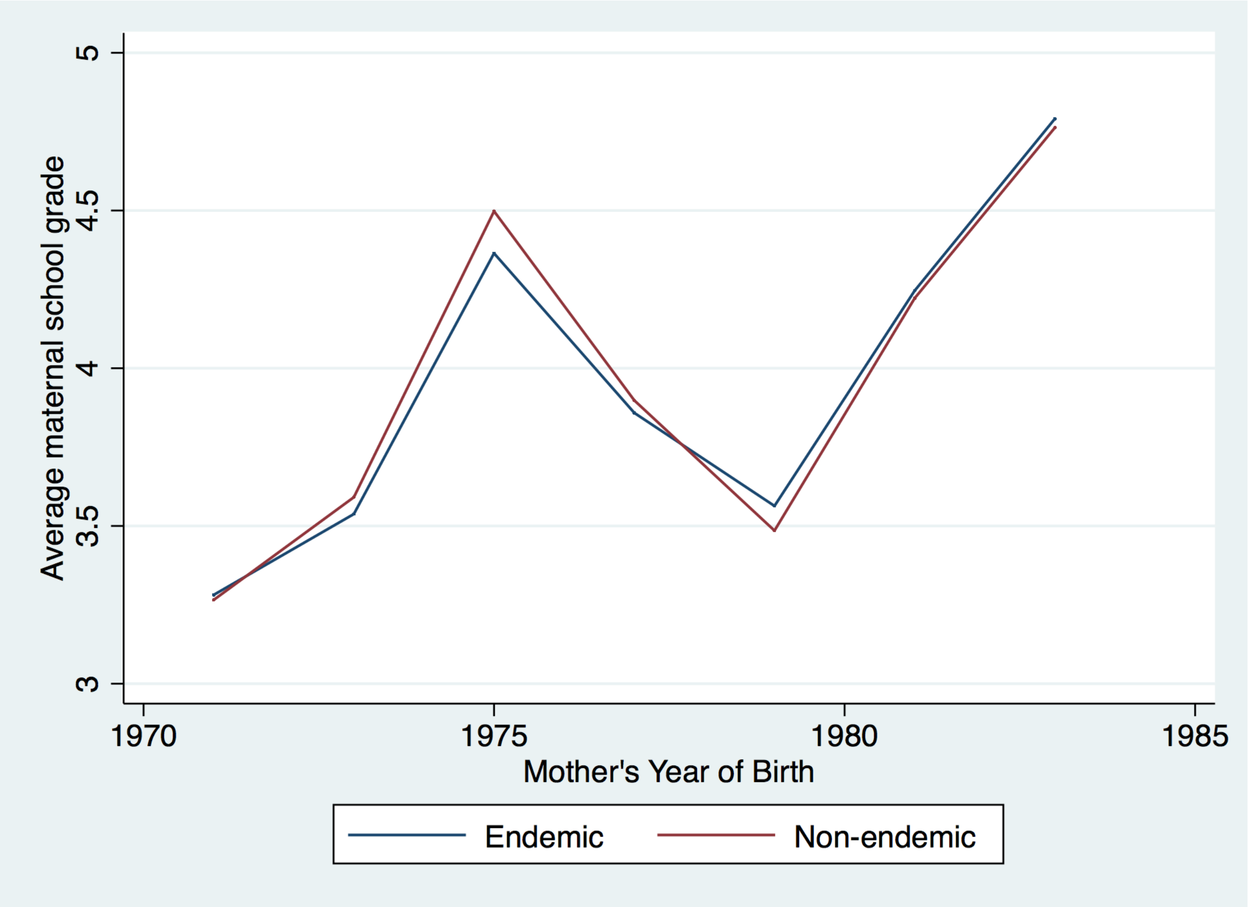
This tables shows the regression results from Equation 2 with the exception that I measure endemicity by the standardised number of goitre areas per state. The outcome variable are age standardised overall test scores in numeracy and literacy for children aged 5-10 using the ASER data. Robust standard errors clustered on states and are presented in parentheses. Columns 1-6 are estimated for the pooled sample, columns 7-12 are estimated for the sub-sample of girls and columns 13-18 are estimated for the sub-sample of boys. The following fixed effects are included; year of birth, survey year, survey year*year of birth and linear state trends. Gender specific linear trends on state level are included in the estimates for the pooled sample.* $p < .10$, ** $p < .05$, *** $p < .01$

