London School of Economics and Political Science

Public policy and social determinants of nutrition behaviour and outcomes – quasi-experimental evidence from low- and middle-income countries

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Declaration of Authorship

I certify that the thesis I have presented for examination for the PhD degree of the London School of Economics and Political Science is solely my own work other than where I have clearly indicated that it is the work of others (in which case the extent of any work carried out jointly by me and any other person is clearly identified in it).

I warrant that this authorisation does not, to the best of my belief, infringe the rights of any third party.

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Statement of co-authored work

I confirm that Chapter 2 was co-authored with Dr. Joan Costa-Font and Dr. Belén Saénz de Miera Juárez. The co-authors provided access to administrative data as well as guidance on the literature, empirical strategy, and institutional background in Mexico. We jointly conceived the idea for the analysis, while I carried out all the estimates and wrote all the sections of the chapter. Overall, I contributed 65% of the work. Chapter 3 was co-authored with Dr. Joan Costa-Font, who provided the idea for the overall research topic and provided guidance on the empirical strategy and the structure of the paper. We jointly conceived the idea for the specific analysis to be carried out. I investigated appropriated data sources, merged and prepared the data for the analysis, carried out all the estimates and wrote all the sections of the chapter. Overall, I contributed 55% of the work for chapter 3.

Abstract

As of today approximately 3.19 billion people worldwide, i.e. 42 percent of the world's population, are malnourished. Out of them 811 million are undernourished and 2.38 billion people are overweight or obese. Both undernutrition and overnutrition are a health risk for the affected individuals, and lower their productive capacities and labour market perspectives. This thesis provides evidence on how public policy can create an incentive architecture which is conducive to healthy nutrition behaviour in low and middle income countries (LMICs).

The first paper analyses whether the conditional cash transfer programme *Bolsa Familia* in Brazil has influenced food consumption and nutritional outcomes among its beneficiaries. The results show that the bulk of the cash transfers is spent on food, with a disproportionate increase in the consumption of dairy and sugary products, but no overall impact on overweight and obesity.

The second paper investigates whether the free health insurance programme Seguro Popular in Mexico has altered nutritional choices and outcomes among low-income families in Mexico. The analysis suggests that the programme has increased obesity among those who were already overweight at baseline, and that beneficiaries have reduced the consumption of carbohydrates in favour of meat.

The third paper focuses on the importance of gender norms in determining nutritional outcomes and describes the growing disparities in obesity rates between women and men. It shows that female empowerment leads to lower gender obesity gaps in a worldwide sample of countries, but that this effect is entirely driven by the MENA region.

The fourth paper focuses on peer effects and social learning. It assesses the impact of a behaviour change campaign to reduce child malnutrition in Mozambique. The paper shows that the programme did not only improve nutritional practices among the programme's participants, but also among untreated neighbours, suggesting the presence of social learning effects.

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List of Abbreviations

2SLS – Two-stage Least Squares

ACA – Affordable Care Act

AIBF – *Avaliação de Impacto do programa Bolsa Familia* dataset

ATT – Average Treatment Effect on the Treated

BCI – Behaviour Change Intervention

BF – Bolsa Familia

BMI – Body Mass Index

BRL – Brazilian Real

CCT – Conditional cash transfer

CNPSS - *Comisión Nacional de Protección Social en Salud*

CONEVAL - *Consejo Nacional de Evaluación de la Política Social*

CT – Cash transfer

DiD – Difference-in-difference

FAO – Food and Agriculture Organisation of the United Nations

FE – Fixed Effect

GDI - Gender Development Index

GDP – Gross Domestic Product

INEGI - Instituto Nacional de Estadística y Geografía

IV – Instrumental Variable

LMICs - Low and middle income countries

MENA - Middle East and North Africa

MP – Member of Parliament

MxFLS - Mexican Family Life Survey

OECD – Organisation of Economic Cooperation and Development

OLS – Ordinary Least Squares

RE – Random Effect

SBCC – Social and Behaviour Change Communication

SP – Seguro Popular

WFP – World Food Programme

WHO – World Health Organisation

UK – United Kingdom

UNDP – United Nations Development Programme

US – United States of America

USD – United States Dollar

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1. Introduction

More and more low- and middle-income countries (LMICs)[1] are affected by a 'triple-burden of malnutrition – persisting undernutrition goes hand in hand with micronutrient deficiencies as well as rising levels of overweight and obesity. All three phenomena have dramatic consequences for the health and wellbeing of the affected individuals and can pose an obstacle to economic development at large.

[1] LMICs are defined following the World Bank's definition: Gross National Income per capita < USD12,536

Malnutrition in all of its forms negatively affects the human capital available in an economy and can put the sustainability of public health systems at risk.

In this context, this thesis provides evidence on how public policy can create an incentive architecture which is conducive to healthy nutrition behaviour. It analyses the effectiveness of different incentives for healthy nutrition behaviours and aims at closing – or at least narrowing – a number of research gaps in the area. In particular, it investigates on four topics for which there has only been scarce evidence before:

- **Monetary incentives / social cash transfers**: the intended and unintended impacts of conditional cash transfers on food consumption and nutritional outcomes among low-income households in Brazil
- **In-kind incentives / free health insurance**: the potential of free health insurance to counteract overnutrition in a context of sharply rising obesity rates in Mexico
- **Social incentives / gender norms**: the importance of patriarchal gender norms in explaining rising disparities in obesity between men and women, with a focus on the Middle East and North Africa (MENA) region
- **Social incentives / social learning**: the role of social learning in promoting healthy nutrition behaviours in rural villages of Mozambique which are characterised by a high prevalence of undernutrition and food insecurity

This introductory chapter will illustrate the relevance of this research by analysing recent trends related to both undernutrition and overnutrition (section 1.1), and presenting previous research on their causes and consequences (section 1.2). Section 1.3 will discuss the role of individual behaviours in determining nutrition-related outcomes, based on both theoretical and empirical literature. Based on this discussion, section 1.4 identifies a number of research gaps and presents the research questions to be addressed in this thesis.

1. Prevalence and trends in underweight, overweight and obesity

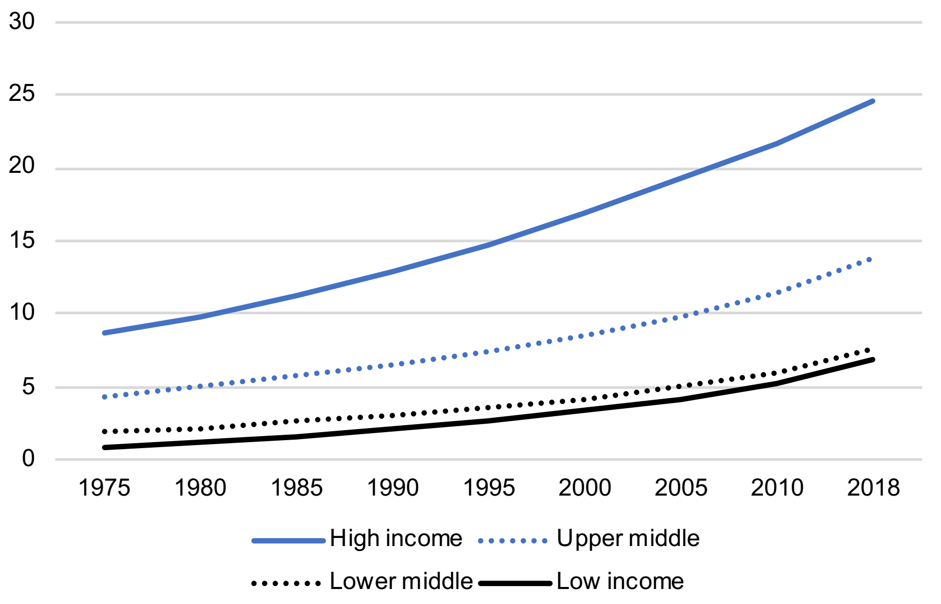
Today approximately 3.18 billion people worldwide are malnourished – this corresponds to almost 42 percent of the world's population[2]. Out of them 811

[2] Throughout this thesis, the term „malnutrition" is intended to encompass both undernutrition and overnutrition.

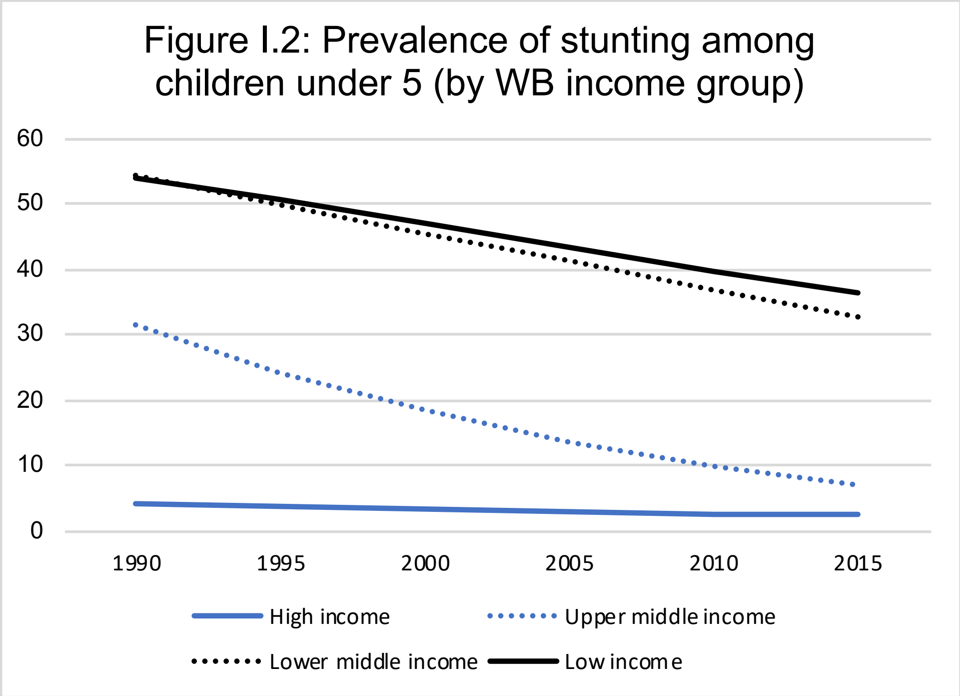
million people, or 10.8% of the world's population are undernourished, while 2.38 billion people are overweight (31.3 percent) and 822 million people are obese (10.8 percent)[3]. (FAO et al. 2019)

Overweight and obesity are no longer a problem affecting only high-income countries. Obesity rates in LMICs have been rising substantially over the last three decades, as illustrated in figure 1. In upper middle-income countries obesity rates have doubled since 1990, and even in low-income and lower-middle-income countries, the growth in obesity has accelerated recently. As a consequence, the WHO has been describing obesity as a "global epidemic" (James 2008; World Health Organization 2000).

Figure I.1: Obesity prevalence over time
(% of population, by WB income groups)



[3] Following the approach of the World Health Organization (2014), overweight is defined as a Body Mass Index (BMI) larger than 25. Obesity is defined as a BMI larger than 30. The BMI is defined as $BMI = \frac{Weight\ in\ kg}{(Height\ in\ meter)^2}$. This implies that the number of obese people cited here is a subset of the number of overweight people.
Following the UN Food and Agriculture Organization's approach, undernourishment is defined as consuming less calories than the FAO-determined country-specific threshold on the minimum caloric requirements for performing light or sedentary activities.



On the other hand, undernutrition remains an important problem, as illustrated by figure 2. While upper-middle income countries have e.g. managed to substantially reduce stunting among children, progress has been much slower in low-income and lower-middle-income countries, where on average still more than a third of children are stunted. Moreover, while undernourishment across all age groups had been declining until 2015 when it reached a minimum of 785.4 million people (10.6 percent of the world population), it has been increasing both in absolute and relative terms since then (FAO 2019). Moreover, it is estimated that 1.5 billion people are affected by at least one form of micronutrient deficiency (Development Initiatives 2018).

More and more countries are therefore affected by a double or triple burden of malnutrition, with a high prevalence of overweight/obesity, undernourishment and/or micronutrient deficiencies at the same time. Development Initiatives (2018) shows that out of 141 analysed countries, 88 percent suffered from at least two forms of malnutrition, while 29 percent were affected by all three forms. It is important to note that multiple forms of malnutrition do not only co-exist in the same countries, but also within a single household or even at the individual level. As argued by the FAO (2018), it is more and more common for households to feature both a stunted child and an overweight mother. Development Initiatives (2018) found that 1.9 percent of all children under 5 are at the same time stunted and overweight. Even if both conditions may not always coincide at the same time, several studies have confirmed that childhood stunting is a major risk factor for overweight/obesity during adolescence and adulthood (Popkin et al. 1996, Hoffmann et al. 2000)

International organisations have also pointed out that food insecurity, i.e. poor food access, and overnutrition go hand in hand very frequently today. Especially households exposed to moderate levels of food insecurity tend to opt for diets which are energy-dense, but lack important micronutrients like iron or vitamin A. For children this can lead to impaired growth, while for adults it increases the risk of overweight and obesity. Moreover, psychosocial factors may also play a role, with food insecurity causing stress and anxiety, which has been associated to an overconsumption of energy-dense “comfort foods” (FAO et al. 2018, FAO et al. 2019)

Moreover, even in many LMICs overweight and obesity are increasingly affecting low-income populations. Templin et al. (2019) show for example that with increasing GDP levels over time, overweight prevalence increases substantially among the poor, but remains unchanged among richer parts of the population. If LMICs follow the path of today’s high-income countries, it can be expected that in the future their low-income populations will also experience the highest obesity burden. This poses additional challenges for the targeting of policies to address both over- and undernutrition and increases the risk of unintended consequences of policies.

What are the main takeaways from this analysis of trends: First, the numbers illustrate that malnutrition is a tremendous challenge, affecting almost half of the world’s population. Secondly, LMICs are already disproportionately affected by the triple burden of malnutrition and can be expected to carry an even higher burden in the future. Third, this implies that research on nutrition-related policies in LMICs are of high policy relevance, and important to achieve overarching international goals, such as the Sustainable Development Goals 2 (ending hunger and malnutrition) and 3 (Ensure healthy lives and promote well-being for all at all ages). The following paragraphs discuss the causes and consequences of malnutrition and discuss how both phenomena can be addressed by policy.

2. Causes and consequences of malnutrition

Overnutrition arises when an individual's caloric intake is higher than his caloric expenditure (Costa-Font, Mas, and Navarro 2013; Cutler, Glaeser, and Shapiro 2003; Lakdawalla and Philipson 2009). Over the last decades, a decrease of manual tasks in everyday life and an increase of "sedentary" activities have led to lower caloric requirements for many people. Nevertheless, the average daily intake of calories has increased in most high and middle income countries (Costa-Font, Mas, and Navarro 2013). This is often attributed to an increased consumption of processed food and meals out, which typically contain higher levels of calories, sugar, and fat, than home-cooked meals (Chou, Grossman, and Saffer 2004; Popkin and Gordon-Larsen 2004; Stoddard et al. 2011)

Undernutrition occurs when an individual cannot meet her caloric needs, i.e. caloric intake is smaller than caloric expenditure (Black et al. 2013; Dasgupta and Ray 1986) However, undernutrition can also be caused by a lack of nutritional diversity and/or the shortage of certain micronutrients, such as Vitamin A or iron (Banerjee and Duflo 2011; Black et al. 2013). Infectious diseases such as malaria and diarrhoea can also contribute to malnutrition (see e.g. Bhutta et al., 2013)

Both undernutrition and overnutrition have important negative implications for the health and labour market outcomes of the affected individuals. Undernutrition limits the capacity for both physical and intellectual work (Banerjee and Duflo 2011; Dasgupta and Ray 1986). For children, it leads to lower educational attainment and worse labour market outcomes in adulthood (Case and Paxson 2008; E. Field et al. 2009; Miguel and Kremer 2004) and is also a major risk factor for child mortality (Black et al. 2008). Overweight and obesity are associated with several chronic diseases such as high blood pressure, high cholesterol, type II diabetes, cancer, heart disease and arthritis (Di Cesare et al. 2016; A. E. Field et al. 2001; Sturm 2002)

At the macro level, undernutrition leads to a lower level of human capital in the economy, and may undermine a country's perspective for growth and economic development (Banerjee and Duflo 2011). Overweight and obesity and the associated chronic diseases may put the sustainability of public health systems at risk. Sturm (2002) estimates that health care costs for obese people are 36 percent higher, and medication costs 77 percent higher than for people in a normal weight range. Both undernutrition and overnutrition should therefore be an important concern to societies aiming to maximize their welfare.

In the broadest sense, one can distinguish between three different factors which influence nutritional outcomes. First, there are inherent individual-level (e.g. genetic) factors which determine individual tastes, the functioning of an individual's metabolism and thus their propensity to absorb nutrients and accumulate fat, as well as an individual's immune system which determines the risk of contracting infectious diseases and related nutritional conditions. Secondly, there are supply-side factors, as e.g. the availability and diversity of food on local markets, relative prices of different foods (determined *inter alia* by the available food production technologies, transport costs, agricultural policies, see e.g. Popkin et al. 2012), or the availability and quality of health care to detect nutrition-related conditions and provide treatment to the affected individuals. Lastly, there are also demand-side factors which may influence an individual's nutrition-related choices and outcomes, such as an individual's income, coverage by health insurance, their knowledge about and attitudes towards nutrition, or their preferences for exercising. This thesis focuses particularly on these demand-side factors and the question to what extent public policy can influence individual choices related to nutritional outcomes.

3. Malnutrition as a sub-optimal market outcome – the rationale for policy intervention

In conventional economic theory, nutrition behaviour can be modelled as the outcome of rational decisions taken by individuals who maximize the present value of their lifetime utility under scarce resources (Cawley 2004). Given competitive markets where prices reflect both the internal and external costs of all goods, the individual nutrition decisions will necessarily maximize the individual's welfare and at the same time contribute to the maximization of society's welfare. If these assumptions held, the high levels of both undernutrition and obesity would be optimal market outcomes and public policies to alter these outcomes would decrease overall welfare (Cawley 2004; Mazzochi, Traill, and Shogren 2009)

However, as argued by Mazzocchi et al. (ibid), there is reason to assume that (a) nutritional markets do not always work perfectly and (b) humans do not always make completely rational nutrition decisions. Market prices of processed food might for example only reflect the costs of its production, but not external costs caused through its impact on obesity and health. On the other hand, humans might hold preferences for eating healthy food, but behavioural factors like present-biased preferences and instantaneous emotional cues might prevent them from making rational decisions. (Liu et al. 2014; Mazzochi, Traill, and Shogren 2009). In such a situation, public policy interventions that alter nutritional behaviour can increase a society's overall welfare.

4. Public policy and social determinants of nutrition behaviour - theory

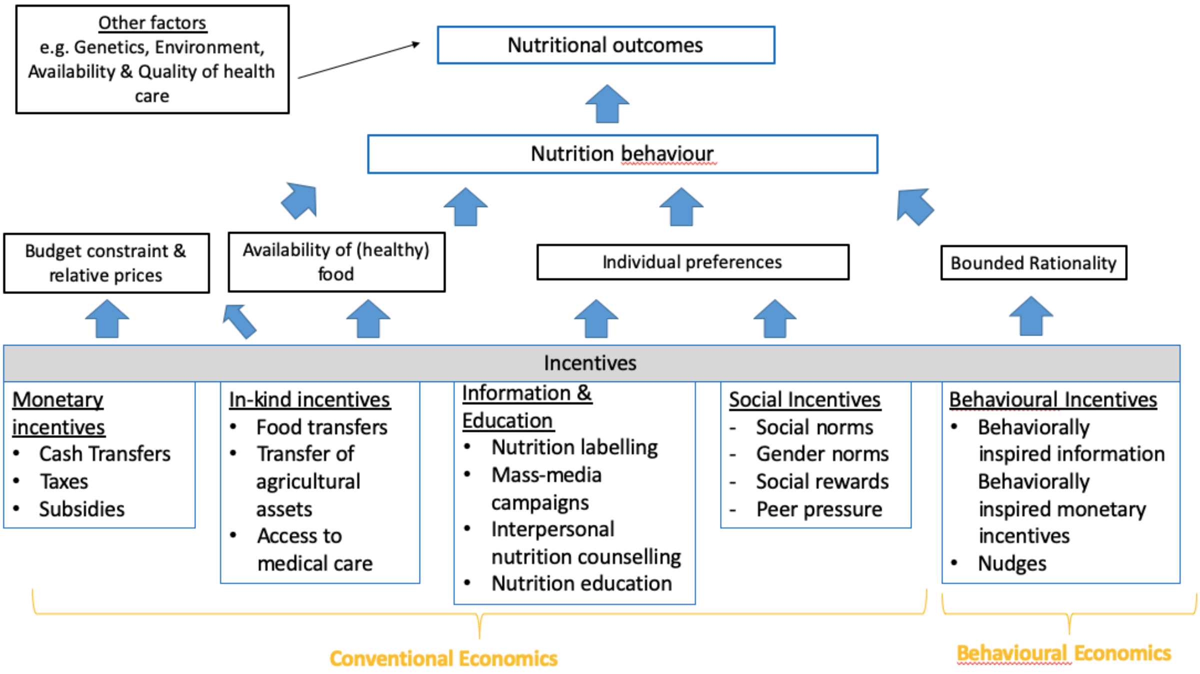
Public policy can change nutrition behaviour, and ultimately improve nutritional outcomes, by modifying the incentive structure which individuals face when making their nutrition-related choices (Costa-i-Font et al. 2013). Throughout this thesis an incentive is defined as "a thing that motivates or encourages someone to do something" (Oxford Dictionaries 2016). Apart from public policy, the literature also points to an important role of social determinants of individual nutrition behaviour:

- Monetary incentives act on an individual's / household's budget constraint or change the relative prices of different foodstuff: Cash transfers may e.g. increase a household's budget constraint thereby allowing a household to purchase more food and/or to diversify its food consumption; taxes and subsidies change relative prices of different foodstuff thereby incentivizing healthy nutritional choices (Galizzi 2014)
- In-kind incentives can act in two different ways: First, they can increase the availability of healthy and/or unhealthy food, either through direct food transfers, or indirectly through the in-kind provision of other goods and services which are considered beneficial for nutritional outcomes (e.g. agricultural assets, free access to health services). Secondly, they increase the beneficiaries' budget constraint, as expenditure on the transferred good can be cut and more resources become available for the purchase of other goods.
- Information and education about healthy nutrition behaviour and its benefits can change individual preferences – and ultimately an individual's utility function – with regards to nutrition and exercising. Information

policies can be based on consumer-focused information and nutritional labelling, mass-media campaigns, but also individual nutritional counselling. Nutrition education in schools can also change individual nutrition preferences (McAleese and Rankin 2007).

- Incentives can also be designed with a view to overcome the "bounded rationality" of individuals. Such incentives are usually inspired by the insights of behavioural science which – unlike conventional economics – departs from the assumption that humans always make completely rational decisions (Galizzi 2014; Thaler 1994). These incentives encompass behaviourally inspired information programmes, as well as behaviourally inspired monetary incentives, and nudges.
- Social determinants of nutrition behaviour encompass social norms, including gender norms, the (non-) acceptance of certain behaviours in one's peer group and interpersonal rewards for engaging in a certain behaviour. Although social policy can only influence these social determinants indirectly, a number of studies have argued that an understanding of social processes is crucial in order to design effective incentives for nutrition behaviour (Costa-i-Font et al. 2013; Gittelsohn and Lee 2013)
- Regulation can also be considered as an incentive to promote healthy nutrition behaviour, e.g. by limiting sugar or fat contents in foods, or by mandating the fortification of certain foods in order to ensure an adequate supply of micronutrients among the population (Best et al. 2011, Allen et al. 2006)

Figure I.3: Incentives and Nutritional Outcomes



Source: Own elaboration based on Galizzi (2014) and Liu et al. (2014).

5. Public policy and social determinants of nutrition behaviour– empirical evidence

The following paragraphs aim at providing a synthetic overview on the available evidence on the effectiveness of different incentives for healthy nutrition behaviour and identify the knowledge gaps that deserve further research. The review assesses incentives for undernutrition and overnutrition separately, given that most studies have focused on only one of both outcomes.

Undernutrition

Monetary incentives: There is substantial evidence that cash transfers (CTs) can be an effective policy measure for reducing undernutrition. A recent literature review on CT programmes by Bastagli et al. (2016) found that 23 out of 31 impact evaluations which analysed the impact of CTs on food expenditure, detected positive impacts. Out of the 12 evaluations analysing nutritional diversity, 7 found positive impacts. Lastly, 5 out of the 13 studies which collected anthropometric information also found positive impacts of the CTs on the prevalence of stunting and/or wasting among children[4] [5].

Commodity price subsidies are also classified as a monetary incentive for better nutrition. While there is evidence that subsidies can effectively increase caloric intake and incentivize the consumption of nutritious food (H Alderman and del Ninno 1999; Stifel and Alderman 2006; Tuck and Lindert 1996), their main drawback is their distributional inefficiency. In opposition to cash transfers or food transfers, it is impossible to restrict the benefits of a food subsidy to the food insecure population[6]. International organizations have therefore pointed to the inefficiencies related to food subsidies (see e.g. The World Bank, 2010)

In-kind incentives: In-kind food transfers (FTs) have also been popular policy measures to reduce undernutrition and food insecurity. FTs can take different forms, such as food distribution, food vouchers / food stamps, school feeding, or food for work. FTs are often used in emergency situations when the regular food supply of a region is interrupted temporarily. Gilligan and Hoddinott (2007) show that such emergency transfers can have a positive long-term impact on the beneficiary households' welfare, in addition to their immediate effect on food insecurity.

A recent literature review on school feeding programmes in developing countries (Harold Alderman and Bundy 2012) points out that these programmes can effectively increase the daily caloric intake of beneficiary children. Gentilini (2016) reviews 11 studies which directly compare the effectiveness of CTs and FTs. His findings suggest that CTs are more effective in promoting food expenditure of a household while FTs are more effective in increasing caloric consumption.

[4] The authors of the review underline that the lack of evidence on anthropometric impacts in 8 of the 13 studies may be a consequence of short follow-up periods between baseline and endline. Anthropometric changes materialize slowly and are often only detectable after several years.

[5] Some examples of relevant findings include an increase on overall food consumption in Colombia (Attanasio et al. 2004), improved height-for-age scores of beneficiary children in South Africa (Aguero, Carter, and Woolard 2006), increased height of beneficiary children in Mexico (Gertler 2004), and increased weight-for-height of children in Brazil (Brauw et al. 2012)

[6] Alderman and del Ninno (1999) show for example that a VAT exemption for milk in South Africa lead to a 0.18 percent increase in overall protein consumption, but only a 0.03 percent increase for the poorest 40% of the population.

Free health insurance is another form of in-kind transfer, where the beneficiary households receive access to health care free of charge[7]. Wagstaff and Pradhan (2005) show that Vietnam's poverty-targeted health insurance decreased undernutrition among children. The authors argue that the detected impacts compare favourably with other social protection programmes, such as cash transfers (ibid).

Information: There is only limited evidence on the potential of information to address undernutrition in LMICs. Most of the available evidence on the effectiveness of information campaigns focuses on other dimensions of health. A recent review of 111 evaluations of mass-media campaigns for child survival in LMICs (Naugle and Hornik 2014) points out that the evaluation design of most of the reviewed evaluations is too weak to draw conclusions on the interventions' effectiveness[8]. Another review, focussing on HIV/AIDS-related behaviours (Bertrand et al. 2006) found mixed evidence and generally small treatment effects.

On the other hand, there is evidence that information campaigns which are based on interpersonal and/or individualised communication rather than the mass-media can be more effective in altering health-related behaviours. The provision of household-specific water purity test results has successfully incentivised water purifying practices among poor households in India and Bangladesh (Jalan and Somanathan 2008; Madajewicz et al. 2007). Girls in Kenya receiving information about the relative risk of contracting HIV by type of partners were substantially less likely to have unsafe cross-generational sex (Dupas 2011b).

Another promising channel to diffuse health and nutrition information are *community health workers* (Haines et al. 2007). Community health workers (CHWs) are ordinary community members who undergo basic training in order to support simple medical tasks such as awareness raising, preventive treatments, case management of smaller diseases and referrals. A number of studies on CHW yield encouraging results, but most of them focus on health rather than nutritional

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[7] There is a substantial amount of literature which considers the provision of free or subsidized health insurance as an in-kind transfer (see e.g. Currie & Gahvari, 2007; Garfinkel, Rainwater, & Smeeding, 2006; Smeeding, 1977), even though it might also be considered as an informational incentive as health insurance facilitates the access to health and nutrition information. See chapter xx for a detailed discussion of possible pathways of impact of health insurance.

[8] The only field for which the authors found sufficient rigorous evidence is reproductive health where 40 out of the 46 reviewed evaluations showed positive impacts.

outcomes (see e.g. Brenner et al., 2011; Chang et al., 2011; Chowdhury, Chowdhury, Islam, Islam, & Vaughan, 1997; Ramsey et al., 2013). Luby et al. (2018) and Null et al. (2018) describe randomised controlled trials evaluating an intervention to reduce diarrhoea among children in Bangladesh and Kenya, based on intensive counselling about handwashing, sanitation, and/or appropriate child nutrition for mothers, and find positive impacts on children's height.

Overall, the literature review suggests that the way in which information is delivered may be crucial for the effectiveness of nutrition information campaigns. However, more research would be needed in order to gain solid evidence on the determinants of success and failure of communication campaigns.

Social determinants: There is a growing body of literature on the importance of gender roles and gender norms for nutritional outcomes. A number of studies document an association between women's empowerment and nutritional diversity, dietary intake and nutritional outcomes for both women and their children (Imai et al. 2014, Malapit & Quisumbing 2015, Malapit et al. 2015, Jones et al. 2020, Kunto & Bras 2018, Kunto & Bras 2019, Holland & Ramohan 2019).

Moreover, there is initial evidence that social learning and peer effects may also play a role in determining nutritional outcomes. Hoddinot et al. (2017) who show that a behaviour change intervention in Bangladesh aiming to improve child nutrition has created spillovers to non-participants. However, this is the only available study to date indicating that peer effects may play a role in the determination of nutritional outcomes.

Behavioural incentives: Although it is generally acknowledged that undernutrition can have behavioural causes (Black et al. 2013; Dupas 2011a) [9], interventions to combat malnutrition have rarely drawn directly on the insights from behavioural economics. Whether and how insights from behavioural economics can be used to design undernutrition policies emerges as a major gap from this literature review.

Overnutrition

[9] This is particularly true in contexts where undernutrition is fostered by infectious diseases and/or the insufficient intake of easily available micronutrients (see the section 'Context&Relevance' for a more detailed discussion on the matter.

Monetary incentives: While the impact of cash transfers on undernutrition is well investigated, there is only limited and inconclusive evidence on the impact of cash transfers on overnutrition. Fernald, Hou and Gertler (2008a and 2008b) show that participants of the Mexican Oportunidades programme have a significantly lower BMI and prevalence of obesity than among non-participants, but that the programme's cash component leads to higher BMI, higher levels of blood pressure and a higher prevalence of overweight and obesity. This finding also goes in line with a more recent study by Levasseur (2019), which suggests that the overall decrease in obesity related to Oportunidades is caused by the programmes conditionalities, not the cash transfers as such. On the contrary, two studies on Colombia's Familias en Acción programme (Attanasio et al. 2005 & Forde et al. 2012) also found that the programme increased both BMI and the odds of being obese.

'Fat taxes' and 'thin subsidies' are another form of monetary incentives to promote healthy eating behaviour. Colchero et al. (2016) and Batis et al. (2016) examine the impact of a recent tax on non-essential food and sugar-sweetened beverages in Mexico[10]. They show that the tax reduced the consumption of sugar-sweetened beverages by 12% and the consumption of the taxed energy-dense foods by 5.1%. The impacts were most pronounced in the lowest socioeconomic groups. Chile also introduced a tax on sugar-sweetened beverages, but initial consumption effects were small, likely due to the low tax rates which allowed producers to absorb it, rather than passing it on to consumers (Caro et al. 2018). Most of the academic discussion on thin subsidies is based on simulations based on data from the US and yields mixed results (see Cash, Sunding, and Zilberman 2005; Chouinard et al. 2007; Epstein et al. 2010). Overall, the available evidence suggests that fat taxes can be effective while the evidence on thin subsidies is inconclusive.

In-kind incentives: This literature review did not find any studies on in-kind food transfers to reduce obesity. However, there are a number of studies on the impact of free or subsidised health insurance on overnutrition, although all of these

[10] Sugar-sweetened beverages are taxed with 1 peso per liter (approximately 0.05 USD) and non-essential energy-dense foods are taxed with 8% of their purchase price.

papers are from high-income countries, most notably the US[11]. Moreover, the available evidence is not conclusive: while earlier studies from the US indicated that health insurance may increase both BMI and obesity prevalence through a moral hazard effect (Bhattacharya et al. 2009, Rashad & Markovitz 2009), while more recent studies based on the Affordable Care Act Expansions indicate that health insurance reduces overweight and obesity (Rhubart et al. 2018) or did not have any detectable impact on nutrition-related outcomes (Simon et al. 2016).

Information & Education: According to Downs, Loewenstein, and Wisdom (2009) the main policy response to the obesity epidemic has been enhancing access to information. However, Galizzi (2014) reviewed studies on nutritional information campaigns through mass media and concludes that the evidence is only mixed. Informational campaigns, like the 'five-a-day' campaign of the UK government have successfully increased the consumption of fruits and vegetables, but effect sizes are relatively small (Capacci & Mazzochi 2010). Besides, there is evidence that calorie-labels on restaurant menus can reduce the number of calories consumed, even though the estimated treatment effects vary substantially between studies (Cawley et al. 2018, Roberto et al. 2009), and one study did not detect any impact at all (Ellison et al. 2014)

However, in line with the evidence on health information campaigns from LMICs, presented above, there is evidence that obesity-related information can be more effective if it is tailored to the recipient. The most frequent form of interpersonal obesity counselling occurs through physicians (Anis et al. 2004; Bleich, Pickett-Blakely, and Cooper 2011; Galuska 1999; Kushner 1995). Several studies from high-income countries found that patients who are diagnosed with obesity by a physician are more likely to both attempt and actually achieve a reduction in weight (Kant and Miner 2007; Kreuter et al. 1997; Levy and Williamson 1988; Loureiro and Nayga 2007).

Social incentives: There is a growing body of literature suggesting that social incentives are important determinants of our eating and exercising behaviour. A

[11] The study by Wagstaff and Pradhan (2005) cited above which assessed the impact of free health insurance on undernutrition in Vietnam did not assess the programme's impact on overweight/obesity. However, in the evaluation sample only 1% of the interviewed individuals were obese in their period of interest (1992/1993).

number of studies illustrate that obesity and unhealthy eating behaviour are very often transmitted through social networks (Christakis and Fowler 2007; Renna, Grafova, and Thakur 2008; Trogdon, Nonnemaker, and Pais 2008). On the other hand, exercising behaviour has be shown to be "contagious" within groups of friends (Ali, Amialchuk, and Heiland 2011; Babcock and Hartman 2010; Carrell, Hoekstra, and West 2011)

Unlike for undernutrition, there is only limited evidence on the effect of gender roles on overweight and obesity. Azizi et al. (2005) and Wardle et al. (2004) point to gender-based differences in diets. Wells et al. (2012) and Garawi et al. (2014) provide evidence for a negative association between women empowerment and obesity differentials between men and women in a worldwide sample of countries. However, there has not yet been any causal analysis on the relationship between women empowerment and overweight/obesity.

Social and behavioural determinants: Behaviourally inspired information policy has also proven effective in improving dietary behaviour and promoting healthy eating choices. Obesity scholars agree that the consideration of human emotions and visceral processes in the design of information campaigns can increase their effectiveness (Liu et al. 2014). Examples include a traffic-light system for nutrition labels which provides a visual cue in addition to the neutral nutritional information (Galizzi 2014) or the provision of caloric information as physical activity equivalent (Bleich et al. 2012).

Simple changes to the choice architecture which leave the overall freedom of choice of individuals unaltered – 'nudges' in the terminology of behavioural economics – have also proven effective in changing nutrition behaviour (Liu et al. 2014). Examples of effective nudges include the placement of low-calorie options on the first page of a restaurant's menu (Downs, Loewenstein, and Wisdom 2009) or storing sweets in opaque rather than transparent containers (Wansink, Painter, and Lee 2006).

6. Research gaps addressed in this thesis and research hypotheses

Table 1 summarizes the findings of the literature review and illustrates the areas which deserve further research. A '+' or '++' indicates that there is evidence that an incentive is effective in affecting nutritional outcomes in the desired direction (i.e. reduce undernutrition and overnutrition). A '-' indicates that there is evidence for an adverse effect on the respective outcome. For both cases, only studies which aim at establishing causality are included in the table. A '0' means that studies have assessed the impact of the incentive, but that they have not found evidence for its effectiveness. A '?' indicates that none, or very few studies have investigated on the incentive, and that there is no conclusive evidence on its effectiveness.

In general, the table illustrates that our knowledge about the effectiveness of different behavioural incentives for healthy nutrition behaviour is not complete and that the area deserves further research. Evidence is particularly scarce for low- and middle-income countries, although these countries are hit hardest by the global burden of malnutrition. The proposed PhD thesis shall therefore contribute to the following overarching research question: ***How can public policy effectively incentivize healthy nutrition behaviour and improve health and nutrition outcomes in low- and middle-income countries?*** This question is addressed through four independent studies relating to the different research gaps identified above.

Table 1.1: Evidence on the effectiveness of different incentives for nutrition & Research Gaps

Undernutrition		Effectiveness
Monetary incentives	Cash transfers	++
	Taxes & Subsidies	+
In-kind incentives	In-kind transfers / food aid	++
	Health Insurance	+ / ?
Information / Education	Mass-media campaigns	+ / ?
	Interpersonal communication	+
	Community Health Workers	+
Social incentives	Social learning	?
	Gender / empowerment of women	+
	Peer pressure	+ / ?

Behavioural incentives	Behaviourally inspired information	?
	Nudges	?

Overnutrition

Monetary incentives	Cash transfers	- / ?
	Taxes & Subsidies	+ / ?
In-kind incentives	In-kind transfers / food aid	?
	Health Insurance	+ / - / ?
Information / Education	Nutrition labels / mass-media campaigns	+
	Interpersonal communication	++
Social incentives	Social learning	?
	Gender / Empowerment of women	?
	Peer effects	++
Behavioural incentives	Behaviourally inspired information	++
	Nudges	++

Source: Own elaboration based on the litterature cited in this introduction

The first and second paper of the thesis assess the impact of two public policy interventions on nutrition choices and outcomes. The first study focuses on the role of monetary incentives in the context of overnutrition. In particular, it evaluates whether a positive income shock due to the social assistance cash transfer *Bolsa Familia* has affected nutritional choices and outcomes of the programme's beneficiaries in Brazil. The literature review has shown that monetary incentives, as e.g. through cash transfer programmes, have been crucial in reducing undernutrition and that they can boost caloric intake and nutritional diversity in food-insecure households. However, their impact on overweight/obesity and the consumption of unhealthy food is not very well investigated. Previous studies have suggested that the cash component of CCT programmes may increase overweight and obesity, while some papers have shown that their aggregate impact (cash and non-cash components) leads to a reduction in overweight and obesity. Based on the literature on CCTs and undernutrition, which suggests that CCTs lead to an increase in food expenditure (see e.g. Bastagli et al. 2016; comprehensive literature review in chapter 2) as well as a reduction in undernutrition (at least according to some studies, see e.g. Gertler 2004, Maluccio & Flores 2005, Macours et al. 2012) and the emerging literature pointing to an increase in overweight and obesity in response these programmes (Attanasio et al. 2005, Fernald et al. 2008a, Forde et al. 2012, Leroy et al. 2013), the following hypotheses shall be tested:

H 1.1: The Bolsa Familia conditional cash transfer programme in Brazil has lead to an increase in food expenditure

H 1.2: The programme has led to a reduction in undernutrition

H 1.3: The programme has led to an increase in overweight and obesity among its beneficiaries

The second study provides evidence on the impact of free health insurance, i.e. an in-kind transfer, on nutritional outcomes in a middle-income country. The literature review has shown that free health insurance can help to reduce undernutrition among low-income households. Moreover, there is mixed evidence on the impact of health insurance on overweight and obesity from the USA. The paper therefore evaluates the impact of the free Mexican health insurance *Seguro Popular* on food choices and nutrition outcomes. It is one of the first studies investigating on the nutritional impact of health insurance in a context of a higher-middle-income country with steeply rising obesity rates.

Based on existing literature on health insurance and nutrition, we developed a number of testable hypotheses. There is only one study which has investigated the impact of health insurance on undernutrition (Wagstaff and Pradhan 2005) and it did find that free health insurance improved weight-for-age and weight-for-height among children. Therefore, we formulate the following hypothesis regarding undernutrition:

H2.1: The Mexican health insurance programme Seguro Popular has reduced undernutrition among its beneficiaries

As mentioned, the existing evidence on the impact of health insurance on overweight and obesity is ambiguous. While studies based on older US data suggest that health insurance may increase overweight and obesity through a moral hazard effect (Bhattarchya et al. 2009, Rashad and Markovitz 2009), studies based on more recent data suggest a zero effect or even a reduction in overnutrition (Simon et al. 2016, Courbage and Colon 2004, Rhubart 2018). However, departing from the research findings that health insurance increases health care usage (see e.g. Finkelstein et al. 2012, Baicker et al. 2013; detailed literature review in chapter 3), and presuming that health care usage leads to better health outcomes (see e.g. Currie and Gruber 1996, Pfutze 2015, Robbins et al. 2015, Sommers et al. 2017; detailed literature review in chapter 3) as well as an increase in preventative efforts (Miller et al. 2013), we expect that health insurance will lead to a more healthy and less calorie-dense diet and reduce overweight and obesity. Therefore we also test the following two hypotheses:

H2.2: Seguro Popular has reduced overweight and obesity among its beneficiaries

H2.3: Seguro Popular coverage leads to a decrease in households' spending on carbohydrates and sugar, and an increase in spending on proteins, vegetables and fruit.

The third and fourth paper of the thesis focus on the social determinants of nutrition behaviour and outcomes. Paper 3 examines to what extent gender norms can explain the rising disparities in obesity between men and women. The study draws on worldwide cross-country data, but focuses particularly on the Middle East and North Africa (MENA) region, where the obesity prevalence among women is on average 10 percent higher than for men. The literature review has shown that women empowerment is associated with lower levels of undernutrition among both women and children in low-income countries. This paper assesses to what extent women empowerment can predict gender-based differences in overweight and obesity, both worldwide and in the MENA region Moreover, and assesses if there is evidence that there is a causal relationship between both variables. Given that previous literature has found evidence for a positive association between female empowerment and nutritional diversity (Malapit & Quisumbing 2015), as well as a negative association between empowerment and obesity in a world-wide sample (Wells et al. 2012, Garawi et al. 2014), we test the following hypothesis:

H 3.1: The political and economic participation of women leads to lower levels of overweight and obesity among women in the MENA region

Moreover, given that there is no previous literature on regional heterogeneities, we assume *a priori* that this effect holds in all world regions, including the MENA region with its pronounced gender obesitgy gaps. Therefore the second testable hypothesis for this paper is:

H 3.2: The effect of political and economic participation on overweight and obesity does not differ between the MENA region and other parts of the world.

Lastly, the fourth study asks whether social learning or peer effects can contribute to a reduction in undernutrition. The literature review has shown that the effectiveness of monetary incentives and in-kind incentives on undernutrition is well investigated, but that there is only limited evidence on the role of social learning. The paper evaluates the impact of a Social and Behaviour Change Communication (SBCC) campaign in rural Mozambique on nutrition-related knowledge and practices, among both participants of the SBCC intervention, and neighbouring households which did not participate. Based on the literature which shows how social learning influences knowledge and practices in agriculture and microfinance (see e.g. Bandiera and Rasul 2006, Banerjee et al. 2013), as well as the importance which theoretical SBCC models attach to peer effects (see e.g. Michie, van Stralen and West 2011), the following hypothesis is proposed:

H 4.1: Social learning has contributed to the adoption of recommended nutrition-practices among non-participants of an SBCC campaign, who live in the proximity of participating households.

Moreover, based on the fact that both social learning models and empirical research on social learning suggest that updating processes through social learning may not be complete (Alatas et al. 2016, Acemoglu et al. 2011, Gale & Kariv 2003), we also test the following hypothesis:

H 4.2 : *Changes in knowledge and practices are more pronounced among individuals who were directly exposed to trainings within the SBCC campaign, as compared to those who were only exposed to spillovers / social learning effects.*

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2. The impact of conditional cash transfers on overweight and obesity – evidence from Brazil's *Bolsa Família* programme

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Abstract

Conditional cash transfer (CCT) programmes have effectively reduced undernutrition among children from low-income households around the globe. However, only very few studies have examined how these programmes affect overweight and obesity. This paper examines the impact of the Brazilian Bolsa Familia programme – one of the largest CCT programmes worldwide – on overweight, obesity and the composition of food expenditure. The identification strategy relies on fixed effects regressions to control for time-invariant unobservable confounders, along with a wide range of time-varying observable control variables. The findings suggest that Bolsa Familia may have increased overweight among beneficiary children by 4 percentage points (10% significance). Moreover, there is evidence for an income effect, reflected in an increase in total household food expenditure by approximately 15 percent (1% significance). The paper also documents substitution effects, with a disproportionate increase in household expenditure on dairy and sweets. However, the latter effects are sensitive to the choice of the outcome variable.