Figure A.15: Pre-Trends in Literacy



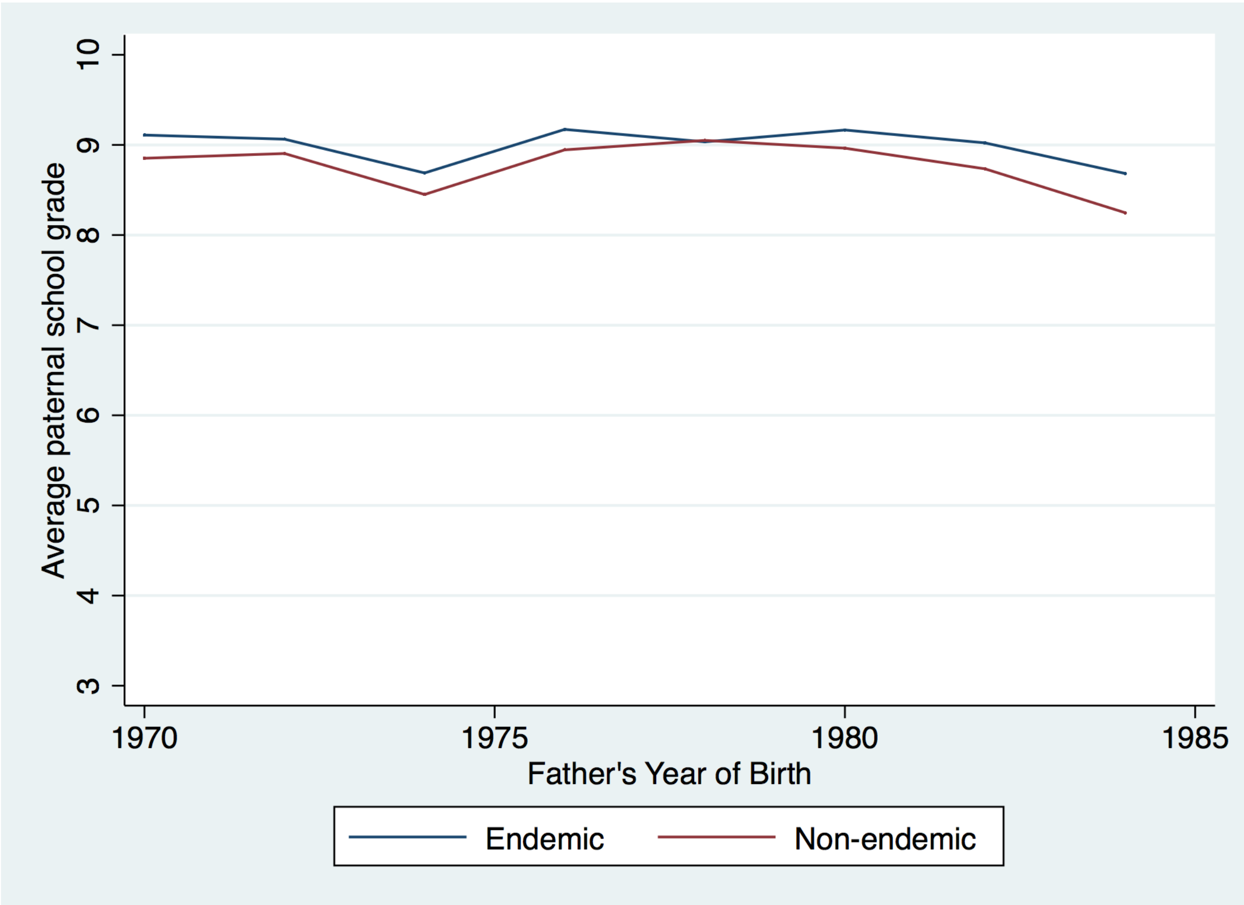
x

Figure A.16: Pre-Trends in Schooling Attainment - Mothers



Bla

Figure A.17: Pre-Trends in Schooling Attainment - Fathers



Bla

Table A.40: Balance of Covariates: Observed Properties Uncorrelated with Policy Timing.

	(1) Mother's Educ	(2) Pucca House	(3) Girl	(4) Gvt Primary School	(5) Anganwadi	(6) Pucca road	(7) Ration shop
Iodised * Endemic	-0.073	-0.014**	0.000**	0.002	-0.015***	-0.004	-0.004
	(0.050)	(0.006)	(0.000)	(0.004)	(0.005)	(0.006)	(0.007)
Observations	1175015	1102800	1237498	1044654	958189	1093464	1091376
R^2	0.545	0.459	1.000	0.938	0.928	0.791	0.741

Robust standard errors clustered on district in parentheses. The following covariates are included: year of birth, survey year, survey year*year of birth and gender specific linear district trends.