Keywords: Conditional Cash Transfers, Social Protection, Obesity, Overweight, Bolsa Familia, Brazil

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1. Introduction

We know very little about the causal relationship between income and overweight and obesity. Cross-country analyses show that a country's obesity prevalence tends to grow with its income level (FAO 2020). At the same time, individual data suggests that in low-income countries, the burden of obesity predominantly falls on high-income households, while in high-income countries obesity is more prevalent in low-income households (Templin et al. 2019, Popkin et al. 2020), suggesting non-linearities in the income-obesity relationship.

Overweight and obesity are also a growing concern among low-income households in upper-middle income countries, as e.g. Brazil or Mexico[13]. However, most of the studies investigating on the causal impact of income on overnutrition have focused on high-income countries (Cawley et al. 2010, Cawley & Price 2011, Cesarini 2016 et al., Finkelstein et al. 2007). This paper provides additional evidence on the income-obesity link in a middle income country by examining the impact of Brazil's conditional cash transfer programme *Bolsa Familia*. The programme's transfers represent a sizable income shock to its poor and vulnerable beneficiaries, amounting to 10.7% of their monthly pre-transfer income. Thanks to the programme's staggered rollout over several years, Bolsa Familia particularly lends itself for a causal analysis on the relationship between income transfers and obesity.

Conditional cash transfer (CCT) programmes have the objective of reducing poverty and promoting the social inclusion of the poorest and most vulnerable parts of the population: They alleviate poverty immediately through a regular and stable monetary transfer. Moreover, they incentivise investments into the human capital of the beneficiary household's children through education and health-related conditionalities, with the aim of breaking the inter-generational transmission of poverty in the medium run (depending on the programme, the receipt of the cash transfer might be conditional on the regular school attendance of the beneficiary household's children, regular pre-natal checkups for pregnant women, vaccination of children). There has been a substantial amount of research on the impacts of

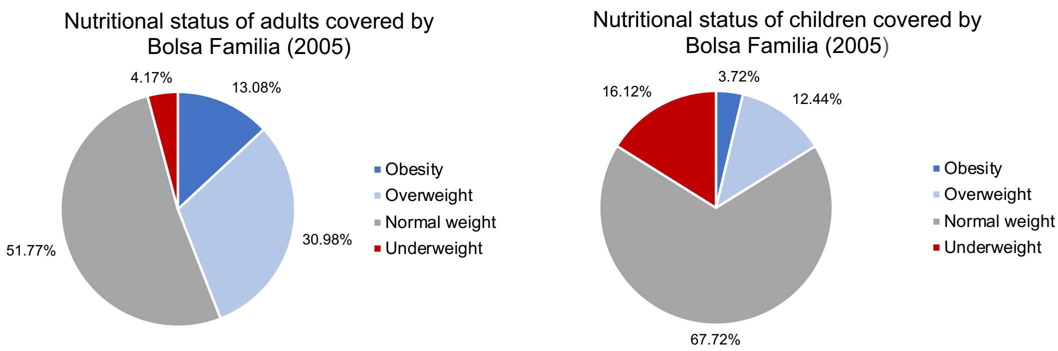
[13] Templin et al. (ibid) note that in countries with GDP per capita levels between $10,000-$15,000, overweight and obesity are more prevalent in the second-poorest quintile than in the top quintile.

conditional cash transfer programmes on both adult and child wellbeing. The evidence shows that conditional cash transfer programmes are in a position to alleviate monetary poverty and increase consumption (Asfaw et al. 2014), improve school enrolment and attendance among children (Barham, Macours, Maluccio 2013; Baird, McIntosh & Özler 2009) and reduce undernutrition in the programme's beneficiary families (Barber & Gertler 2008; Evans et al. 2014). For many of these outcome variables, there is evidence that the positive effects can also persist in the long run (Gertler, Martinez, Rubio-Codina 2012)[14].

While there is a substantial amount of evidence illustrating that conditional cash transfers are effective in reducing undernutrition, we know very little about their impact on overweight and obesity. This is likely due to the CCTs' initial focus on reducing extreme poverty and hunger (see e.g. Gertler 2004, Maluccio and Flores 2005). However, today many LMICs are affected by a "triple burden of malnutrition" – undernutrition, overnutrition, and micronutrient deficiencies, which can coexist at the country-, household- and individual-level (Pinstrup-Andersen 2007, Gomez et al. 2013). Figure 1 illustrates that even in the early years of Bolsa Familia in 2005, overweight and obesity were just as prevalent among beneficiary children than underweight, both amounting to approximately 16 percent. At the same time approximately 44 percent of adults from beneficiary households were affected by overweight or obesity, while only 4 percent suffered from underweight. It is therefore important to ask the question whether conditional cash transfers, are in a position to reduce overweight and obesity, or whether they even might have had unintended adverse impacts on these outcomes.

[14] See Bastagli et al. (2016) and Fizbein, Schady et al. (2009) for an extensive review of the literature on CCTs.

Figure 2.1 – Nutritional status of Bolsa Familia beneficiaries in 2005



CCTs can affect nutritional outcomes through a number of channels. Cash transfers increase the disposable income of a beneficiary household, giving rise to an increase in total consumption expenditure and at the same time a change in the composition of the household's consumption bundle (adjusting expenditure shares for different goods, depending on their income elasticities of demand). This change in the composition of household expenditure could result both in a more energy-dense diet, e.g. in cases where consumers substitute home-cooked food for processed food, or a less energy-dense diet, e.g. when simple carbohydrate sources are substituted for more protein-dense foods. The overall effect of cash transfers on nutritional outcomes will thus depend on the relative magnitude of the food expenditure increase and the changes in the household's consumption bundle. In CCT programmes there may also be effects due to the programme's conditionalities, which often incentivise regular health checkups and regular school attendance.

Empirical evidence on the impact of CCT programmes on overnutrition is only available two countries – Mexico and Colombia – and the results are contradictory. For the Mexican *Oportunidades* programme, studies have found that the programme's cash component may increase BMI and the risk of being obese (Fernald, Hou & Gertler 2008b), while its overall impact is negative thanks to the conditionalities (Fernald, Hou & Gertler 2008b, Levasseur 2019). On the other hand, studies on Colombia's *Famílias en Acción* programme and another CCT programme from Mexico indicate that these programmes may increase both BMI and obesity among their participants. Additional studies are therefore needed in order to obtain more conclusive evidence on the causal impact of CCT programmes and overweight or obesity. Moreover, it is crucial to understand the channels through which CCTs can affect nutritional outcomes.

Bolsa Família (BF) is a promising case study because of its sizeable transfers, its implementation in a country with growing obesity rates, and the availability of rich and reliable data. The programme is one of the largest conditional cash transfer programmes on earth, covering 13.9 million poor Brazilian families. The programme is targeted at the Brazilian population living below the national poverty line (170 BRL / 55 USD per month per capita). It aims at alleviating poverty immediately through cash transfers, while at the same time incentivising investments into the human capital of the recipients' children through education and health-related conditionalities (regular school attendance and participation in health checkups/vaccination). The monthly transfers per household vary between BRL 39 and BRL 280 (12-88 USD), depending on the depth of poverty and the demographic composition of the household. On average, this amounts to approximately 10.7% of the beneficiary households' monthly income[15], constituting a sizeable income shock. (Bastagli 2008; Caixa Econômica Federal 2016; Soares 2012; Soares, Perez Ribas, and Veras Soares 2011).

This paper implements a fixed effects estimation strategy based on the *Avaliação de Impacto do Programa Bolsa Familia* (AIBF) dataset in order to assess Bolsa Familia's impact on undernutrition, overnutrition, as well as diet-related consumption behaviours. The AIBF dataset was collected in two waves (2005 and 2009) covering the time period of the programme's rollout. While the programme was made available simultaneously across all Brazilian municipalities, the pace of enrolment of eligible households differed both between municipalities and between households within the same municipality. The programme's impact is estimated through regressions with household-level fixed effects, which control for any time-invariant unobservable factors which may have driven enrolment. Moreover, a large set of control variables reduces the risk of any bias due to time-varying factors.

The findings provide suggestive evidence (significant at the 10% level) that Bolsa Familia has led to an average increase in overweight among children by

[15] This estimate is based on the Brazilian household survey Pesquisa Nacional por Amostra de Domicílios (PNAD), assuming that variable v1273 in the survey correctly identifies Bolsa Família benefits.

approximately 4 percentage points. This effect is mainly driven by the urban Southeastern region of the country. Moreover, the results show that Bolsa Familia has increased overall consumption expenditure by approximately 11 percent (significant at the 5% level), and in particular food consumption expenditure by 15 percent (significant at the 1% level). The results on changes to the composition of household expenditure are mixed. While the absolute expenditure on dairy and sugary products has increased disproportionately, it was not possible to detect any statistically significant effect when food shares (in total expenditure) are used as outcome variables.

The rest of this paper is organised as follows. Part 2 gives an overview on the relevant literature on the topic and part 3 describes the instutional background of Bolsa Familia's rollout. Part 4 presents the data which is used for the analysis, and part 5 discusses the identification strategy. The findings are presented in part 6, while part 7 elaborates on the policy implications and concludes.

2. Literature

Previous evaluations which have investigated on the nutritional impacts of CCTs have mostly focussed on undernutrition among children (underweight, stunting, wasting). These studies provide convincing evidence that CCTs can indeed improve the nutritional status of malnourished children (Gertler 2004, Attanasio et al. 2005, Macours et al. 2012, Maluccio and Flores 2005, Hidrobo et al. 2013, Gitter and Caldes 2010, Attanasio et al. 2005, Ruiz-Arranz et al. 2002)

However, based on theory, one might expect a number of channels through which CTs might also affect overweight and obesity. First, the cash transfer will lead to an increase in disposable income, which will potentially lead to an increase in total expenditure, and potentially also an increase in total food expenditure. The beneficiary household will have a higher disposable income and will therefore be able to purchase larger quantities of the consumption bundle it had consumed previously. One would therefore expect that the household will consume a larger amount of calories. A number of studies have documented the positive impact of CT programmes on overall consumption expenditure (Angelucci et al. 2012, Haushofer & Shapiro 2016), as well as food consumption expenditure (Braido et al. 2012, Palermo et al. 2012). Moreover, there is also evidence for a positive correlation between income and overweight/obesity on the other hand, both at the country-level

(Masood & Reidpath 2017, Grinspun et al. 2020, FAO 2019) and at the individual level (Templin et al. 2019, Jolliffe 2010,).

Secondly, one would also expect that the composition of a household's consumption basket will change in response to the income shock. Beneficiary households will substitute inferior goods for superior goods and potentially also adjust the expenditure share of each normal good, depending on its income elasticity. In this context one would expect that a household diversifies its food consumption, substituting cheaper sources of caloric intake (basic carbohydrates) for more nutritious food (e.g. proteins, fruit, vegetables) and/or food which is considered more tasty (e.g. sweets, fatty foods). Indeed, some studies have found positive impacts of CT programmes on dietary diversity (Gitter & Caldes 2010, Hidrobo et al. 2013), even though the overall evidence is mixed (Bastagli et al. 2016).

Moreover, there may also be effects due to an improved access to social services (e.g. health, education, sanitation) caused by the cash transfer, which can in turn lead to adaptations in a household's nutrition-related choices and outcomes. Moreover, it has been shown that the receipt of CT programmes can also reduce stress levels among poor households (Haushofer & Shapiro 2016). As lower stress levels are in turn associated with lower risks of overweight and obesity (Torres & Nowson 2007), it could be another intermediary between CTs and nutritional outcomes.

For conditional CT programmes, as Bolsa Familia, there may also be effects through the associated conditionalities. These can lead to an increased exposure to health services due to the requirements for vaccinations and regular medical checkups for children (Akresh et al. 2012), potentially contributing to the early detection of under- or overnutrition. Moreover, the education-related conditionalities can increase school attendance and the educational achievement of children (Akresh et al. 2013, Baird et al. 2011). Given the negative association between education and obesity risk (Devaux et al. 2011), one might also expect a negative long-term effect on obesity.

Very few papers have investigated on the impacts of CCTs on overweight/obesity, food consumption, as well as the composition of food expenditure among beneficiary households. Most of these studies are based on Mexico's flagship social assistance programme *Prospera* (originally denominated *Progresa* and later *Oportunidades*). Fernald, Hou and Gertler (2008a and 2008b) find that participants of the Mexican Oportunidades programme have a significantly lower BMI and prevalence of obesity is also lower than among non-participants, but that the programme's cash component leads to higher BMI, higher levels of blood pressure and a higher prevalence of overweight and obesity. This finding is also confirmed in a more recent study by Levasseur (2019), which attributes the overall BMI-reducing effect to the conditionalities of the programme, rather than the cash payments. In this context, it is important to highlight that one of the Prospera-related conditionalities is participation in education sessions on health and nutrition, which need to be attended by at least one household member aged 15 years or older (CONEVAL 2019). This is a major difference between *Prospera* and many other CCTs including *Bolsa Familia*, where conditionalities do not provide information on healthy diets.

Apart from these studies on Propsera, there are two papers on the impacts of other CT programmes on overnutrition. Attanasio et al.'s (2005) evaluation of Colombia's Famílias en Acción programme found a positive impact on overall food consumption, and in particular an increase in the consumption of meat, milk, cereals, fat and oil. Forde et al. (2012) found a positive impact of *Familías en Acción* on BMI and increased odds of being obese. Lastly, Leroy et al. (2013) corroborate these findings in their analysis of the Mexican food aid programme *Programa de Apoyo Alimentário*, which provides cash and/or in-kind transfers to poor rural households. They find large impacts on the body weight of women who are already overweight or obese (no impact on those who have a BMI<25).

Overall, the evidence from these studies is mixed. Cash transfers have been associated with both a decrease in the prevalence of underweight, an increase in overweight/obesity and also an increase in the nutritional diversity of food (more animal products, protein sources), while conditionalities have led to a decrease in overweight and obesity. The proposed study aims at shedding further light on the relationship between cash transfers and nutrition, investigating on both the nutritional outcomes, as well as the underlying nutrition decisions of cash transfer beneficiaries.

3. Institutional background

Bolsa Familia is one of the largest conditional cash transfer programmes worldwide, covering 13.9 million low-income families. The programme is targeted at the

Brazilian population living below the national poverty line (170 BRL / 55 USD per month per capita) and provides monthly cash transfers ranging between BRL 39 and BRL 280 (12-88 USD), depending on the depth of poverty and the demographic composition of the household. On average, the transfers amount to approximately 10.7% of the beneficiary households' monthly income[16], constituting a sizeable income shock. (Bastagli 2008; Caixa Econômica Federal 2016; Soares 2012; Soares, Perez Ribas, and Veras Soares 2011). Bolsa Familia aims at alleviating poverty immediately through these cash transfers, while at the same time incentivising investments into the human capital of the recipients' children through education and health-related conditionalities (regular school attendance and participation in health checkups/vaccination).

Bolsa Familia was created in 2003 as the flagship social programme of the newly elected President Lula da Silva from the country's centre-left Worker's Party (*Partido dos Trabalhadores)*. In Brazil, cash transfer programmes as well as in-kind social transfers existed even before the introduction of Bolsa Familia. However, these programmes were fragmented, they had different objectives and targeting mechanisms and did not systematically cover the country's poor and vulnerable households. In 2003, four social programmes were merged into the new Bolsa Familia programme: the *Programa Bolsa Escola* (School Grant Programme), *Programa Bolsa Alimentação* (Food Grant), *Auxílio Gás* (Gas Subsidy Programme) and the *Programa Nacional de Acesso à Alimentação* (National programme for access to food). A fifth programme, the *Programa de Erradicação do Trabalho Infantil* (Programme for the eradication of child labour) was only fully incorporated in 2005.

However, as illustrated in figure 2, the number of beneficiaries after merging these predecessor programmes amounted to only approximately 4 million families in 2003 (9 families million in 2005), while 12-14 million households lived below the national poverty line. The government's objective was to enrol all Brazilian citizens living below the national poverty line into Bolsa Familia. Low-income families which had not been covered by any of Bolsa Familia's predecessor programmes were therefore invited to register for the country's unified social registry, the

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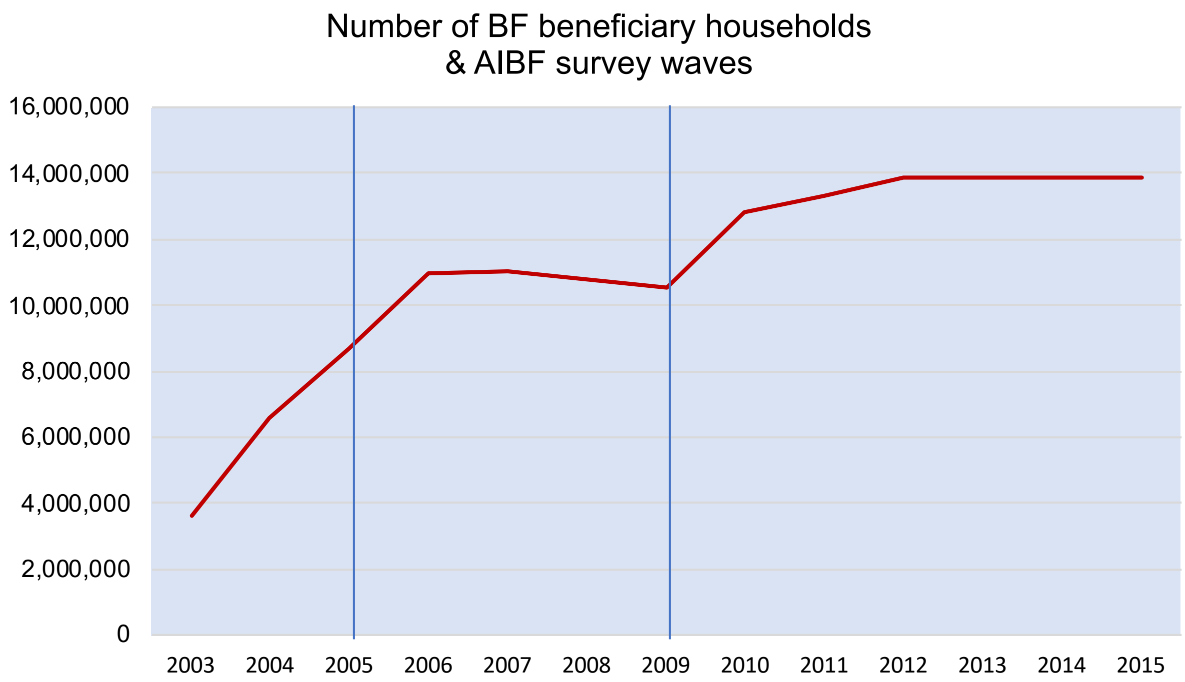
16 This estimate is based on the Brazilian household survey Pesquisa Nacional por Amostra de Domicílios (PNAD), assuming that variable v1273 in the survey correctly identifies Bolsa Família benefits.

Cadastro Único, which serves as a basis for assessing a household's eligibility for the country's major social assistance programmes and decide on the timing of enrolment[17]. Inscriptions were administered at the municipality level through two modalities: first, households could register on their own initiative at local social assistance centres. Secondly, social workers conducted active outreach campaigns across the country in order to ensure that populations which live in remote areas, or might not know about the government's initiative, would also be inscribed "on the spot". While the inscription and data collection for the *Cadastro Único* has always been decentralised, the data processing, eligibility verification, and payment processing have taken place at the central-government level and are exclusively electronic. The centralisation and digitalisation of the eligibility verification process also increases the objectivity of the targeting process and effectively prevents any personal interference or manipulation by social workers or government officials (Mostafa & Sátyro 2014).

Figure 2.2 – Bolsa Familia coverage and AIBF survey waves



[17] The government's objective was to enrol all households with per capita incomes corresponding to less than half of the country's minimum wage into Cadastro Único. It is important to note that a registration in Cadástro Unico does not automatically imply participation in Bolsa Familia (Bastagli 2008)

Bolsa Familia is a means-tested programme. Households are eligible for participation if their income is below a certain eligibility threshold. This threshold has been defined in accordance with Brazil's national poverty line and amounted to 100 BRL per capita per month between 2003 and 2006 (approximately 34 USD at the time), 120 BRL between 2006 and 2009, and 140 BRL from 2009 onwards[18]. The Cadástro Unico relies on self-declared income, but the information is cross-checked with other national databases (e.g. civil registries, tax registries) in order to avoid fraudulent applications (Hellmann 2015).

However, not all households which fulfilled the income-related eligibility criteria were instantaneously admitted to Bolsa Familia. Due to budget constraints, and in order to ensure an equal and fair distribution of programme benefits across the country, the central government established municipality-level quota indicating the maximum number of Bolsa Familia beneficiaries per municipality. The quotas were calculated based on each municipalities' poverty rate during the latest census in 2000, and subsequently updated based on household survey data on changes to poverty rates at state level (i.e. updates were identical for all municipalities within a state). This implies that during the programme's rollout between 2003 and 2011, there were always families who were eligible for Bolsa Familia's benefits, but were not covered by the programme. Soares (2010) describes them as a "a strange category of family: eligible but not beneficiary" (p. 6). These households can be used as a comparison group for estimating Bolsa Familia's impact.

Indeed, there are a number of reasons why otherwise similar households would benefit from Bolsa Familia in one case, but not another. Explanations can be found both at the municipality and household level: First, the number of available BF benefits in 2003 (= quota - current beneficiaries) depended on the number of households covered by BF's predecessor programmes who had been automatically enrolled into Bolsa Familia (Silva Parsons 2015). In municipalities, where the predecessor programmes coverage was already close to the municipality-level quota, the odds for additional households to be enrolled would be very small. Second, the

[18] Moreover, families qualify for additional monetary benefits if their incomes are also below the extreme poverty line (BRL 50 per capita per month between 2003-2005, 60 BRL between 2006 and 2009 and 70 BRL from 2009 onwards).

updating of the original poverty estimates from the census based on household survey data introduced a certain degree of imprecision – in municipalities whose poverty rate was growing more quickly than the state average, the quotas would not keep up with the number of poor people, resulting in lower chances of admission and vice versa (Soares et al. 2010). Third, administrative capacity to enrol households into the *Cadastro Único* may also have differed between municipalities and influenced chances of families to benefit (Silva Parsons 2015). Lastly, the individual incentives of a municipality's mayors may also have influenced enrolment. De Janvry et al. (2012) show that *Bolsa Familia's* predecessor programme *Bolsa Escola* performed much more successfully in municipalities where the mayors were in their first term and thus could be re-elected, as compared to municipalities with mayors in their second and thus last term in office.

Moreover, there are a number of factors which influence the order of priorization at the household level: First of all, being enrolled in one of Bolsa Familia's predecessor programmes would guarantee enrolment into Bolsa Familia. Second, particularly vulnerable categories of households were granted priority, in particular indigenous families, families living from waste collection or recycling, and families where there was child labour (Hellmann 2015). Third, families with lower self-reported incomes would be enrolled as a priority. However, it is important to bear in mind that income was self-reported and prone to substantial measurement error (Soares et al. 2010). Fourth, households with a higher number of children under the age of 17 would be granted priority over households with a lower number of children. (Hellmann 2015, De Brauw et al. 2015).

This discussion illustrates that there was a degree of "randomness" in Bolsa Familia's rollout and that chances of enrolment differed substantially between municipalities and households. One possibility in order to exploit this situation for estimating BF's treatment effects would be an IV strategy, using one of the above-mentioned factors as an instrumental variable. However, due to data constraints and given that a multiplicity of factors influenced the individual chances of enrolment, this paper draws on fixed effect regressions (see section 5 for details). Fixed effects can control for a potential confounding effect of time-invariant unobservable factors and are less prone to model misspecification (in particular regarding violations of the exclusion restriction), and are therefore considered an appropriate alternative in the context of Bolsa Familia.

4. Data

The research questions are analysed based on the *Avaliação de Impacto do Programa Bolsa Família (*AIBF) datasets which were collected in two rounds (2005 and 2009) in the framework of Bolsa Familia's impact evaluation. Figure 1 illustrates that the survey has covered the rollout of the programme very well. During the first survey wave in 2005 Bolsa Familia had covered approximately 9 million households and in 2009, during the second wave, approximately 11 million households. However, the programme only achieved full coverage of its target population (households with annual incomes below the national poverty line) in 2012, reaching 13.9 million households. This implies that there is a sufficient number of uncovered but eligible households during both survey waves, which can serve as a comparison group for this study.

During the AIBF survey, a nationally representative sample was interviewed, although low-income households were oversampled. Out of the 15,416 households interviewed in 2005, 11,372 households were tracked again during the second wave in 2009. The sample of analysis is restricted to households which were interviewed in both survey waves and which fulfil the formal eligibility criteria, i.e. with incomes below 100 Brazilian Reals (BRL) in 2005, and below 170 BRL in 2009. This yields a sample of 7,427 households, of which approximately 59 percent benefitted from Bolsa Familia in 2009 and 41 percent were eligible but not yet enrolled.

The relevant outcome variables include the anthropometric measures of all household members[19], as well as detailed accounts of the households' spending on different food items (e.g. carbohydrate sources by type, protein sources by type, vegetables, sweets, processed food, and meals consumed outside of the household). Moreover, the survey also collected a rich set of household-level characteristics, such as the household's access to government-provided infrastructure (e.g. water, sanitation, electricity) as well as housing quality, which are used as control variables. The AIBF dataset also includes data on household income, but it is less consistently reported and prone to misreporting, given Bolsa Familia is a means-tested programme and the AIBF survey may have been perceived as an government's data

[19] In the second AIBF wave, this information was only collected for children under the age of 10 and their mothers, implying a smaller sample for these outcomes in the second survey wave.

collection. As a consequence the analysis focuses primarily on expenditure, rather than income data.

Tables 1 and 2 provide summary statistics for the key outcome and control variables, for both the treatment and the comparison group in this study. Table 1 illustrates that even though both the treatment and the comparison group fulfil the formal eligibility criteria for Bolsa Familia, there are important demographic and socioeconomic differences between both groups. Bolsa Familia households are on average larger (4.85 vs. 4.24 household members), they have more children (2.17 vs. 1.32 in the comparison group), the household heads tend to be younger (41.16 vs. 46.57 years of age) and work more frequently in the informal sector (56.2 percent vs. 43.6 percent) than household heads in the comparison group. Moreover, households from the treatment group tend to live in villages/neighbourhoods where the public infrastructure is less developed, as e.g. manifest in a lower share of paved roads, connections to the water grid and access to centralised waste collection. Lastly, per capita consumption per week is also much lower for treatment households with 45.78 BRL (approximately 15 USD at the time of the survey), as compared to 62.54 BRL (21 USD) in the comparison group. This implies that even after the Bolsa Familia cash transfers, the programme participants on average only marginally surpassed the World Bank's absolute poverty rate of $1.90 USD per day. Most of the difference in per capita consumption can be explained by gaps in non-food consumption between both groups, while food consumption expenditure is relatively similar.

Table 2.1: Descriptive statistics by Bolsa Familia participation (household level)

	Control			Treatment			t-test for equality of means (p-values)
	Mean	SD	N	Mean	SD	N	
Control variables							
Share of HH members aged 0-4	0.0475	0.0000	4693	0.0730	0.0000	6967	0.000
Share of HH members aged 5-9	0.0633	0.0000	4693	0.1215	0.0000	6967	0.000
Share of HH members aged 10-14	0.0799	0.0001	4693	0.1439	0.0000	6967	0.000
Share of HH members over 65	0.0865	0.0002	4693	0.0203	0.0000	6967	0.000
Number of children	1.3280	0.0023	4693	2.1741	0.0014	6967	0.000
HH size	4.2482	0.0068	4693	4.8518	0.0024	6967	0.000
Age HH head	46.5715	0.5015	4538	41.1640	0.1211	6741	0.000
Female HH head (binary)	0.4772	0.0005	4544	0.5207	0.0002	6760	0.000
Employed HH head (binary)	0.6171	0.0005	4501	0.6688	0.0002	6718	0.000
Informal sector (binary)	0.4362	0.0006	4350	0.5621	0.0003	6501	0.000
Pavement	0.5539	0.0005	4690	0.4380	0.0003	6965	0.000
Paved road	0.5709	0.0005	4691	0.4346	0.0003	6962	0.000
Tapped water	0.8773	0.0001	4684	0.7587	0.0002	6952	0.000
Centralised waste collection	0.8413	0.0002	4677	0.7177	0.0002	6941	0.000
Improved floor	0.6215	0.0004	4693	0.3972	0.0003	6966	0.000
Improved roof	0.8202	0.0003	4693	0.8040	0.0002	6966	0.000
Improved sanitation	0.6425	0.0004	4564	0.4812	0.0003	6795	0.000
Outcomes							
Total consumption	190.87	107.88	4683	156.35	19.46	6966	0.00
Total consumption (per capita)	62.54	9.96	4506	45.78	1.43	6727	0.00
Total food consumption	91.35	18.05	4683	87.18	6.01	6966	0.47
Total food consumption (per capita)	29.85	2.28	4506	25.28	0.42	6727	0.00
Total nonfood consumption	99.52	49.80	4684	69.17	6.26	6967	0.00
Total nonfood consumption (per capita)	32.69	4.14	4507	20.50	0.55	6728	0.00
Total income	55.61	12.14	3200	79.96	7.08	4484	0.00
Total income (per capita)	15.47	1.05	3058	21.26	0.45	4317	0.00

Note: Descriptive statistics based on pooled data from both AIBF waves. The consumption outcomes are reported in Brazilian Reals (1 BRL corresponded to approximately 2-2.5 USD in 2005-2009). The reference period for these outcomes is one week. Survey weights based on the first survey wave.

Table 2.2: Descriptive statistics (individual level)

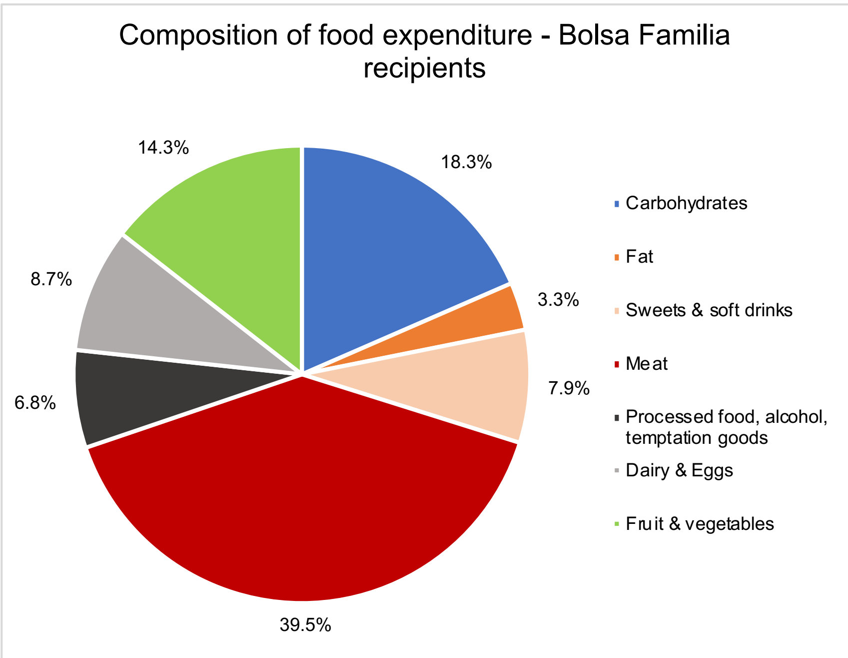
	Control			Treatment			
	Mean	**SD**	**N**	**Mean**	**SD**	**N**	**t-test for equality of means (p-values)**
Adults							
Age	39.39	0.22	13474	35.91	0.07	18578	0.00
Female	0.53	0.00	13710	0.52	0.00	18873	0.98
Primary education (binary)	0.58	0.00	7433	0.71	0.00	10361	0.00
Secondary education (binary)	0.36	0.00	7459	0.23	0.00	10351	0.00
BMI	24.14	0.03	4493	24.33	0.01	7744	0.00
Overweight	0.38	0.00	4493	0.37	0.00	7744	0.02
Obesity	0.11	0.00	4493	0.10	0.00	7744	0.43
Underweight	0.06	0.00	4493	0.06	0.00	7744	0.00
Children							
Age	9.15	0.03	7906	9.48	0.01	16196	0.00
Female	0.47	0.00	7902	0.49	0.00	16177	0.98
Height-for-age (z-score)	-0.24	0.00	4728	-0.45	0.00	10040	0.19
Weight-for-age (z-score)	-0.04	0.00	3474	-0.14	0.00	6930	0.00
Weight-for-height (z-score)	0.03	0.01	2165	0.18	0.00	4114	0.27
BMI-for-age (z-score)	0.03	0.00	4692	-0.01	0.00	9982	0.00
Stunting	0.08	0.00	4728	0.10	0.00	10040	0.81
Wasting	0.06	0.00	2165	0.04	0.00	4114	0.63
Underweight	0.21	0.00	4292	0.19	0.00	9491	0.00
Overweight	0.15	0.00	4292	0.14	0.00	9491	0.02
Obesity	0.04	0.00	4292	0.03	0.00	9491	0.43

Note: Descriptive statistics based on both waves of the AIBF (pooled). Survey weights based on the first survey wave.

In spite of the important socioeconomic and demographic differences, the nutritional outcomes between both groups are very similar. The BMI among adults in both groups amounts to approximately 24, while the prevalence of overweight ranges between 37 and 38, and of obesity between 10 and 11 percent. Children in the treatment group have lower height-for-age and weight-for-age z-scores, but higher weight-for-height z-scores than in the comparison group. The prevalence of stunting is slightly higher in the treatment group (10 vs. 8 percent), but the difference not statistically significant. The prevalence of underweight (19 percent), overweight (14 percent) and obesity (3 percent) is slightly lower among children in the treatment group.

Lastly, figure 1.3 provides an initial overview on the composition of food expenditure among households participating in Bolsa Familia. In spite of the low overall consumption expenditure, its composition is relatively diverse, with 18.9 percent dedicated to simple carbohydrates (rice, bread, potatoes, etc.), almost 40 percent to meat and fish, and 14 percent to fruit and vegetables. Moreover, 8 percent of household expenditure is dedicated to sweets and soft drinks, and 1.6 percent are spent on processed food. The differences to the comparison group are negligible as illustrated in figure A1 and table A2 in the appendix.

Figure 2.3 – Composition of household food expenditure among Bolsa Familia recipients



Source: own elaboration based on AIBF 1 dataset.

5. Methods

In order to estimate the impact of Bolsa Familia on the outcomes of interest, regressions with household-level fixed effects are estimated. For the household-level outcomes, our regressions take the form

$$Y_{ht} = \beta\, BF_{ht} + \rho\, X'_{ht} + \lambda_t + \eta_h + \varepsilon_{ht}$$

where BF_{ht} indicates Bolsa Familia participation of household h at time t, X'_{ht} is a vector of observable time-variant control variables, λ_t is a time dummy for the second time period (2009), and ε_{ht} is a time-variant household-level idiosyncratic shock. The fixed effect is defined as

$$\eta_h = \eta + \alpha\, A_h$$

where η is a constant and A_h is a set of time-invariant household level confounders. Drawing on regressions with household-level fixed effects implies that our impact estimation results rely on the variation in Bolsa Familia participation between different households in a given municipality, i.e. they do not take into account variation between municipalities. The advantage of this approach is that the estimates are not prone to bias due to unobservable time-invariant municipality-level characteristics. The disadvantage is that we cannot draw on the potentially random variation between municipalities (e.g. due to the municipality-level quotas) which was described in section 3.

The identifying assumption of our estimates is that selection into treatment is exclusively based on time-varying observables included in X'_{ht}, as well as time-invariant unobservable characteristics captured by the fixed effect η_h. In other words, selection into treatment is not based on *time-varying* unobservables. If this assumption holds true, β will indeed reflect the causal impact of Bolsa Familia on the outcomes of interest.

In the context of this study, this assumption can be considered as relatively realistic. First, the AIBF survey provides rich information on observable time-varying household characteristics, such as the demographic composition of households, employment of the household head, as well as the municipality-level infrastructure which a household can access. Secondly, the unobservable factors which could bias the regression results are time-invariant, e.g. ability and psychological predispositions of different household members, genetic risk factors for overweight and obesity, as well as their preferences and tastes for certain foods. Apart from these factors, it is at least not obvious which time varying factors could be simultaneously correlated with Bolsa Familia treatment and the outcomes of interest.

Regressions with individual-level outcomes also include household-level, rather than individual level fixed effects. This has two main reasons: first, the AIBF survey has exactly matched households, but not individuals between rounds. Matching different individuals manually, e.g. based on age, would thus entail a large degree of uncertainty. Secondly, the undernutrition indicators are most relevant for children in the age bracket between 2 and 10 years of age. Many observations from the second survey wave would thus need to be excluded from an analysis with individual-level fixed effects, as these children are only observed in the second survey wave. The individual level regressions thus take the form

$$Y_{iht} = \beta\, BF_{ht} + \rho\, X'_{ht} + \delta\, Z'_{it} + \lambda_t + \eta_h + \varepsilon_{iht}$$

where the subscript i represents the individual, and Z'_{it} is a vector of time-varying individual-level control variables.

In a first step, the paper assesses Bolsa Familia's overall impact on nutritional outcomes among both children and adults. The nutritional outcomes presented in table 2 are regressed on Bolsa Familia participation based on the fixed effects models presented above.

In a second step, the paper investigates the channels which have contributed to this observed effect, in particular on the relative importance of the overall consumption increase and changes in the composition of food expenditure. In order to investigate the overall consumption effect, total food expenditure as well as expenditure on different food items is regressed on Bolsa Familia participation. To investigate changes in the composition of food expenditure, I regress the relative share of different food items in a household's consumption basket on Bolsa Familia treatment. Although it would be interesting to also test the other channels hypothesized in section 2, e.g. the role of conditionalities and education, this is not feasible based on the available data (only short run data on education available) and study setting (all households were subject to conditionalities).

The standard errors for all regressions with individual-level outcomes are clustered at the household-level, given that treatment is also assigned at the household level, following the guidance by Abadie et al. (2017). Standard errors for household level outcomes are robust to heteroscedasticity but not clustered, given that treatment assignment was based on a household-level means test and thus independent from municipality or state level characteristics. Lastly, it should be noted that the consumption-related outcomes are reported both as household totals, and per capita consumption based on an adult equivalent scale specifically developed for Brazil based on data from the period of interest (Vaz & Vaz 2007). However, other equivalence scales were tested and results are stable with regards to the choice of the equivalence scale.

6. Results

Table 3 presents the fixed effect estimates on the impact of Bolsa Familia on nutritional outcomes among children (columns 4-6), as well as OLS estimates for comparison (columns 1-3). The OLS estimates in column 1 suggest that children from Bolsa Familia households tend to have lower weight-for-age, BMI-for-age scores, and a lower prevalence of overweight. However, these results lose their significance once further household-level controls are included in the regressions. The fixed effect estimates in columns 4-6, which unlike the OLS estimates also control for time-invariant unobservable factors, provide suggestive evidence that Bolsa Familia increased overweight among children by approximately 4 percentage points. This finding is robust to the choice of control variables, but only statistically significant at the 10% level. The estimated coefficients for all other nutritional outcomes are close to zero and not statistically significant.

Table 2.3: Impact of Bolsa Familia on nutritional outcomes among children (<18)

	OLS estimates			FE estimates			
	(1)	(2)	(3)	(4)	(5)	(6)	N
Height-for-age (z-scores)	-0.0347	0.0003	0.0059	-0.015	-0.021	-0.001	14,249
	(0.023)	(0.023)	(0.023)	(0.062)	(0.062)	(0.066)	
Weight-for-age (z-scores)	-0.071***	-0.0220	-0.0247	-0.026	-0.016	0.005	9,954
	(0.025)	(0.026)	(0.026)	(0.057)	(0.057)	(0.062)	
Weight-for-height (z-scores)	-0.0347	-0.0134	-0.0196	0.041	0.045	0.079	6,032
	(0.038)	(0.039)	(0.04)	(0.111)	(0.114)	(0.117)	
BMI-for-age (z-scores)	-0.069***	-0.0320	-0.0338	-0.015	0.000	0.009	14,167
	(0.025)	(0.025)	(0.026)	(0.077)	(0.077)	(0.082)	
Stunting	0.0012	-0.0034	-0.0044	0.002	0.003	0.003	14,249
	(0.005)	(0.005)	(0.006)	(0.017)	(0.017)	(0.018)	
Wasting	0.0026	0.0001	-0.0002	-0.006	0.002	-0.001	6,032
	(0.006)	(0.007)	(0.007)	(0.022)	(0.021)	(0.021)	
Underweight	0.0074	0.0046	0.0059	0.016	0.017	0.022	13,288
	(0.008)	(0.008)	(0.008)	(0.022)	(0.022)	(0.022)	
Overweight	-0.0135**	-0.0076	-0.0074	0.036*	0.039*	0.043*	13,288
	(0.006)	(0.006)	(0.006)	(0.021)	(0.022)	(0.023)	
Obesity	-0.0062	-0.0042	-0.0040	0.001	0.000	-0.001	13,288
	(0.003)	(0.004)	(0.004)	(0.011)	(0.011)	(0.012)	
Controls individual	x	x	x	x	x	x	
Controls demography (HH-level)		x	x		x	x	
Controls socioeconomic situation (HH-level)			x			x	

Note: Summary of the regression coefficients on Bolsa Familia treatment for the four nutritional outcomes of interest (obesity, overweight, underweight, BMI). All regressions include a time dummy for the second time period. Standard errors are clustered at the household level. *** p<0.01, ** p<0.05, * p<0.1.

Table 4 presents OLS and FE estimates on Bolsa Familia's impact on adults. The OLS estimates show that conditional on the standard set of control variables, Bolsa Familia participants' BMI is on average 0.2 index points higher, and their risk of being overweight is 2.5 percentage points higher than for non-participants. This finding is rather unexpected, given that Bolsa Familia beneficiaries on average have lower consumption expenditures than non-beneficiaries, as illustrated in section 3. However, once fixed effects are added to the regression models, these coefficients lose their statistical significance. Overall, it can be concluded that there is a statistically significant correlation between Bolsa Familia treatment and overweight, but there is no evidence that this relationship is causal.

Table 2.4: Impact of Bolsa Familia on nutritional outcomes among adults (Fixed effect estimates)

	OLS estimates			**FE estimates**		
	(1)	(2)	(3)	(4)	(5)	(6)
BMI	0.232**	0.191*	0.185*	0.210	0.235	0.371
	(0.0996)	(0.102)	(0.103)	(0.308)	(0.311)	(0.328)
Overweight	0.0246**	0.0246**	0.0249**	-0.0054	-0.0091	-0.0052
	(0.0107)	(0.0109)	(0.0110)	(0.0368)	(0.0372)	(0.0387)
Obesity	0.00755	0.00623	0.00625	0.0252	0.0255	0.0296
	(0.00690)	(0.00709)	(0.00712)	(0.0233)	(0.0236)	(0.0242)
Underweight	0.00350	0.00491	0.00528	0.0112	0.00649	0.00388
	(0.00518)	(0.00534)	(0.00541)	(0.0165)	(0.0167)	(0.0173)
Controls individual	x	x	x	x	x	x
Controls demography (HH-level)		x	x		x	x
Controls socioeconomic situation (HH-level)			x			x
Number of observations	8,453	8,453	8,309	8,453	8,453	8,309
Number of households	4,666	4,666	4,586	4,666	4,666	4,586

Note: Summary of the regression coefficients on Bolsa Familia treatment for the four nutritional outcomes of interest (obesity, overweight, underweight, BMI). All regressions include a time dummy for the second time period.. Standard errors are clustered at the household level. *** p<0.01, ** p<0.05, * p<0.1.

Heterogeneities

Given that Brazil is characterised by important geographic disparities, this paper also investigates on the heterogeneities in Bolsa Familia's impact between the five large geographic regions of the country: the North, mainly covering the Amazon rainforest; the Northeast consisting of coastal areas and a semi-arid hinterland which features the highest poverty rates in the country (and by extension the highest share of Bolsa Familia beneficiaries); the Centre-West which is characterised by both large-scale and small-scale agriculture; the more urban Southeast including the country's largest cities São Paulo and Rio de Janeiro; as well as the affluent South bordering Argentina and Uruguay.

In order to analyse the heterogeneous treatment effects between these regions, the anthropometric outcomes of interest have been regressed on Bolsa Familia treatment status, dummy variables for four of Brazil's geographic regions (the Centre-West is used as a reference category), as well as interaction terms between each of the regions and Bolsa Familia treatment. Based on these estimates, the overall treatment effect for each region can be estimated as the linear combination of each region dummy and the corresponding interaction term.

Table 5 presents the results of these regressions for children. It suggests that there may have been regional disparities in treatment effects. For the Northern region including the Amazon, the results suggest that Bolsa Familia has reduced obesity among children by 8.2 percentage points, as manifest in the significant linear combination coefficient in column 9. On the other hand, for the urban Southeast, there is evidence that the programme has led to an overall increase in overweight by 8.7 percentage points (significant at the 5% level) and of obesity by 3.6 percentage points (significant at the 10% level).