* $p < .10$, ** $p < .05$, *** $p < .01$

Table A.41: Balance of Covariates: Observed Properties Uncorrelated with Policy Timing.

	(1) Mother's Educ	(2) Pucca House	(3) Girl	(4) Gvt Primary School	(5) Anganwadi	(6) Pucca road	(7) Ration shop
Iodised * Endemic	0.001	-0.017**	0.000**	0.006	-0.015***	-0.004	0.002
	(0.055)	(0.007)	(0.000)	(0.005)	(0.005)	(0.007)	(0.007)
Pucca	2.279***		0.000	0.001	0.004***	0.036***	0.024***
	(0.039)		(0.000)	(0.001)	(0.001)	(0.003)	(0.003)
HH size	-0.017***	0.009***	0.000***	-0.000	0.000	-0.000	-0.000
	(0.004)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Girl	13.502	0.150		0.296	0.611	-0.846	-0.651
	(8.571)	(0.824)		(0.486)	(0.564)	(0.836)	(0.929)
Gvt Primary School in Vlg	0.036	0.003	0.000		0.140***	0.037***	0.114***
	(0.044)	(0.004)	(0.000)		(0.012)	(0.008)	(0.010)
Vlg has Anganwadi	0.222***	0.017***	0.000	0.118***		0.082***	0.217***
	(0.038)	(0.004)	(0.000)	(0.010)		(0.008)	(0.010)
Vlg is connected to a pucca road	0.410***	0.051***	-0.000	0.014***	0.036***		0.167***
	(0.027)	(0.003)	(0.000)	(0.003)	(0.004)		(0.007)
Vlg has ration shop	0.365***	0.034***	-0.000	0.037***	0.083***	0.148***	
	(0.023)	(0.003)	(0.000)	(0.004)	(0.004)	(0.006)	
Mother's Educ			0.000	0.000	0.001***	0.004***	0.004***
			(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Observations	852979	887174	852979	852979	852979	852979	852979
R^2	0.580	0.473	1.000	0.942	0.930	0.803	0.757

Robust standard errors clustered on district in parentheses. The following covariates are included:
year of birth, survey year, survey year*year of birth and gender specific linear district trends.
* $p < .10$, ** $p < .05$, *** $p < .01$

Table A.42: Falsification Checks - The effect of iodine fortification on contemporaneous vaccinations and diarrhoea

	(1) BCG	(2) BCG	(3) Measles	(4) Measles	(5) Vitamin A	(6) Vitamin A	(7) Had Diarrhoea	(8) Had Diarrhoea
Iodised * Endemic	-0.057**		-0.006		-0.006		0.003	
	(0.028)		(0.033)		(0.033)		(0.013)	
Iodised (Both bans) * Endemic		-0.002		-0.013		-0.013		0.008
		(0.012)		(0.016)		(0.016)		(0.006)
Mother's Education	0.009***	0.011***	0.007***	0.010***	0.007***	0.010***	0.000	-0.000
	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Primary school in village	0.021***	0.020***	0.018***	0.018***	0.018***	0.018***	-0.008**	-0.006*
	(0.006)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.004)	(0.003)
Girl	-0.012***	-0.015***	-0.009***	-0.012***	-0.009***	-0.012***	-0.006***	-0.006***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Anganwadi in vlg	0.019***	0.020***	0.011***	0.011***	0.011***	0.011***	0.001	0.003
	(0.005)	(0.005)	(0.004)	(0.004)	(0.004)	(0.004)	(0.003)	(0.003)
Semi-Pucca	0.037***	0.040***	0.025***	0.030***	0.025***	0.030***	0.001	0.000
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.002)	(0.002)
Pucca	0.044***	0.053***	0.037***	0.049***	0.037***	0.049***	-0.001	-0.001
	(0.005)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.003)	(0.003)
Observations	175567	217804	175507	217711	175507	217711	175170	217861
R^2	0.587	0.633	0.472	0.527	0.472	0.527	0.194	0.192

Robust standard errors clustered on district in parentheses. Data from the DLHS 2 and DLHS 3 is used.
I control for year of birth, interview year, interview year*year of birth linear district trends.
* $p < .10$, ** $p < .05$, *** $p < .01$