As a matter of caution, it should be noted that these coefficients are surprisingly large, and should thus be interpreted carefully. One possible explanation is that the available sub-samples in each of the 5 regions (especially the sparsely populated North) are too small in order to precisely estimate these heterogeneous treatment effects. However, they may suggest a tendency which merits further investigation.

Table 2.5: Heterogeneous treatment effects of Bolsa Familia across Brazilian regions (children<18), fixed effects estimates

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Height-for-age (z-score)	Weight-for-age (z-score)	Weight-for-height (z-score)	BMI-for-age (z-score)	Stunting	Wasting	Underweight	Overweight	Obesity
Bolsa Familia (BF)	-0.120	-0.0487	-0.557*	0.328	0.0297	0.0151	-0.0367	0.177**	0.0230
	(0.215)	(0.206)	(0.319)	(0.232)	(0.0428)	(0.139)	(0.0907)	(0.0725)	(0.0250)
BF * North	0.194	-0.217	0.0888	-0.759**	-0.0279	0.0458	0.0963	-0.209**	-0.105***
	(0.271)	(0.272)	(0.473)	(0.349)	(0.0663)	(0.151)	(0.106)	(0.0990)	(0.0394)
Linear combination (BF* North) + BF	0.074	-0.265	-0.468	-0.431*	0.002	0.061	0.060	-0.032	-0.082**
	(0.163)	(0.1748)	(0.3457)	(0.2511)	(0.0506)	(0.0536)	(0.0551)	(0.0664)	(0.0308)
BF* Northeast	0.0658	0.0399	0.728**	-0.263	-0.0335	-0.0135	0.0547	-0.152*	-0.0254
	(0.234)	(0.223)	(0.341)	(0.252)	(0.0489)	(0.141)	(0.0958)	(0.0794)	(0.0309)
Linear combination (BF* Northeast) + BF	-0.054	-0.009	0.172	0.065	-0.004	0.002	0.018	0.025	-0.002
	(0.0944)	(0.0866)	(0.1492)	(0.1089)	(0.0242)	(0.0287)	(0.0316)	(0.0338)	(0.0194)
BF * Southeast	0.118	0.229	0.898**	-0.162	-0.0181	-0.0264	0.0345	-0.0903	0.0131
	(0.252)	(0.234)	(0.400)	(0.283)	(0.0546)	(0.146)	(0.102)	(0.0833)	(0.0338)
Linear combination (BF* Southeast) + BF	-0.002	0.180	0.341	0.166	0.012	-0.011	-0.002	0.087**	0.036*
	(0.1321)	(0.114)	(0.2444)	(0.1602)	(0.0353)	(0.0438)	(0.0461)	(0.0407)	(0.0217)
BF * South	0.355	0.178	0.767	-0.423	-0.0426	-0.130	0.113	-0.141	0.0114
	(0.334)	(0.283)	(0.476)	(0.370)	(0.0740)	(0.159)	(0.116)	(0.109)	(0.0564)
Linear combination (BF* South) + BF	0.235	0.130	0.210	-0.095	-0.013	-0.115	0.076	0.036	0.034
	(0.2534)	(0.1949)	(0.3552)	(0.2996)	(0.0602)	(0.08)	(0.0725)	(0.0798)	(0.0501)
Individual Controls	x	x	x	x	x	x	x	x	x
HH-level cotrols (demographic & socioeconomic characteristics)	x	x	x	x	x	x	x	x	x
Number of observation	11,734	8,310	4,968	11,653	11,734	4,968	10,989	10,989	10,989
Number of households	4,624	3,942	2,846	4,598	4,624	2,846	4,543	4,543	4,543

Note: All regressions include a time dummy for the second time period. Standard errors are clustered at the household level. *** p<0.01, ** p<0.05, * p<0.1.

Channels

As a next step, I have investigated on the channels through which the Bolsa Familia cash transfers affect nutritional outcomes, in particular whether there is evidence for an increase in total food expenditure and/or a change in the composition of food expenditure. Table 6 summarises Bolsa Familia's impact on overall household consumption expenditure, also disaggregated by food consumption and non-food consumption. The OLS estimates in columns 1 and 2 suggest a negative and significant correlation between Bolsa Familia participation and total consumption expenditure, as well as total non-food expenditure. This also confirms the finding from the descriptive analysis which indicated that Bolsa Familia participants are less well-off than eligible non-participants (our comparison group).

However, once household-level fixed effects are included, the coefficients on Bolsa Familia become positive and significant, suggesting that the programme led to important welfare gains for its beneficiaries. Bolsa Familia is estimated to increase the average per capita household expenditure by 5.2 BRL per week (1.73 USD at the time of the survey, or 11 percent of total consumption expenditure in treated households). This finding is significant at the 5% level. The bulk of this increase can be attributed to additional food spending, amounting to 3.7 BRL (1.25 USD, or approximately 15 percent of total food expenditure) per capita per week. This finding is significant at the 1% significance level. Overall, this can be considered as evidence for an income effect, i.e. Bolsa Familia leads to an increase in overall food expenditure.

Table 7 provides evidence how this overall increase in food spending has been distributed across different food items. In particular, the per capita spending on each of 13 food items has been regressed on Bolsa Familia treatment and the usual control variables and fixed effects. The results suggest that the average household spent a large share of its additional income on meat and fish (1.22 BRL, corresponding to 32 percent of the total increase in food spending). This is followed by carbohydrates (0.41 BRL, corresponding to 11.1 percent of the increase in food spending), sweets (0.39 BRL or 10.5 percent of the increase in food spending), and dairy (0.38 BRL, or 10.2 percent of the total increase in food spending). It should be noted that, although large, the coefficient on meat is not statistically significant, while the latter three findings are all significant at the 1% level. Moreover, the expenditure data does not allow any definite conclusions on eventual changes in the intake of calories. This analysis is hampered by the fact that different food items are aggregated in the AIBF survey, e.g for sweets.

Table 8 further investigates on changes in the composition of household's consumption bundles, using the expenditure share of different food items as the outcome variable. However, these regressions do not yield any statistically significant results. All in all, the analysis provides solid evidence that Bolsa Familia has led to an increase in overall consumption expenditure, including increases in total consumption and food consumption, but that there is not enough evidence to conclude that the composition of the beneficiary households' consumption bundle has changed in response to the programme.

Table 2.6 - Impact of Bolsa Familia on overall household income & consumption

	OLS		FE	
	(1)	(2)	(3)	(4)
Total consumption	-15.40***	-11.67***	12.17**	15.83**
	(3.322)	(3.634)	(5.471)	(6.397)
Total consumption (per capita)	-4.180***	-3.474***	4.079**	5.213**
	(1.127)	(1.241)	(1.765)	(2.043)
Total food consumption	-0.951	0.154	8.962***	10.83***
	(1.293)	(1.334)	(3.102)	(3.411)
Total food consumption (per capita)	-0.232	-0.0941	3.057***	3.664***
	(0.405)	(0.423)	(0.982)	(1.059)
Total non-food consumption	-14.44***	-11.82***	3.207	4.999
	(2.857)	(3.191)	(3.875)	(4.838)
Total non-food consumption (per capita)	-3.948***	-3.379***	1.023	1.549
	(0.995)	(1.112)	(1.279)	(1.583)
Total income	13.21***	15.13***	38.80***	25.62**
	(1.560)	(1.653)	(10.86)	(10.61)
Total income (per capita)	3.864***	4.127***	9.653***	6.933***
	(0.408)	(0.429)	(2.467)	(2.653)
Controls demographic composition	x	x	x	x
Controls socioeconomic situation		x		x
Number of observations	11,245	10,475	11,245	10,475

Note: All regressions include a time dummy for the second time period. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 2.7: Impact of Bolsa Familia on per capita food expenditure by food group in BRL

	OLS		FE	
	(1)	(2)	(3)	(4)
Carbohydrates	0.158**	0.153**	0.242	0.407***
	(0.0638)	(0.0672)	(0.152)	(0.156)
Plant-based protein	0.136***	0.114***	0.0282	0.0375
	(0.0379)	(0.0399)	(0.0462)	(0.0501)
Fruit	0.0568	0.0893*	0.221	0.181
	(0.0494)	(0.0518)	(0.142)	(0.123)
Vegetables	0.0315	0.0526	0.128	0.210
	(0.0463)	(0.0493)	(0.124)	(0.136)
Meat & Fish	-0.482*	-0.466*	1.010	1.225
	(0.261)	(0.271)	(0.737)	(0.813)
Dairy	-0.132	-0.102	0.329**	0.388***
	(0.0857)	(0.100)	(0.131)	(0.150)
Fat	0.0111	0.00441	0.131**	0.162**
	(0.0318)	(0.0358)	(0.0636)	(0.0738)
Eggs	0.0176	0.0195	0.0542	0.0579
	(0.0149)	(0.0154)	(0.0344)	(0.0371)
Meals out	0.0197	0.00941	0.187**	0.190*
	(0.0514)	(0.0546)	(0.0926)	(0.0991)
Sweets	0.0280	0.0431	0.307***	0.390***
	(0.0401)	(0.0419)	(0.0948)	(0.101)
Alcohol	-0.0191	-0.00887	0.126*	0.0808**
	(0.0237)	(0.0250)	(0.0706)	(0.0385)
Processed food	-0.0293	-0.0156	0.0810	0.0783
	(0.0213)	(0.0225)	(0.0563)	(0.0632)
Coffee	0.0220	0.0173	0.00583	0.0245
	(0.0151)	(0.0155)	(0.0194)	(0.0206)
Temptation goods	-0.0252	-0.0152	0.0677	0.0807
	(0.0319)	(0.0320)	(0.0592)	(0.0647)
School snacks	-0.0204	-0.00615	0.0684	0.0545
	(0.0210)	(0.0216)	(0.0435)	(0.0455)
Controls demographic composition	x	x	x	x
Controls socioeconomic situation		x		x
Number of observations	13,575	12,732	12,276	12,254

Note: All regressions include a time dummy for the second time period. *** p<0.01, ** p<0.05, * p<0.1.

Table 2.8: Impact of Bolsa Familia on the composition of household food expenditure (shares of food group in total food expenditure) - FE estimates

	OLS		FE	
	(1)	(2)	(3)	(4)
Carbohydrates	0.00417	0.00321	-0.00319	-0.000639
	(0.00256)	(0.00266)	(0.00603)	(0.00644)
Plant-based protein	0.00561***	0.00412***	-0.00101	-0.00139
	(0.00107)	(0.00111)	(0.00279)	(0.00307)
Fruit	0.00143	0.00259**	0.00542*	0.00482
	(0.00122)	(0.00129)	(0.00313)	(0.00330)
Vegetables	0.00162	0.00271**	0.00203	0.00397
	(0.00129)	(0.00133)	(0.00310)	(0.00335)
Meat & Fish	-0.00718	-0.00758	-0.00749	-0.00821
	(0.00458)	(0.00471)	(0.00995)	(0.0106)
Dairy	-0.0062***	-0.0051***	-0.00287	-0.00509
	(0.00183)	(0.00191)	(0.00417)	(0.00448)
Fat	0.000115	-0.000378	-0.00074	-0.00147
	(0.000816)	(0.000873)	(0.00189)	(0.00194)
Eggs	0.00113	0.00103	0.000834	0.000545
	(0.000869)	(0.000913)	(0.00206)	(0.00210)
Meals out	0.000990	0.000527	0.00228	0.00228
	(0.00120)	(0.00123)	(0.00282)	(0.00301)
Sweets	0.00267*	0.00284*	0.00428	0.00512
	(0.00153)	(0.00159)	(0.00374)	(0.00397)
Alcohol	-0.00130**	-0.00136**	0.00182	0.00113
	(0.000624)	(0.000660)	(0.00138)	(0.00118)
Processed food	-0.00140*	-0.00123	0.000311	1.53e-05
	(0.000826)	(0.000863)	(0.00176)	(0.00193)
Coffee	-0.000823	-0.00102*	-0.0029*	-0.0031**
	(0.000595)	(0.000614)	(0.00127)	(0.00135)
Temptation goods	-0.00127	-0.00118	0.000945	0.00155
	(0.00105)	(0.00111)	(0.00209)	(0.00220)
School snacks	-0.000820	-0.000334	-0.00061	-0.000607
	(0.00111)	(0.00115)	(0.00218)	(0.00230)
Controls demographic composition	x	x	x	x
Controls socioeconomic situation		x		x
Number of observations	13,575	12,732	12,276	12,254

Note: All regressions include a time dummy for the second time period. *** p<0.01, ** p<0.05, * p<0.1.

Robustness Checks

Evaluating Bolsa Familia's impact on the beneficiary households' consumption behaviours required running a relatively large number of regressions with different outcomes. To some extent, this is also true for the nutritional outcomes of children, for which a larger number of measures apply than for adults (including both z-scores and binary outcomes). However, testing many hypotheses increases the risk of "false positives" i.e. wrongly rejecting the null hypothesis of zero programme impact. In order to quantify this risk, tables 9 and 10 present corrected p-values which take into account multiple hypothesis testing. The table presents corrected p-values based on the methods proposed by both Bonferroni, Holm and Holland. Based on these corrected p-values, only the coefficients on total food consumption, per capita food consumption, and consumption of sweets would be significant at the 5% significance level.

Table 2.9: P-values with correction for multiple hypothesis testing

	Specification I (column 3 in table x)				Specification II (column 4 in table x)			
	Orig. p-value	Corrected p-value			Orig. p-value	Corrected p-value		
		Bonferroni	Holm	Holland		Bonferroni	Holm	Holland
Adults								
BMI	0.400	1.000	1.000	0.802	0.233	0.931	0.931	0.653
Overweight	0.695	1.000	1.000	0.907	0.743	1.000	1.000	0.934
Obesity	0.333	1.000	1.000	0.802	0.264	1.000	0.931	0.653
Underweight	0.958	1.000	1.000	0.958	0.814	1.000	1.000	0.934
Children								
Height-for-age (z-scores)	0.737	1.000	1.000	1.000	0.984	1.000	1.000	1.000
Weight-for-age (z-scores)	0.780	1.000	1.000	1.000	0.934	1.000	1.000	1.000
Weight-for-height (z-scores)	0.704	1.000	1.000	1.000	0.507	1.000	1.000	0.993
BMI-for-age (z-scores)	0.999	1.000	1.000	1.000	0.916	1.000	1.000	1.000
Stunting	0.852	1.000	1.000	1.000	0.880	1.000	1.000	1.000
Wasting	0.932	1.000	1.000	1.000	0.968	1.000	1.000	1.000
Underweight	0.531	1.000	1.000	0.998	0.413	1.000	1.000	0.986
Overweight	0.104	0.934	0.934	0.627	0.084	0.755	0.755	0.545
Obesity	0.939	1.000	1.000	1.000	0.983	1.000	1.000	1.000

Table 2.10: P-values with correction for multiple hypothesis testing (consumption-related outcomes)

	Specification I (column 3 in table x)				Specification II (column 4 in table x)			
	p-value	Corrected p-value			p-value	Corrected p-value		
		Bonferroni	Holm	Holland		Bonferroni	Holm	Holland
Expenditure by food group								
Carbohydrates	0.16	1.00	1.00	0.82	0.02	0.30	0.28	0.25
Plant-based protein	0.56	1.00	1.00	0.82	0.47	1.00	1.00	0.74
Fruit	0.16	1.00	1.00	0.82	0.16	1.00	1.00	0.74
Vegetables	0.33	1.00	1.00	0.82	0.14	1.00	1.00	0.74
Meat & Fish	0.21	1.00	1.00	0.82	0.15	1.00	1.00	0.74
Dairy	0.04	0.61	0.57	0.44	0.02	0.31	0.28	0.25
Fat	0.08	1.00	1.00	0.66	0.04	0.66	0.53	0.42
Eggs	0.16	1.00	1.00	0.82	0.14	1.00	1.00	0.74
Meals out	0.08	1.00	1.00	0.66	0.07	1.00	0.74	0.54
Sweets	0.01	0.21	0.21	0.19	0.00	0.02	0.02	0.02
Alcohol	0.12	1.00	1.00	0.75	0.05	0.79	0.58	0.45
Processed food	0.19	1.00	1.00	0.82	0.23	1.00	1.00	0.74
Coffee	0.77	1.00	1.00	0.82	0.25	1.00	1.00	0.74
Temptation goods	0.29	1.00	1.00	0.82	0.23	1.00	1.00	0.74
School snacks	0.16	1.00	1.00	0.82	0.25	1.00	1.00	0.74
Share of food group in total expenditure								
Carbohydrates	0.61	1.00	1.00	1.00	0.92	1.00	1.00	1.00
Plant-based protein	0.73	1.00	1.00	1.00	0.66	1.00	1.00	1.00
Fruit	0.13	1.00	1.00	0.87	0.16	1.00	1.00	0.93
Vegetables	0.53	1.00	1.00	1.00	0.25	1.00	1.00	0.98
Meat & Fish	0.51	1.00	1.00	1.00	0.27	1.00	1.00	0.98
Dairy	0.71	1.00	1.00	1.00	0.46	1.00	1.00	1.00
Fat	0.29	1.00	1.00	0.99	0.22	1.00	1.00	0.97
Eggs	0.48	1.00	1.00	1.00	0.45	1.00	1.00	1.00
Meals out	0.23	1.00	1.00	0.97	0.35	1.00	1.00	0.99
Sweets	0.86	1.00	1.00	1.00	0.99	1.00	1.00	1.00
Alcohol	0.70	1.00	1.00	1.00	0.80	1.00	1.00	1.00
Processed food	0.69	1.00	1.00	1.00	0.59	1.00	1.00	1.00
Coffee	0.06	0.94	0.94	0.62	0.04	0.58	0.58	0.45
Temptation goods	0.67	1.00	1.00	1.00	0.49	1.00	1.00	1.00
School snacks	0.79	1.00	1.00	1.00	0.80	1.00	1.00	1.00
Income & consumption								
Total income	0.01	0.07	0.06	0.06	0.03	0.23	0.12	0.11
Total income (pc)	0.01	0.05	0.05	0.05	0.02	0.16	0.12	0.11
Total consumption	0.06	0.49	0.22	0.20	0.03	0.21	0.12	0.11
Total consumption (pc)	0.05	0.43	0.22	0.20	0.02	0.18	0.12	0.11
Total food consumption	0.02	0.19	0.12	0.11	0.01	0.05	0.04	0.04
Total food cons (pc)	0.02	0.14	0.10	0.10	0.00	0.03	0.03	0.03
Total non-food cons	0.44	1.00	0.87	0.68	0.32	1.00	0.64	0.53
Total non-food (pc)	0.45	1.00	0.87	0.68	0.34	1.00	0.64	0.53

However, in the context of this study, it is considered reasonable to consider the other significant findings reported above as suggestive evidence for a treatment effect. As we know very little about the impact of cash transfers on overweight and obesity, it may make sense to start building a picture of the impacts based on available data and evidence, even if the small relatively small sample size of this study implies that treatment effects are estimated with relatively large standard errors, and may therefore not pass multiple hypothesis tests.

Another concern relates to the large regional disparities in Brazil and the fact that region-specific trends, not accounted for by the linear time trend in the main specifications, may explain part of the findings. In order to address this risk, all main regression models were re-estimated with a region-specific trend for each of Brazil's five main geographic regions. The results of this robustness check are presented in tables A4-A7 and corroborate the findings from the main analysis.

7. Conclusion

Overall, this paper provides suggestive evidence that Bolsa Familia has led to an increase in overweight among children by approximately 4 percentage points. However, there was no statistically significant effect on child obesity or on anthropometric outcomes among adults. Neither was there a statistically significant effect on undernutrition among children.

The impacts on food consumption suggest that Bolsa Familia leads to higher food expenditure, and possibly also less healthy diets. This study documents an increase in total food expenditure in response to the Bolsa Familia transfers by 15 percent. There is also evidence for a disproportionate increase in the *absolute per capita expenditure* on dairy products and sugary products (sweets, soft drinks), even though this effect could not be detected in the *expenditure shares* for each of these food items.

How do these findings relate to other studies? With regards to overnutrition, Fernald et al.'s (2008a) and Levasseur (2019) showed that the *Oportunidades* programme's conditionalites in Mexico have helped to reduce BMI and overweight/obesity among the programme's participants. Although the adverse nutritional impacts of Bolsa Familia detected in this study were small and limited to child overweight, there is no evidence that the programme contributes to a reduction of overnutrition in Brazil. A possible explanation for this, is that the Mexican Oportunidades is already "obesity-sensitive", while Bolsa Familia is not. The Mexican conditionalities include e.g. the regular participation in trainings sessions (*pláticas*) which provide *inter alia* information on healthy diets. In this context, it is also important to point to recent evidence illustrating that cash transfers are more effective in reducing undernutrition when combined with training sessions, or social and behaviour change communication (SBCC) campaigns (Field & Maffioli 2020). Explicitly testing the effectiveness of obesity-related conditionalities, as under Oportunidades, should therefore also be considered a priority for further research.

With regards to undernutrition, the results are in line with the only previous impact evaluation on Bolsa Familia which assessed anthropometric outcomes among children (De Brauw et al. 2010). Their study detects a statistically significant effect on BMI-for-age z-scores among children, but no effect on undernutrition as measured by stunting, wasting, height-for-age z-scores, or weight-for-age z-scores. Bastagli et al.'s review (2016) shows that even in other countries, cash transfer evaluations have rarely detected statistically significant effects on measures of undernutrition: only five out of 13 studies found an impact on stunting, one out of 5 for wasting, and zero out of seven for weight-for-age z-scores. Possible explanations for the lack of significant (observed) effects on undernutrition include an insufficient follow-up period to observe the slow changes to height and weight, and the fact that anthropometric outcomes are particularly susceptible to measurement error (especially for younger children). Moreover, the timing of cash transfers may matter for reducing undernutrition, with the first 1000 days in the life of a child being crucial. Cash transfer evaluations which do not focus exclusively on children who were exposed to the treatment in this period, may therefore not be able to capture the full effect of the interventions on undernutrition.

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Appendix

Table 2.A1: Composition of household income - by treatment status

	Control			Treatment			t-test for equality of means
	Mean	SD	N	Mean	SD	N	(p-values)
Total income	55.61	12.14	3200	79.96	7.08	4484	0.00
Labour income	36.36	4.46	4693	47.26	2.71	6967	0.00
Social security (contributory)	14.98	2.59	4693	9.18	0.74	6967	0.00
Intra-family transfers	3.86	0.68	4693	2.57	0.08	6967	0.00
Bolsa Familia	0.00	0.00	4693	18.42	0.10	6967	0.00
Total income (per capita)	15.47	1.05	3058	21.26	0.45	4317	0.00
Labour income (per capita)	10.40	0.41	4515	12.86	0.19	6728	0.06
Social security (per capita)	4.40	0.24	4515	2.47	0.06	6728	0.00
Intra-family transfers (per capita)	1.37	0.12	4515	0.80	0.01	6728	0.00
Bolsa Familia (per capita)	0.00	0.00	4515	5.53	0.01	6728	0.00

Note: Descriptive statistics based on pooled data from both AIBF waves. The consumption outcomes are reported in Brazilian Reals (1 BRL corresponded to approximately 2-2.5 USD in 2005-2009). The reference period for these outcomes is one week. Survey weights based on the first survey wave.

Table 2.A2: Composition of household food expenditure - by treatment status

	Control			Treatment			t-test for equality of means (p-values)
	Mean	SD	N	Mean	SD	N	
Carbohydrates	0.167	0.000	2908	0.183	0.000	4319	0.000
Pulses	0.033	0.000	2908	0.040	0.000	4319	0.000
Fruit	0.051	0.000	2908	0.043	0.000	4319	0.862
Vegetables	0.065	0.000	2908	0.060	0.000	4319	0.308
Dairy	0.083	0.000	2908	0.064	0.000	4319	0.051
Fat	0.031	0.000	2908	0.033	0.000	4319	0.108
Sweets & soft drinks	0.075	0.000	2908	0.079	0.000	4319	0.008
Meat	0.384	0.000	2908	0.395	0.000	4319	0.003
Alcohol	0.006	0.000	2908	0.004	0.000	4319	0.001
Processed food	0.017	0.000	2908	0.016	0.000	4319	0.487
Eggs	0.021	0.000	2908	0.024	0.000	4319	0.020
Coffee	0.025	0.000	2908	0.022	0.000	4319	0.342
Meals out	0.019	0.000	2908	0.013	0.000	4319	0.933
Temptation goods	0.013	0.000	2908	0.013	0.000	4319	0.005
School snacks	0.012	0.000	2908	0.012	0.000	4319	0.263

Note: Descriptive statistics based on pooled data from both AIBF waves. Survey weights based on the first survey wave.

Figure 2.A1: Composition of food expenditure – Comparison groups

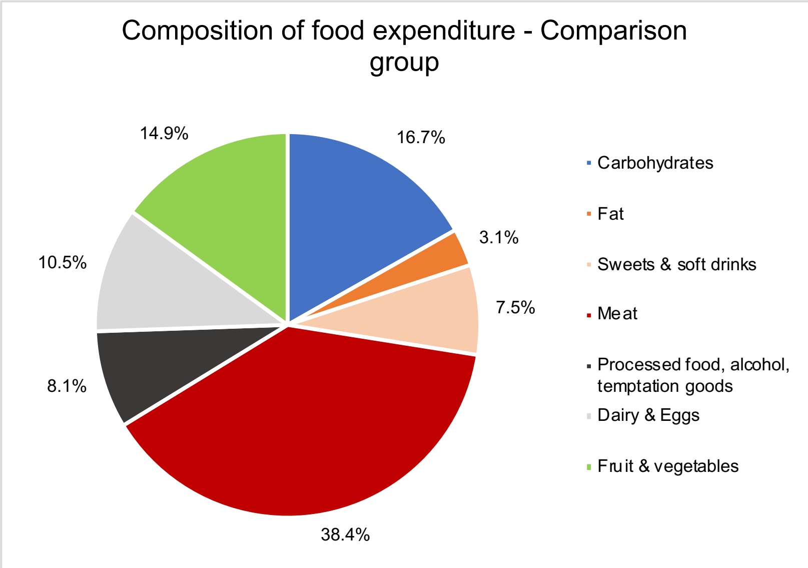

Table 2.A3: Heterogeneous treatment effects of Bolsa Familia across Brazilian regions (adults)

	(1)	(2)	(3)	(4)
	BMI	Overweight	Obesity	Underweight
Bolsa Familia (BF)	1.253	0.203	0.0820	-0.101
	(1.142)	(0.162)	(0.0740)	(0.105)
BF * North	-0.346	-0.148	-0.0956	0.0928
	(1.379)	(0.203)	(0.109)	(0.120)
Linear combination (BF* North) + BF	0.9067	0.0548	-0.0136	-0.0081
	(0.757)	(0.117)	(0.08)	(0.057)
BF* Northeast	-0.934	-0.244	-0.0303	0.106
	(1.246)	(0.170)	(0.0780)	(0.108)
Linear combination (BF* Northeast) + BF	0.3189	-0.0411	0.0517	0.0055
	(0.486)	(0.051)	(0.032)	(0.024)
BF * Southeast	-1.124	-0.232	-0.0683	0.121
	(1.274)	(0.178)	(0.0878)	(0.109)
Linear combination (BF* Southeast) + BF	0.1291	-0.0292	0.0137	0.0202
	(0.578)	(0.076)	(0.05)	(0.034)
BF * South	-1.009	-0.0577	-0.113	0.100
	(1.745)	(0.235)	(0.0911)	(0.107)
Linear combination (BF* South) + BF	0.2447	0.1453	-0.0312	-0.0007
	(1.333)	(0.171)	(0.054)	(0.015)
Individual Controls	x	x	x	x
HH-level cotrols (demographic & socioeconomic characteristics)	x	x	x	x
Number of observation	6,639	6,639	6,639	6,639
Number of households	3,683	3,683	3,683	3,683

Table 2.A4 : Impact of Bolsa Familia on nutritional outcomes among adults (Fixed effect estimates)

	FE estimates		
	(1)	(2)	(3)
BMI	0.184	0.195	0.325
	(0.309)	(0.312)	(0.33)
Overweight	-0.008	-0.013	-0.008
	(0.038)	(0.038)	(0.039)
Obesity	0.020	0.020	0.022
	(0.024)	(0.024)	(0.025)
Underweight	0.011	0.007	0.005
	(0.017)	(0.017)	(0.018)
Region-specific trend	x	x	x
Controls individual	x	x	x
Controls demography (HH-level)		x	x
Controls socioeconomic situation (HH-level)			x
Number of observations	8,453	8,453	8,309
Number of households	4,666	4,666	4,586

Note: Summary of the regression coefficients on Bolsa Familia treatment for the four nutritional outcomes of interest (obesity, overweight, underweight, BMI). All regressions include a region-specific time trend for each of the five official geographic regions of the country (North, Northeast, Centre-West, Southeast and South). *** p<0.01, ** p<0.05, * p<0.1.

Table 2.A5: Impact of Bolsa Familia on nutritional outcomes among children (<18)

	FE estimates			
	(1)	(2)	(3)	N
Height-for-age (z-scores)	0.011409	0.0023325	0.018033	14,249
	(0.062)	(0.062)	(0.066)	
Weight-for-age (z-scores)	-0.01017	-0.002362	0.021168	9,954
	(0.057)	(0.057)	(0.061)	
Weight-for-height (z-scores)	0.024563	0.0302312	0.071413	6,032
	(0.112)	(0.115)	(0.118)	
BMI-for-age (z-scores)	-0.02734	-0.012652	0.001713	14,167
	(0.078)	(0.078)	(0.083)	
Stunting	-0.00051	0.0014484	0.000303	14,249
	(0.017)	(0.017)	(0.018)	
Wasting	-0.00118	0.0061733	0.001173	6,032
	(0.022)	(0.022)	(0.022)	
Underweight	0.018539	0.0194754	0.022043	13,288
	(0.022)	(0.022)	(0.023)	
Overweight	0.036*	0.040*	0.044*	13,288
	(0.021)	(0.022)	(0.023)	
Obesity	0.00083	0.0001835	-0.00106	13,288
	(0.011)	(0.011)	(0.012)	
Region-specific trends	x	x	x	
Controls individual	x	x	x	
Controls demography (HH-level)		x	x	
Controls socioeconomic situation (HH-level)			x	

Note: Summary of the regression coefficients on Bolsa Familia treatment for the four nutritional outcomes of interest (obesity, overweight, underweight, BMI). All regressions include a region-specific time trend for each of the five official geographic regions of the country (North, Northeast, Centre-West, Southeast and South). Standard errors are clustered at the household level. *** p<0.01, ** p<0.05, * p<0.1.

Table 2.A6: Impact of Bolsa Familia on total consumption (fixed effect estimates with region-specific trends)

	FE	
	(1)	(2)
Total consumption	10.598**	14.68**
	5.205	6.048
Total consumption (per capita)	3.42*	4.71*
	(1.607)	(1.893)
Total food consumption	9.42***	11.145***
	(3.143)	(3.422)
Total food consumption (per capita)	3.18***	3.739***
	(0.98)	(1.052)
Total non-food consumption	1.169	3.535
	(3.425)	(4.338)
Total non-food consumption (per capita)	0.241	0.977
	(1.048)	(1.384)
Total income	28.459***	18.18*
	(10.542)	(10.77)
Total income (per capita)	7.831***	5.33*
	(2.687)	(2.885)
Region-specific time trend	x	x
Controls demographic composition	x	x
Controls socioeconomic situation		x
Number of observations		

Note: *** p<0.01, ** p<0.05, * p<0.1. All regressions include a region-specific time trend for each of the five official geographic regions of the country (North, Northeast, Centre-West, Southeast and South).

Table 2.A7: Impact of Bolsa Familia on food expenditure by food group in BRL (Fixed Effect estimates with region-specific time trends)

	FE	
	(1)	(2)
Carbohydrates	0.186	0.345**
	(0.154)	(0.157)
Plant-based protein	0.040	0.049
	(0.046)	(0.05)
Fruit	0.245*	0.190
	(0.143)	(0.126)
Vegetables	0.176	0.259**
	(0.108)	(0.119)
Meat & Fish	1.056	1.258
	(0.728)	(0.799)
Dairy	0.336**	0.394**
	(0.154)	(0.17)
Fat	0.142**	0.168**
	(0.067)	(0.076)
Eggs	0.061*	0.0623*
	(0.035)	(0.037)
Meals out	0.165*	0.167*
	(0.087)	(0.095)
Sweets	0.322***	0.399***
	(0.095)	(0.102)
Alcohol	0.149*	0.096**
	(0.076)	(0.039)
Processed food	0.082	0.078
	(0.055)	(0.061)
Coffee	-0.002	0.019
	(0.021)	(0.02)
Temptation goods	0.091	0.103
	(0.062)	(0.067)
School snacks	0.078*	0.065
	(0.044)	(0.046)
Linear time trend	x	x
Controls demographic composition	x	x
Controls socioeconomic situation		x
Number of observations	12,276	12,254

Note: *** p<0.01, ** p<0.05, * p<0.1. All regressions include a region-specific time trend for each of the five official geographic regions of the country (North, Northeast, Centre-West, Southeast and South).

3. Do health insurance extensions affect nutritional choices and outcomes? – A case study of Mexico's Seguro Popular

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Abstract

The extension of health insurance to previously uncovered populations can improve access to health care and health information, reduce individuals' out-of-pocket health-care expenditure and reduce precautionary savings. However, insurance extensions can also give rise to moral hazard effects and act as a disincentive to preventative efforts. In this context, we analyse the effect of the Mexican *Seguro Popular* (SP) on overweight, obesity and food consumption. We exploit the arbitrary timing of SP's rollout across Mexico's municipalities to instrument exposure to SP. We do not find significant effects of Seguro Popular on individual's nutritional outcomes, or food consumption choices.

Keywords: obesity, overweight, insurance expansion, Seguro Popular, income effects, prevention, health behaviours.

JEL: 118, J5

1. Introduction

The expansion of health insurance across the world to achieve the goal of universal health coverage reduced individuals' exposure to the financial consequences of ill health, including catastrophic risks, and reduced the need for precautionary savings to pay for health care out-of-pocket (WHO, 2014). In addition to smoothing the consumption and increasing the disposable income of the insured households, insurance expansions can increase access to health care (Nyman, 1999), and by extension to health information, thereby improving health outcomes. However, it has also been argued that insurance can have unintended consequences, such as a reduction of preventative actions and the emergence of moral hazard. Previously uninsured individuals may reduce their preventive efforts and investment in long-term health after being covered by insurance, as they will not have to bear the (monetary) costs of future health treatments (Acharya et al. 2012).

This paper assesses the health effects of subsidised insurance expansions with a particular focus on nutritional choices and outcomes of the beneficiary households. This is a question of considerable policy relevance, given that many middle income countries have introduced (Wang et al. 2011), or consider introducing, equivalent free health insurance programmes for poor and vulnerable citizens who were previously uninsured. At the same time, overweight and obesity are becoming a major concern in low and middle income countries (LMICs). However, as of today, our understanding on the interplay between health insurance and malnutrition in LMICs is incomplete. This paper aims at closing this knowledge gap by exploiting the variation that comes from the introduction of Mexico's Seguro Popular programme on overweight, obesity, as well as undernutrition.

Today, 2.7 billion people worldwide are malnourished –i.e., approximately 37 percent of the world's population—, of which 795 million people are undernourished, 1.9 billion people are overweight and 600 million people are obese· (FAO, IFAD, and WFP 2015; Melorose et al. 2015; World Health Organization 2017). Low- and middle-income countries are affected by a 'double-burden of malnutrition', as persisting undernutrition goes hand in hand with rising levels of obesity. Both phenomena have dramatic consequences for the health and wellbeing of the affected individuals and can also pose an obstacle to economic development at large.

Overweight and obesity are associated with several chronic diseases (Di Cesare et al. 2016; Field et al. 2001; Sturm 2002), which poses important challenges to the sustainability of public health systems. Sturm (2002) estimates that health care costs for obese people are 36 percent higher, and medication costs 77 percent higher than for people in a normal weight range. Moreover, overweight and obesity can also negatively impact labour market outcomes (Cawley 2004, Johanson et al. 2009). Both undernutrition and overnutrition should therefore be an important policy concern.

In recent years, several countries have expanded their health insurance systems with a view to cover the most vulnerable parts of the population and improve overall public health. The most well-evaluated example is the Affordable Care Act ("Obamacare") in the USA, but there are also a number of low- and middle-income countries which have expanded health care to poor and vulnerable parts of the population and/or informal sector workers. Prominent examples include the *Ramed* programme in Morocco, Vietnam's *Health Care Fund for the Poor* and Mexico's *Seguro Popular*. Mexico is the OECD country with the highest obesity rate, and is projected to be the one exhibiting the highest obesity by 2030. Given that many middle-income countries have also been heavily affected by overweight and obesity, an important question for the design of new health insurance programs refers to whether health insurance expansions exert nutritional impacts. More specifically, does the provision of free health insurance, which is found to increase access to health care, exert an effect on obesity and overweight? Or, on the contrary, is there a risk that health insurance exacerbates obesity, through income and/or moral hazard effects?

The available evidence on the relationship between health insurance and overweight/obesity is scarce and not conclusive. In theory, free health insurance may influence nutritional outcomes through several channels, such as an increase in disposable income, more frequent diagnosis and treatment of obesity through the health care system, as well as moral hazard. While earlier studies based on US data have found evidence that health insurance may increase both BMI and obesity (Bhattacharya et al. 2009), more recent evaluations based on the Affordable Care Act (ACA) have not confirmed this finding (Simon et al. 2016, Rhubart 2018).

However, there is evidence that the ACA improved preventative health behaviours (Sommers et al. 2017). In line with this finding, a study from Colombia shows that health insurance expansion can incentivise the use of preventive health services, most notably preventive physician visits and child growth monitoring (Miller et al. 2013). A study from Thailand also suggests an increase in preventive visits, while not detecting evidence for an increase in risky behaviours (Ghislandi et al. 2015). Given the positive relationship between insurance and health prevention in other contexts, this paper assesses whether health insurance can also boost healthy nutrition. Unhealthy nutrition is a major risk factor for several severe diseases including diabetes, heart disease and some form of cancers (Field et al. 2001). It is therefore important to investigate whether health insurance is an adequate policy measure to improve health prevention by means of altering nutrition behaviours and outcomes.

This paper provides additional evidence on the nutritional impacts of health insurance by analysing how the Mexican health insurance programme *Seguro Popular* has impacted underweight, overweight and obesity, as well as expenditure on different food and non-food items. Due to the largely arbitrary timing of Seguro Popular's rollout across Mexico's municipalities (see below), it provides a quasi-experimental setting where we can effectively compare two very similar groups of insured and uninsured individuals in terms of their nutritional behaviours and outcomes. In particular, we use an instrumental variable approach, where we instrument individual Seguro Popular membership with the coverage of Seguro Popular in one's municipality. The IV can be seen as a measure for the availability of Seguro Popular in one's municipality, but does not directly influence nutritional outcomes at the individual level.

Our main data source is the Mexican Family Life Survey (MxFLS), a longitudinal dataset available in three waves, containing not only anthropometric measures, but also comprehensive information on the socioeconomic situation and health of the respondents. The timing of the surveys matches the expansion of Seguro Popular very well, with one pre-treatment wave (2002) and two waves covering the expansion of the programme (2005 and 2009). Moreover, we match the MxFLS data to several administrative data sources on Seguro Popular coverage at the municipality level, as well as other municipality-level characteristics.

Our findings do not yield evidence for any positive or negative impact of Seguro Popular on overweight, obesity or BMI. However, there is suggestive evidence that Seguro Popular decreased the share of carbohydrates in food expenditure and increased the share dedicated to meat. This could be interpreted as evidence that the programme has contributed to less energy-dense diets. However, the finding loses its significance when correcting for multiple hypothesis testing. Moreover, we find important heterogeneities in the programme's impacts: the programme seems to protect the older individuals more effectively against obesity than younger individuals. Lastly, for those who were already overweight at baseline, Seguro Popular may have increased the risk of staying obese. This last finding would be in line with a moral hazard effect.

The rest of the paper is structured as follows: The second part describes the theoretical channels through which health insurance can influence nutritional outcomes and reviews the scarce empirical evidence that is available on health insurance and nutrition. Sections 3 presents the policy context in Mexico, section 4 describes the data and section 5 elaborates on our identification strategy. Sections 6-8 present our results, section 9 discusses the robustness checks that were conducted, and section 10 concludes.

2. Literature

Pathways of health insurance influence on nutritional outcomes

Overweight and obesity arise when an individual's caloric intake exceeds caloric expenditure (Cutler et al. 2003; Lakdawalla and Philipson 2009); undernutrition occurs when individuals cannot meet their caloric needs (Black et al. 2013; Dasgupta and Ray 1986). However, undernutrition can also be caused by a lack of nutritional diversity and/or the shortage of certain micronutrients, such as Vitamin A or iron (Banerjee and Duflo 2011; Black et al. 2013) or by infectious diseases (e.g. Bhutta et al. 2013). Health insurance can influence these outcomes through a number of pathways.

First, if health insurance is provided for free or at a subsidised price, as in the case of Seguro Popular, it *increases the disposable income* of the insured individuals. This is because individuals no longer need to (co-)pay for their present-day medical expenses, and hence nor hold precautionary savings for large health expenditures in the future. Overall one can expect that a higher disposable income will translate into an increase of food expenditure will, up to a certain point, lead to an increase in caloric intake and influence nutritional outcomes.

Secondly, one can expect that beneficiary households will *adjust the composition of food expenditure* in response to the increase in disposable income. Beneficiary households will substitute inferior goods for superior goods and potentially also adjust the expenditure shares on different normal goods, depending on their income elasticity of demand. Individuals may switch from healthier to more unhealthy food or vice versa (e.g. from self-produced agriculture products to industrially processed food; or from a calorie-rich diet based on simple carbohydrates towards a diet based on animal-sourced protein).

Third, health insurance lowers the costs of using *health care* and accessing health information, so that overnutrition and undernutrition can be diagnosed and treated at a lower cost, and comprehensive information can be gathered. However, the prevalence of such a health care effect will crucially depend on the extent to which the specific health insurance plan does indeed provide preventive care, especially obesity-related examinations and treatments, and the effectiveness of those treatments in improving outcomes. An increased health care usage may also decrease the costs of obtaining preventative actions and *nutrition-related information* and make it easier for individuals to learn about healthy eating. This information effect could potentially lead to a lower caloric intake and/or increased caloric expenditure through exercising for those at risk of overweight.

Fourth, health insurance may also affect the *time use* of the insured individuals. The increase in disposable income may induce individuals to reduce paid work and increase leisure, which may lead to a decrease in caloric expenditure for those engaged in non-sedentary work like farming or construction. On the other hand, increased leisure time may also incentivise individuals to prepare healthier meals or to exercise more.

Finally, a number of authors have assessed the possibility whether health insurance leads to *moral hazard* among the insured individuals, as they are no longer pay the full costs of potential sickness in the future. In theory, this could increase caloric intake and lead to a higher willingness to accept overweight and obesity. On the other hand, there may also be *behavioural hazard*, as suggested by Baicker et al.

(2013), i.e. insured individuals may over-use preventive health care: instead of choosing the socially optimal consumption level (marginal benefit = marginal cost), insured individuals might use preventive care until their individual marginal benefit equals zero. Overall this could lead to an earlier detection of underweight, overweight and obesity, and a more effective treatment (also fostering the health care and information channels mentioned above).

The overall impact of health insurance on nutritional outcomes will depend on the magnitude of the different effects. One can also expect that impacts will differ depending on the implementation details of a specific health insurance scheme such as co-payments, coverage of obesity-related examinations and treatments, as well as the income and nutritional status of the programme's target population. Later in the paper we will discuss the extent to which our results are reflective on any of these effects.

Evidence on the impact of health insurance on nutrition

The literature on the effects of health insurance on overweight and obesity is inconclusive. Two studies drawing on US data from the 1980s and 1990s found evidence that health insurance increases overweight and obesity (Bhattarchya et al. 2009, Rashad and Markovitz 2009). The authors of these studies interpreted their findings as a moral hazard effect, spurring additional interest in this hypothesis in subsequent studies.

However, none of the more recent studies drawing on data from the 2000s or other contexts than the US were able to confirm these findings. Simon et al. (2016) evaluate the impact of the Medicaid expansion under the Affordable Care Act ("Obamacare") and do not find any impact of the reform on exercising, BMI or obesity, but do find a reduction in smoking among childless adults by 1.9 percentage points. In a similar study setting but without claiming causality, Rhubart (2018) finds that inhabitants of US states which did not expand Medicaid during the Affordable Care Act reforms are more likely to be overweight and obese, but less likely to drink heavily. Focusing on the elderly population in the US, Card et al. (2008) do not find any evidence that Medicare coverage affects the prevalence of obesity or exercising behaviour among the elderly. Courbage and Colon (2004) use UK data in order to assess the impacts of private insurance – purchased in addition to the universal NHS system – and do not find any effects on exercising, smoking or attending regular health check-ups.

We are not aware of any study investigating the effect of health insurance on overweight and obesity in a low- or middle-income country context. An evaluation of a free health insurance programme in Vietnam (Wagstaff and Pradhan 2005) found evidence of a decrease in undernutrition and an increase in BMI among the programme's target population. However, in their period of interest less than 1% of the Vietnamese population was classified as overweight or obese, so the increases in BMI were mainly interpreted as a success in reducing undernutrition. More generally, a study from Colombia showed that health insurance expansions can promote preventive health behaviours (Miller et al. 2013), but a study from Thailand found no evidence that healthy behaviours or preventative actions were influenced by the expansion of insurance coverage (Ghislandi et al. 2015).

Evidence on the impact of health insurance on other outcomes

There is a large amount of evidence suggesting that free or subsidised health insurance leads to an increase in the disposable income of the insured, and facilitates consumption smoothing over the life cycle (Baicker et al. 2013, Hu et al. 2016, Mazumder et al. 2016, King et al. 2009, Saenz de Miera 2017, Sommers et al. 2017, Wagstaff & Pradhan 2005). In particular, using randomised encouragement King et al. (2009) found that SP led to a 23% reduction in catastrophic health expenditures. Galárraga et al. (2010) confirmed this finding using an instrumental variables approach and nationally representative data.

Moreover, several papers document that health insurance increases the utilization of both inpatient and outpatient health care (Finkelstein et al. 2012, Baicker et al. 2013, Ghosh et al. 2017, Bleich et al. 2007, Sosa-Rubi et al. 2009, Sommers et al. 2017, Jowett et al. 2004, Wagstaff and Pradhan 2005, Wagstaff et al. 2009). While Rivera-Hernández et al. (2019) found no effects of SP on the use of preventive services such as screening for diabetes, hypertension, breast cancer and cervical cancer among individuals 50 to 75 years, using a specialised survey on aging Parker et al. (2019) found significant effects of the programme on utilization and diagnostic tests. In addition, Sosa-Rubi et al. (2009) showed that SP increased access to obstetrical services.

However, there is only mixed evidence on whether health insurance indeed improves health outcomes. Several studies have shown that health insurance leads to improvements in self-reported health (Sommers et al. 2012, Cercone et al. 2010, Teruel et al. 2012), while others have not found any impact on self-assessed health (King et al. 2009, Barros 2008). The provision of health insurance does seem to reduce infant mortality (Currie and Gruber 1996, Pfutze 2015, Saenz de Miera 2017, Conti and Ginga 2016, Celhay et al. 2019), increase birthweight (Camacho and Conover 2013), improve mental health outcomes (Baicker et al. 2013), improve cancer prevention and treatment (Robbins et al. 2015, Loehrer et al. 2016), and improve preventive health care with regards to glucose and cholesterol testing (Sommers et al. 2017). On the other hand, studies analysing health insurance's impact on hypertension and high cholesterol have mostly not found any statistically significant impacts (Baicker et al. 2013, King et al. 2009, Brook et al. 1983, Barros 2008). Supply-side constraints and low capacity of the medical staff may help explain why higher health care usage does not necessarily translate into better health outcomes (e.g. Lagarde and Palmer 2011, De Allegri et al. 2012, Dzakpasu et al. 2014).

3. Institutional background

Mexico has a very high prevalence of obesity (25.3 percent of the population at the end of our study period in 2009, as compared to 10.9 worldwide) and overweight (61.2 percent of the population in 2009 as compared to 35.2 percent worldwide[22]), placing Mexico among the 25 countries most affected by obesity worldwide and the most affected country in Latin America. Moreover, Mexico experienced a quite substantial increase in obesity by 3.5 percentage points during the study period (as compared to 1.8 percentage points worldwide) allowing us to study the impact of health insurance in a context of rising obesity rates (World Health Organization 2017).

Before the introduction of Seguro Popular in the early 2000s, health insurance in Mexico was provided to formal sector employees alone through the country's social security systems which is based on payroll taxes. Only a very small

[22] Including those who are obese.

share of the population (less than 3%) held private insurance. Informal workers, small-scale family farmers and the unemployed had to pay their health care expenditure out of pocket. Seguro Popular precisely aimed at covering these hitherto uninsured parts of the Mexican population and established access to health care as a universal right. In this way Seguro Popular expanded health insurance to groups of the population that could not afford insurance before. Indeed, the only eligibility criterion for enrolling in Seguro Popular was not to be covered by a contributory / payroll-based health insurance or private insurance. Seguro Popular compares to other worldwide experiences in the United States (e.g. the ACA and Medicaid expansions), China, Vietnam and Morocco, where health insurance has also recently been expanded to cover the poorest and most vulnerable groups of the population.

A pilot of Seguro Popular started in 2002 and the implementation of the actual programme began in 2004, but was only gradually rolled out through the country due to financial constraints. Individuals were only able to enrol in the programme once the programme was offered in their municipality. This in turn required that the state's government had signed an agreement with the central government on the programme's implementation. The central government established that more marginalised, rural and indigenous areas ought to be prioritised in the rollout, but no objective criteria and/or indicators had been established to guide the rollout. Previous studies found that municipalities with a higher population size tended to implement the programme earlier. Moreover, the sympathy of a municipality government with the central government may also have played a role, as Seguro Popular was seen as a prestige project of the central government. Besides these factors, previous studies investigating on the issue could not detect any other observable municipality-level factors that were correlated with the rollout (Azuara and Marinescu 2013, Bosch and Campos 2014, King et al. 2009, Pfutze 2015).

Seguro Popular affiliates have access to a wide range of free health services as defined in Mexico's Universal Catalogue of Health Services (UCHS)[23], covering approximately 95% of Mexico's disease burden (King et al. 2007). The diagnosis and, to some extent also the treatment of obesity and obesity-related diseases are

[23] In Spanish *Catálogo Universal de Servicios de Salud (CAUSES)*.

included in the UCHS. However, during the longest part of our study period, this is limited to children and adults over the age of 40 :

- In the 2004 version of the UCHS, the diagnosis of obesity is included within the triannual check-ups for men and women over the age of 40. Dietary and exercise-related counselling is included as a treatment of diabetes II and hypertension.
- Since 2006, the UCHS also included the diagnosis of both undernutrition and obesity for children and adolescents, along with a comprehensive list of treatments for those who are diagnosed (e.g. 3-5 monthly nutrition counselling appointments with a GP)
- From 2008 onwards, preventive health services are included for adults aged 20-59. This includes measures to prevent and detect a number of chronic diseases, including obesity. However, unlike for children, no specific obesity-related treatments are listed. The UCHS only mentions educational measures to improve self-care for individual health.

4. Data

Our main data source is the Mexican Family Life Survey (MxFLS), a longitudinal dataset with survey waves in 2002, 2005/06 and 2009-12 (Rubalcava and Teruel 2006, 2008, 2013). It includes information on insurance status, anthropometric measures of children and adults taken by specifically trained enumerators, consumption expenditure on different food items, as well as a wide range of socioeconomic characteristics. The timing of the survey waves matches the roll-out of Seguro Popular very well, as the first wave took place before the official start of the programme, the second wave at the early stages of the rollout when approximately 20% of the target group were covered, and the third wave in 2009-12, when the programme already reached between 55% and 90% of the target population.

The MxFLS data was matched to administrative records of Mexico's National Commission for Social Protection in Health (*Comisión Nacional de Protección Social en Salud, CNPSS*) with trimestral information on the number of Seguro Popular beneficiaries in each of the Mexican municipalities. Moreover, we draw on information from the National Statistics and Geography Institute (*Instituto*

Nacional de Estadística y Geografía, INEGI) for municipality-level information on the overall population size, and on data from CONAPO (*Consejo Nacional de Poblacion*), CONEVAL (*Consejo Nacional de Evaluación de la Política Social*) and the Mexican Ministry of Health to measure the overall socioeconomic development of the municipality and the available health infrastructure. The CNPSS data together with the INEGI data also allow us to compute the share of a municipality's population covered by *Seguro Popular* in a certain year.

This allows us to construct a rich set of control variables for our regressions, both at the individual level (sex, age, years of schooling, civil status, employment status, BMI at baseline, chronic disease at baseline), household level (participation in the *Oportunidades* cash transfer programme, consumption expenditure at baseline, household size and demographic composition of the household at baseline, as well as information on the household head analogous to the individual-level controls), and municipality level (urban vs. rural, population size, poverty rate, illiteracy rate, percentage of the population earning less than two minimum wages, percentage of women, and the proportion of households without access to piped water, without electricity connection and without access to sanitation). Summary statistics on all control variables are presented in table 1.

Our sample of analysis consists of all individuals who were surveyed in all three MxFLS waves, who were uninsured and at least 18 years old at baseline, not pregnant at the time of the survey and for whom the full set of control variables as well as the anthropometric outcome variables are available. We identified 28,117 individuals for whom data is available in all three waves, corresponding to 84,351 observations, and 9875 households in 275 municipalities. Out of them, only 9,063 are uninsured at baseline, 8088 are also at least 18 years of age at baseline, and for 5,848 individuals we also have information on *Seguro Popular* insurance status and the anthropometric outcomes. After excluding pregnant women and observations for whom we do not have the full set of control variables, we end up with 3,732 individuals, corresponding to 5,445 observations, in 2,283 households and 138 municipalities.

Restricting the sample to individuals who were uninsured at baseline decreases the sample size by almost 70%. However, it should be noted that Seguro Popular was only intended to cover the previously uninsured parts of the population. Individuals who previously held contributory public insurance were not eligible for participating in Seguro Popular. Private insurance was infrequent and accessible only to high-income households which did not have plausible incentives to renounce to the more comprehensive benefit package offered by the private providers[24]. As a consequence, we do not consider it reasonable to include previously insured households in the impact estimation. Their probability of being treated by Seguro Popular is very close to zero, making them not suitable as a comparison group. This also implies that the estimated treatment effects refer to Seguro Popular's target population, not to the Mexican population at large.

Table 1 illustrates that our sample of analysis differs in important aspects from the overall MxFLS sample, which is representative for the Mexican population. As expected, the individuals in our sample are poorer than the average population, have attained lower levels of schooling, and live more frequently in rural areas. However, the nutritional outcomes are remarkably similar in both groups, with an average BMI of 28, an overweight prevalence of 71%, and an obesity prevalence of 31%. In this context, it is important to acknowledge that the findings of this study only apply to the target population of Seguro Popular, i.e. uninsured low-income households, but not to the Mexican population on average.

[24] The 2010 INEGI Conteo survey indicates that only 3.3% of the Mexican population had private insurance. Those with private insurance could have switched to SP but this is very unlikely since private insurance gives access to private hospitals and clinics that generally provide better health care.

Table 3.1: Summary statistics

	MXFLS sample			Sample of analysis			t-test
Outcome variables (selection)	Mean	SD	N	Mean	SD	N	(p-val.)
BMI	27.94	5.37	24540	27.92	5.21	5445	0.76
Overweight	0.70	0.46	24540	0.70	0.46	5445	0.76
Obesity	0.31	0.46	24540	0.31	0.46	5445	0.86
Underweight	0.01	0.12	24125	0.01	0.12	5445	0.57
Exercise (binary)	0.13	0.34	26842	0.10	0.30	5445	0.00
Smoking (binary)	0.10	0.30	26834	0.09	0.28	5444	0.00
Smoking (cigarettes per week)	4.25	21.13	26825	4.18	21.57	5444	0.78
Hours worked (week)	43.10	19.08	14247	41.77	21.17	2819	0.00
Controls variables (individual level)							
Female	0.55	0.50	33478	0.59	0.49	5445	0.00
Married	0.50	0.50	33774	0.62	0.49	5445	0.00
Age	45.29	16.32	25547	45.89	14.76	5445	0.00
Age^2	2317	1630	25547	2324	1494	5445	0.73
BMI at baseline	27.40	5.19	28065	27.34	5.08	5445	0.34
Years of schooling	6.81	4.66	26892	5.32	3.94	5445	0.00
Chronic disease at baseline (binary)	0.18	0.38	26425	0.16	0.36	5445	0.00
Employed	0.40	0.49	33774	0.48	0.50	5445	0.00
Controls variables (household level)							
Urban	0.78	0.42	33774	0.68	0.47	5445	0.00
Oportunidades	0.13	0.34	29256	0.24	0.43	5445	0.00
Consumption expenditure at baseline	5382	21487	27793	4182	10413	5445	0.00
HH size at baseline	4.65	2.17	33774	4.90	2.28	5445	0.00
Years of schooling (head)	5.99	4.63	26346	4.74	3.83	5445	0.00
Female HH head	0.21	0.41	26632	0.20	0.40	5445	0.00
HH head married	0.69	0.46	26792	0.69	0.46	5445	0.41
Age HH head	52.72	14.79	23433	51.93	14.18	5445	0.00
Age^2 HH head	2998	1618	23433	2898	1558	5445	0.00
HH head employed	0.66	0.47	26792	0.71	0.45	5445	0.00
Average HH BMI at baseline	27.46	3.97	28322	27.15	3.82	5445	0.00
Control variables (municipality level)							
Population size	311856	404580	32430	184442	329314	5445	0.00
Proportion of women	0.51	0.01	32430	0.51	0.01	5445	0.00
Percentage illiterate	8.32	7.27	32430	10.81	7.66	5445	0.00
Percentage low-income	45.03	18.43	32430	52.12	17.60	5445	0.00
Percentage poor	19.87	14.05	32430	25.16	14.68	5445	0.00
proportion w/o electricity	0.02	0.02	32430	0.03	0.02	5445	0.00
Proportion w/o piped water	0.09	0.10	32430	0.12	0.12	5445	0.00
Propotion w/o sanitation	0.14	0.17	32430	0.19	0.19	5445	0.00

Note: The MxFLS sample contains all individuals for whom data for all three MxFLS waves is available. However, summary statistics only refer to waves 2 and 3, to make it comparable to the sample of analysis. The last column provides the p-values associated to t-tests testing for the equality of the means in both samples (H0: means are equal).

5. Identification strategy

In order to assess the impact of Seguro Popular on nutritional outcomes we are interested in estimating the following model:

$$Y_{it} = \alpha + \beta\, SP_{it} + \gamma\, X_{it} + \mu\, wave_t + \varepsilon_{it} \qquad (1)$$

where Y_{it} is a nutritional outcome (e.g. BMI, overweight, obesity) of individual i at time t. SP_{it} is the individual's affiliation to Seguro Popular at time t and X is a vector of individual, household-level and municipality-level control variables. $Wave_t$ is a linear time trend, and ε_{it} the individual-specific error term.

The main challenge in this specification is that the treatment status SP_{it} may be correlated with the error term ε_{it}, even after controlling for X, potentially leading to a biased estimate of β. In our case, selection bias may occur both at the individual and the municipality level. First, individuals who are obese, or at a higher risk of obesity, might have a higher (or lower) propensity to enrol in Seguro Popular than the average population. Moreover, some other unobservable individual characteristics may be correlated with treatment status (e.g. intelligence, having a genetical predisposition for overweight/obesity, being health-conscious, etc.). Secondly, municipalities with a high (low) obesity prevalence may have been prioritised in the rollout of Seguro Popular, leading to selection bias at the municipality level.

We are adopting two strategies in order to address these threats. First, we instrument individual affiliation to SP at time t with the share of individuals in municipality m who are covered by SP at time t-1 ("SP coverage"). This IV approach aims at eliminating any selection bias at the individual-level based on unobservables, once Seguro Popular is introduced in a municipality. It is important to note that our instrument is lagged by one time period with respect to our treatment variable. This is to avoid that the instrument is jointly determined with the treatment, and instead precedes the treatment decisions. In particular,
the instrument z is calculated as

$$z_{im,t-1} = \frac{SP\ affiliates_{m,t-1}}{Population_{m,t-1}}$$

We argue that this instrumental variable is both relevant (it has a statistically significant impact on the probability of being treated) and valid (it has no direct impact on obesity, and only affects obesity through the treatment).

The first stage estimates presented in table 2 illustrate that the instrument is indeed relevant (i.e. $Cov(z_{mt}, SP_{imt}) \neq 0$), as confirmed by the weak identification and underidentification tests (Kleibergen Paap LM and Kleibergen Paap Wald statistics). This is true for both the individual-level regressions, and the household-level regressions where the sample size is much smaller. Moreover, the first stage remains relevant even after the inclusion of municipality-level fixed effects. The regression results suggest that being female and being a beneficiary of the *Oportunidades* cash transfer programme is positively associated with Seguro Popular treatment. BMI at baseline, or having a chronic disease at baseline is not significantly correlated with Seguro Popular participation. The reduced form estimates do not suggest any statistically significant impact of the instrument on any of our outcome variables (see table 3).

However, even after including state-level fixed effects, there is still a positive correlation between Seguro Popular coverage and the number of doctors per 1000 inhabitants at time t, as well as the share of *Oportunidades* cash transfer recipients in the municipality. Both were to be expected: the correlation with Oportunidades can be explained by the fact that both programmes target low-income households. The association with the availability of doctors can be explained by the simultaneous expansion of health infrastructure which accompanied the Seguro Popular rollout. Nevertheless, both factors are also a concern to our identification strategy. Both, the income effect related to *Oportunidades* and the health care effect related to the increased availability of doctors may have a direct impact on our nutritional outcomes of interest. We therefore control for Oportunidades in all regressions, and include regressions controlling for the health infrastructure as a robustness check (the latter may also be considered as a "bad control" (Angrist and Pischke 2008), as it may be caused by Seguro Popular in the first place. For this reason we have not included it in the main specifications).

Table 3.2 - First stage estimates - SP coverage in municipality and individual SP affliliation

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	SP afflilation (individual-level, t)				SP afflilation (household-level, t)		
SP coverage (municipality-level, t-1)	0.763***	0.773***	0.777***	1.052***	0.810***	0.794***	1.066***
	(0.108)	(0.105)	(0.103)	(0.165)	(0.115)	(0.116)	(0.190)
Female	0.0300**	0.0272**	0.0252**	0.0257**			
	(0.0120)	(0.0126)	(0.0126)	(0.0119)			
Age	0.00108	-0.00119	-0.00136	-0.00265			
	(0.00241)	(0.00274)	(0.00274)	(0.00252)			
Age^2	-1.02e-05	2.17e-05	2.27e-05	3.30e-05			
	(2.39e-05)	(2.77e-05)	(2.77e-05)	(2.56e-05)			
Years of schooling	-0.00364**	-0.00138	-0.00152	-0.00234			
	(0.00184)	(0.00200)	(0.00192)	(0.00179)			
BMI (at baseline)	-0.000550	1.75e-05	-0.000248	-0.000778			
	(0.00109)	(0.00106)	(0.00106)	(0.00104)			
Oportunidades beneficiary		0.121***	0.121***	0.116***	0.146***	0.145***	0.134***
		(0.0192)	(0.0180)	(0.0178)	(0.0221)	(0.0212)	(0.0221)
Individual controls	x	x	x	x			
Household-level controls		x	x	x	x	x	x
Municipality-level controls			x	x		x	x
State-level Fixed Effects	x	x	x		x	x	
Municipality-level Fixed Effects				x			x
Underidentification test (Kleibergen Paap rK LM Statistic)	25.38	26.79	23.96	18.36	25.65	22.06	17.14
P-value associated to rK LM Statistic	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Weak identification test (Kleibergen Paap Wald rK F-Statistic)	50.03	54.64	57.27	40.62	49.63	46.88	31.35
Observations	5445	5445	5445	5445	2757	2757	2757

Note: All regressions include a linear time trend. Standard errors are clustered at the municipality-level. *** p<0.01, ** p<0.05, * p<0.1. Critical value for rejecting the null of weak identification is 16.38 based on Stock & Yogo (2005).

Individual-level controls: sex, age, years of schooling, civil status, employment status, BMI at baseline, chronic disease at baseline

Household-level controls: participation in the Oportunidades cash transfer programme, consumption expenditure at baseline, household size and demographic composition of the household at baseline, as well as information on the household head analogous to the individual-level controls.

Municipality-level controls: urban vs. rural, population size, poverty rate, illiteracy rate, percentage of the population earning less than two minimum wages, percentage of women, and the proportion of households without access to piped water, without electricity connection and without access to sanitation.

Table 3.3: Reduced form estimates: Seguro Popular coverage (t-1) and nutritional outcomes

	OLS estimates			OLS estimates with state-level fixed effects		
Outcomes						
Obesity	-0.0133	-0.0157	-0.0159	0.0236	0.0123	0.0517
	(0.0475)	(0.0467)	(0.0501)	(0.0424)	(0.0428)	(0.0456)
Overweight	0.0552	0.0689	0.0897*	-0.0167	-0.0133	0.0340
	(0.0440)	(0.0454)	(0.0489)	(0.0496)	(0.0518)	(0.0550)
Underweight	0.00773	0.00923	0.00819	0.00866	0.00496	-0.00697
	(0.0132)	(0.0133)	(0.0128)	(0.0146)	(0.0154)	(0.0137)
BMI	-0.0465	-0.0305	0.0773	-0.0336	-0.161	0.349
	-0.465	-0.473	-0.543	-0.445	-0.447	-0.492
Individual-level controls	x	x	x	x	x	x
Household-level controls		x	x		x	x
Municipality-level controls			x			x
Linear time trend	x	x	x	x	x	x
State-level fixed effects				x	x	x
Number of observations	5578	5578	5578	5578	5578	5578

Note: Table summarises the regression coefficients on the coverage of Seguro Popular (at t-1) in regressions of the 4 main nutritional outcomes (obesity, overweight, underweight, and BMI). Standard errors are clustered at the municipality-level. *** denotes statistical significance at the 1% level, ** denotes significance at the 5% level, and * denotes significance at the 1% level.

Table 3.4: Correlation of SP coverage and municipality-level characteristics

Independent variables (separate regressions were run for each ind. var.)	(1)	(2)	(3)	(4)
	Coverage of Seguro Popular at time t-1			
Share obese at baseline	-0.200	-0.0365	-0.260	
	(0.166)	(0.198)	(0.189)	
Share with chronic disease at baseline	-0.169	0.0583	-0.226	
	(0.185)	(0.164)	(0.176)	
Share self-reporting good health at baseline	-0.331***	-0.185*	-0.0851	
	(0.0588)	(0.0960)	(0.107)	
Doctors per 1000 at baseline	-0.00793	-0.00220	0.0116	
	(0.0114)	(0.0115)	(0.0116)	
Doctors per 1000 at t	0.0226	0.0311	0.0471**	-0.000138
	(0.0275)	(0.0236)	(0.0229)	(0.0761)
Clinics per 1000 at baseline	0.305***	0.139	0.166	
	(0.0706)	(0.120)	(0.104)	
Clinics per 1000 at t	0.282***	0.150	0.158	0.423
	(0.0785)	(0.113)	(0.0971)	(0.715)
Oportunidades at baseline	0.191***	0.120**	0.158***	
	(0.0415)	(0.0591)	(0.0489)	
Oportunidades at t	0.186***	0.0749	0.145**	-0.0387
	(0.0521)	(0.0819)	(0.0668)	(0.162)
Municipality-level controls		x	x	x
State fixed effects			x	
Municipality fixed effects				x
Number of observations	236	236	236	236

Note: *Regression results obtained from separate OLS regressions for each of the listed independent variables. Clustered standard errors in parantheses. Analysis is carried out t the municipality-level with observations for 2005 and 2009, as in the main regressions. Municipality level controls are the same as in column 3 of table 3 and based on administrative data / census data. Share overweight at baseline, share obese at baseline, share with chronic disease, and self-reported good health have been constructed based on the MxFLS survey. They are therefore not representative at the municipality level, but are representative for our sample of analysis.*

Additionally, we present regressions with both municipality-level fixed effects and a wide range of time-varying municipality-level control variables. While the municipality-level fixed effects control for any time-invariant characteristics, the municipality-level controls allow us to account for a wide range of time-varying observable characteristics. This strategy aims at eliminating any selection bias at the municipality level. With fixed effects and municipality level controls, the structural model becomes

$$Y_{it} = \alpha + \beta\, SP_{it} + \gamma\, X_{it} + \mu\, wave_t + W_{mt} + \eta_m + \varepsilon_{it} \qquad (1)$$

where W_{mt} is a vector of municipality-level control variables and η_m is a municipality-level fixed effects. This model is eventually estimated by two-stages least square regressions. In regressions where SP_{it} is interacted with other variables of interest V_{it} to investigate on heterogeneous treatment effects, the interaction term is instrumented by ($z_{im,t-1}$* V_{it}). Standard errors for all regressions are clustered at the municipality level in order to account for the clustered treatment assignment.

We prefer this approach over a difference-in-difference (DiD) estimation comparing treated to untreated municipalities. Indeed, by 2009 (our last available survey wave), Seguro Popular was already available in all municipalities covered by the MxFLS survey, leaving us without any control group in a classical DiD setting. Using coverage as an instrument allows to measure varying degrees of availability of Seguro Popular in a municipality, and to exploit the variation in exposure to Seguro both within and between municipalities. A similar IV approach has also been taken by Saenz de Miera (2017) and Pfutze (2015) in previous impact assessments of Seguro Popular, and by Liu and Zhao (2014) in an study on China's Urban Resident Basic Medical Insurance.

6. Results

Seguro Popular's impact on nutritional outcomes

Table 5 reports our baseline estimates of the effect of Seguro Popular on BMI, obesity, overweight and underweight. We report both OLS estimates (columns 1-3), 2SLS estimates with state-level fixed effects (columns 4-6) and 2SLS estimates with municipality-level fixed effects (columns 7-9). Overall, the regression results do not yield evidence for any impact of Seguro Popular on obesity, overweight, underweight or BMI among adults. The coefficients on all outcomes are very close to zero and not statistically significant. This finding is robust to the inclusion of different controls, and irrespective of the use of state-level or municipality-level fixed effects.

Table 6 presents the estimates for the impact of Seguro Popular on children's nutritional outcomes. In addition to the outcomes reported for adults, it also reports Seguro Popular's impact on child malnutrition (low weight-for-age) and stunting (low height-for-age). Overall, the results are very similar than for adults. However, there is suggestive evidence that Seguro Popular may have reduced stunting and increased overweight. These results should be interpreted with caution as they are not robust to the inclusion of municipality-level fixed effects, and only significant at the 10% level. Overall the results indicate that on average, there is no effect of Seguro Popular on nutritional outcomes.

Table 3.5: Impact of Seguro Popular on nutritional outcomes among adults

	OLS estimates			2SLS estimates with state FEs			2 SLS estimates with municipality FEs		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Obesity	-0.0110	-0.00908	-0.00770	0.0301	0.0147	0.0652	0.00909	0.00433	-0.0512
	(0.0116)	(0.0119)	(0.0114)	(0.0555)	(0.0546)	(0.0599)	(0.0743)	(0.0721)	(0.0707)
Overweight	0.00999	0.00924	0.00862	-0.0258	-0.0204	0.0418	-0.0296	-0.0345	-0.000615
	(0.0133)	(0.0138)	(0.0134)	(0.0645)	(0.0664)	(0.0705)	(0.0852)	(0.0831)	(0.0668)
Underweight	-0.00133	-0.000555	-0.000332	0.0127	0.00689	-0.00881	-0.00888	-0.00920	-0.0262
	(0.00385)	(0.00368)	(0.00366)	(0.0193)	(0.0200)	(0.0175)	(0.0245)	(0.0237)	(0.0210)
BMI	-0.0306	-0.0134	0.00284	-0.0469	-0.206	0.454	0.0802	0.0222	-0.131
	(0.0979)	(0.0996)	(0.0983)	(0.574)	(0.573)	(0.628)	(0.638)	(0.612)	(0.460)
Individual-level controls	x	x	x	x	x	x	x	x	x
Household-level controls		x	x		x	x		x	x
Municipality-level controls			x			x			x
State-level fixed effects	x	x	x	x	x	x			
Municipality-level fixed effects							x	x	x
Number of observations	5,445	5,445	5,445	5,445	5,445	5,445	5,445	5,445	5,445

Note: Summary of the regression coefficients on Seguro Popular treatment (individual level) for the four nutritional outcomes of interest (obesity, overweight, underweight, BMI). All regressions include a linear time trend. Standard errors are clustered at the municipality-level. *** p<0.01, ** p<0.05, * p<0.1.
Individual-level controls: sex, age, years of schooling, civil status, employment status, BMI at baseline, chronic disease at baseline
Household-level controls: participation in the Oportunidades cash transfer programme, consumption expenditure at baseline, household size and demographic composition of the household at baseline, as well as information on the household head analogous to the individual-level controls.
Municipality-level controls: urban vs. rural, population size, poverty rate, illiteracy rate, percentage of the population earning less than two minimum wages, percentage of women, and the proportion of households without access to piped water, without electricity connection and without access to sanitation.

Table 3.6: Impact of Seguro Popular on nutritional outcomes among children

	OLS estimates			2SLS estimates with state FEs			2 SLS estimates with municipality FEs		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Obesity	-0.00977	-0.00305	-0.00548	0.0352	0.0482	0.0561	-0.00913	-0.00544	0.0346
	(0.0109)	(0.00969)	(0.0102)	(0.0399)	(0.0380)	(0.0375)	(0.0338)	(0.0313)	(0.0357)
Overweight	-0.0318	-0.0220	-0.0241	0.0392	0.0784	0.108*	0.0638	0.0738	0.0556
	(0.0230)	(0.0205)	(0.0211)	(0.0747)	(0.0678)	(0.0583)	(0.0846)	(0.0808)	(0.0838)
BMI	-0.305	-0.234	-0.233	-0.0255	0.173	0.419	0.303	0.413	-0.0245
	(0.186)	(0.165)	(0.168)	(0.544)	(0.476)	(0.453)	(0.642)	(0.574)	(0.889)
Malnutrition (weight-for-age)	0.00791	0.01000	0.00769	0.0484	0.0522	0.0943	0.123	0.121	0.103
	(0.0165)	(0.0166)	(0.0184)	(0.0555)	(0.0552)	(0.0706)	(0.0849)	(0.0915)	(0.0699)
Stunting (height-for-age)	0.00742	0.00110	0.00534	-0.0370	-0.114*	-0.0877	-0.0200	-0.0153	0.0166
	(0.0175)	(0.0160)	(0.0167)	(0.0627)	(0.0624)	(0.0673)	(0.0668)	(0.0671)	(0.0771)
Individual-level controls	x	x	x	x	x	x	x	x	x
Household-level controls		x	x		x	x		x	x
Municipality-level controls			x			x			x
State-level fixed effects	x	x	x	x	x	x			
Municipality-level fixed effects							x	x	x
Number of observations	4,531	4,531	4,531	4,531	4,531	4,531	4,531	4,531	4,531

Note: Summary of the regression coefficients on Seguro Popular treatment (individual level) for the four nutritional outcomes of interest (obesity, overweight, underweight, BMI). All regressions include a linear time trend. Standard errors are clustered at the municipality-level. *** p<0.01, ** p<0.05, * p<0.1.

Heterogeneous treatment effects

However, the average effects might mask important heterogeneous effects, especially across individuals' age, income and education as well as the existence of a well-developed health infrastructure that allows taking advantage of the lifting of financial barriers to health care.

First, access to insurance might not exert the same effect across individuals' age. Older individuals might be more likely to take advantage of better health care access and standard check-ups on obesity-related conditions like diabetes or heart disease may only be routinely carried out for individuals over a certain age threshold. Table 7 analyses the extent to which the impacts of Seguro Popular on obesity differs between sub-groups of the population. Consistently, we find evidence of negative and significant interaction terms of Seguro Popular across older age groups, i.e. Seguro Popular is more effective in protecting these age cohorts against overweight and obesity. This is also in line with the Seguro Popular programme guidelines on eligibility for different treatments. In our period of interest, regular check-ups on an individual's health and chronic diseases were only foreseen for individuals over the age of 40.

We also interact Seguro Popular coverage with gender, years of schooling, and rural vs. urban residence. There is suggestive evidence (significant at the 10% level) that Seguro Popular may increase the BMI of women, relatively to men, by an additional 0.6 index points. Moreover, we find a significant and positive interaction effect of Seguro Popular affiliation and years of schooling, for both obesity and BMI. This implies that more educated individuals may be subject to a higher risk of becoming obese in response to Seguro Popular than less educated individuals. Such a pattern would not be in line with a health information effect of Seguro Popular as more educated individuals tend to communicate more effectively with doctors (Willems et al. 2005). Possible explanations for this counter-intuitive finding include a moral hazard effect, where more educated individuals are more aware of the benefits of insurance and adapt their behaviours accordingly, or a self-selection into treatment of more educated individuals with a higher obesity risk, which is not well controlled by our identification strategy.

Lastly, we find evidence that individuals who are covered by Seguro Popular and were overweight at baseline may be at a higher risk to become obese than individuals who were overweight at baseline but not covered by Seguro Popular.

This positive interaction term could be interpreted as evidence of a moral hazard effect. Although this effect is significant at the 1% significance level, it should be interpreted with caution, as no similar effect is detected once BMI is used as an outcome variable (see column 12 of table 7).

Table 3.7 - Heterogeneous treatment effects of Seguro Popular - IV estimates with state-level fixed effects

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
	Outcome variable: Obesity							**Outcome variable: BMI**						
Seguro Popular	0.0250	0.324***	0.713**	0.191**	0.0414	0.0985	0.0448174	0.0572	4.039***	7.222**	1.633**	0.930	1.452*	-0.122
	(0.0696)	(0.0980)	(0.305)	(0.0767)	(0.0700)	(0.0713)	0.06887999	(0.669)	(1.154)	(2.917)	(0.794)	(0.847)	(0.879)	(1.014)
Seguro Popular * Female	0.0702							0.663*						
	(0.0523)							(0.354)						
Seguro Popular * Age		-0.00539***	-0.0216*						-0.0751***	-0.207*				
		(0.00136)	(0.0118)						(0.0169)	(0.113)				
Seguro Popular * Age^2			0.000158							0.00129				
			(0.000114)							(0.00112)				
Seguro Popular * Years of schooling				0.0167**							0.139**			
				(0.00683)							(0.0557)			
Seguro Popular * Overweight at baseline					0.143***							0.571		
					(0.0494)							(0.530)		
Seguro Popular * Obese at baseline						0.0545							0.276	
						(0.0537)							(0.631)	
Seguro Popular * Urban							-0.0344							-0.485
							(0.0503)							(0.415)
Linear combination of coefficients (Main effect of SP + Interaction term)	0.095	0.077	0.089	0.092	0.1843**	0.153**	0.045	0.720	0.594	0.694	0.661	1.501*	1.729*	0.629
Standard error	0.063	0.061	0.063	0.063	0.077	0.073	0.069	0.643	0.640	0.649	0.646	0.775	0.925	(0.635)
Observations	5445	5445	5445	5445	5445	5445	5445	5445	5445	5445	5445	5445	5445	5445

Note: Standard errors are clustered at the municipality-level. All regressions include the full set of control variables which are also included in column 3 of table 5, a linear time trend, as well as the main effects corresponding to the respective interaction terms presented in each column.

Seguro Popular's impact on food consumption, life style and health care usage

Lastly, we assess whether Seguro Popular has affected any nutrition-related behaviours, including food consumption patterns, exercising behaviours and health care usage. Table 8 presents regression results on the impact of Seguro Popular on the composition of a household's food expenditure, measured by the share of different food groups in a household's total food expenditure. After including municipality-level fixed effects, we find a statistically significant reduction in the share of carbohydrates in total food expenditure by 6.3 percentage points, which is accompanied by an increase in meat expenditure by 7.7 percentage points. This could be interpreted as an attempt to reduce the consumption of energy-dense food / increase the consumption of protein sources in response to the Seguro Popular treatment. However, this finding is not robust to corrections for multiple hypothesis testing (see table 3.10).

Lastly, we examine whether Seguro Popular might have changed people's lifestyles across any relevant dimension. The results of this analysis are presented in table 9. In the regressions with state-level fixed effects, we find statistically significant evidence for a reduction in smoking on the intensive margin by approximately 11 cigarettes per week. There is also suggestive evidence for the reduction in smoking along the extensive margin by approximately 10 percentage points. However, these coefficients lose their significance once municipality-level fixed effects are included. Moreover, we find suggestive evidence for an increase in exercising along the extensive margin by approximately 13 percentage points.

It should be noted that we do not find any evidence for an impact on health-related absences from work, self-reported health, or health care usage. However, for health care usage, this may be explained by the comparatively short recall periods in the MxFLS survey, with only 4 weeks for outpatient and 12 months for inpatient care.

Table 3.8: Impact of Seguro Popular on composition of household food expenditure (shares of food group in total food expenditure) - 2SLS estimates

	State FEs			**Municipality FEs**		
	(1)	(2)	(3)	(4)	(5)	(6)
Carbohydrates	.032	-.005	-.005	-.014	-0.077**	-0.063**
	(0.033)	(0.039)	(0.038)	(0.032)	(0.032)	(0.031)
Meat	-.046	-.004	-.003	.015	0.098**	0.077**
	(0.034)	(0.035)	(0.034)	(0.041)	(0.043)	(0.042)
Dairy	-.016	.013	.013	-.006	-.012	-.017
	(0.021)	(0.022)	(0.021)	(0.022)	(0.024)	(0.024)
Plant-based protein	.006	-.016	-.016	-.016	-0.032*	-0.026*
	(0.012)	(0.015)	(0.014)	(0.016)	(0.017)	(0.016)
Fruit	-.006	-.006	-.006	.014	.019	.02
	(0.013)	(0.016)	(0.016)	(0.015)	(0.019)	(0.018)
Vegetables	.034	0.040*	0.040*	0.0380281	0.0254159	0.031348
	(0.022)	(0.021)	(0.021)	(0.039)	(0.047)	(0.047)
Sugary Products	.005	.003	.003	-.008	-.004	-.004
	(0.007)	(0.008)	(0.008)	(0.010)	(0.009)	(0.009)
Fat	0.024*	.01	.01	.009	-0.021*	-.017
	(0.010)	(0.009)	(0.009)	(0.012)	(0.013)	(0.012)
Meals out	-.014	-.015	-.015	.023	.027	.013
	(0.017)	(0.022)	(0.021)	(0.024)	(0.027)	(0.026)
Processed food	-.001	-.001	-.001	.001	.001	.001
	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Household-level controls	x	x	x	x	x	x
Municipality-level controls		x	x		x	x
Household consumption (per capita, adult equivalents)			x			x
Number of observations	2757	2757	2757	2757	2757	2757

Note: Standard errors are clustered at the municipality level. All regressions include a linear time trend.
*** p<0.01, ** p<0.05, * p<0.1.

Table 3.9: Impact of Seguro Popular on lifestyle and time use

	State FEs			Municipality FEs			N
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Lifestyle and time use							
Exercise	.056	.065	.063	0.149*	0.138*	0.134*	5545
	(0.069)	(0.071)	(0.070)	(0.085)	(0.082)	(0.075)	
Exercise hours	.108	.104	.105	.193	.186	.169	5029
	(0.196)	(0.202)	(0.201)	(0.227)	(0.223)	(0.187)	
Smoking (binary)	-0.10*	-0.099*	-0.099*	.036	.032	.034	5545
	(0.053)	(0.057)	(0.057)	(0.053)	(0.052)	(0.052)	
Number of cigarettes (per week)	-10.79**	-10.75**	-10.75**	-7.456	-7.475	-6.752	5545
	(4.445)	(4.541)	(4.538)	(5.269)	(5.289)	(4.571)	
Self-assessed health	-.0537	-.0507	-.053	.145	.134	.151	5545
	(0.149)	(0.149)	(0.148)	(0.175)	(0.172)	(0.180)	
	.002	.007	.007	-.035	-.034	-.031	5545
Health-related absence from work	(0.050)	(0.049)	(0.049)	(0.079)	(0.078)	(0.077)	
	.039	.034	.032	.023	.014	.014	5545
Health care usage (binary) in last 4 weeks	(0.058)	(0.060)	(0.060)	(0.082)	(0.082)	(0.076)	
Hours worked (per week)	1.318	.913	.888	3.694	3.22	2.806	3132
	(4.285)	(4.422)	(4.442)	(4.597)	(4.463)	(4.352)	
Individual-level controls	x	x	x	x	x	x	
Household-level controls		x	x		x	x	
Municipality-level controls			x			x	
Linear time trend	x	x	x	x	x	x	

7. Robustness checks

A number of robustness checks have been carried out in order to detect any possible weaknesses in our identification strategy that might have biased the results. The first set of checks were related to the choice of the instrumental variable. We then employ three alternative instruments, in order to rule out any spurious findings caused by the specific calculation of our main instrument:

i. Share of individuals covered by Seguro Popular at time t-1 as a share of those who were covered in 2011, when the rollout had been completed.
ii. Share of individuals covered by Seguro Popular at time t-1 as a share of those eligible for Seguro Popular treatment in 2000, before the inception of the programme.
iii. Share of individuals covered by Seguro Popular at time t as a share of the municipality's total population at time t.

The results of these robustness checks are presented in table A1 in the appendix and confirm the findings presented in the main part. If anything, the regressions with alternative instrument 2 could be interpreted as evidence that Seguro Popular increased obesity. However, this result is only significant for some of the regression specifications, and several regression coefficients under this instrument become implausibly large.

Secondly, we checked the sensitivity of the results with regards to the definition of the sample of analysis. As described above, in the main regressions presented in section 6 we are using a balanced sample, so that coefficients across specifications with different control variables are comparable. Table A2 also presents regressions results for an unbalanced sample, a balanced sub-sample of individuals who were overweight at baseline, and a balanced sub-sample of individuals over the age of 40. These results also confirm the main findings presented in table 5, suggesting that there is no significant impact of Seguro Popular on nutritional outcomes. Given the significant interactions between Seguro Popular and age, as well as Seguro Popular and overweight at baseline, one might have expected significant results in the respective sub-samples. One explanation for the lack of significance could be the lower statistical power in the sub-samples, which have only 50-60% of the original observations.

Our third concern is related to the fact that both the treatment and our outcome variables are binary in the case of underweight, overweight and obesity. It has been argued that the failure of 2SLS regressions to consider the binary nature of these variables may lead to inconsistent estimates (e.g. Dong and Lewbel 2015). We therefore also implement a two-stage residual inclusion (2SRI) approach as described in Terza et al. (2008) in order to take into account the binary nature of both treatment and outcome variables. These results are presented in table A3.

Fourth, we check whether our results are affected by the expansion of health infrastructure, and run additional regressions where we control for the number of doctors per 1000 inhabitants and clinics per 1000 inhabitants (both measured at the municipality level). The corresponding results are presented in table A4. However, even after controlling for a municipality's health infrastructure, we do not find any evidence that Seguro Popular has impacted nutritional outcomes.

Lastly, we investigate whether our significant results on household food expenditure (decrease in carbohydrate expenditure, increase in meat expenditure) can be explained by multiple hypothesis testing. Indeed, we ran regressions on 10 different food consumption outcomes, using 6 different regression specifications. This makes our estimates vulnerable to "false positives". Table 3.10 presents corrected p-values for the relevant specifications in table 3.8. After correcting for multiple hypothesis testing, none of the previously significant findings on carbohydrates, meat or plant-based protein, is significant at the 5% or 10% significance level. As a consequence, we cannot rule out the possibility that our findings on food consumption are purely to be explained by multiple hypothesis testing. The findings should thus be interpreted with caution.

Table 3.10: P-values with correction for multiple hypothesis testing (food consumption)

	Specification I (column 5 in table 3.8)				Specification II (column 6 in table 3.8)			
	p-value	Corrected p-value			p-value	Corrected p-value		
		Bonferroni	Holm	Holland		Bonferroni	Holm	Holland
Carbohydrates	0.017	0.208	0.208	0.189	0.044	0.531	0.531	0.419
Meat	0.025	0.295	0.270	0.239	0.070	0.844	0.774	0.552
Dairy	0.622	1.000	1.000	0.896	0.487	1.000	1.000	0.931
Plant-based protein	0.054	0.646	0.539	0.425	0.103	1.000	1.000	0.662
Fruit	0.314	1.000	1.000	0.896	0.270	1.000	1.000	0.854
Vegetables	0.424	1.000	1.000	0.896	0.241	1.000	1.000	0.854
Sugary Products	0.660	1.000	1.000	0.896	0.675	1.000	1.000	0.941
Fat	0.101	1.000	0.911	0.617	0.177	1.000	1.000	0.789
Meals Out	0.323	1.000	1.000	0.896	0.611	1.000	1.000	0.941
Processed food	0.476	1.000	1.000	0.896	0.691	1.000	1.000	0.941

8. Conclusion

We have assessed the impact of health insurance on nutritional outcomes and choices in a context of growing rates of overweight and obesity. Our results suggest that the expansion of health insurance to low-income households in Mexico *did not exert an average effect on underweight, overweight, and obesity* (most of the estimated coefficients point to a reduction in weight attributable to Seguro Popular). However, we do find evidence of heterogenous effects in the programme's impact, suggesting that *Seguro Popular protected older individuals more effectively against obesity than younger individuals*. Moreover, we find evidence that the programme may have increased obesity among those who were already overweight before the introduction of Seguro Popular, which would be in line with a moral hazard effect. However, the latter effect is sensitive to the choice of the outcome variable and not confirmed in the robustness checks.

Our estimates provide suggestive evidence that *households covered by Seguro Popular have on average decreased the share of household expenditure on carbohydrates, but increased the share of household expenditure on meat*. This result is consistent with a health information effect, where households decrease their consumption of energy-dense carbohydrates, as well as a change in the beneficiary households' consumption bundle in response to the income shock due to Seguro Popular. However, we cannot exclude the possibility that this is a spurious finding and only emerged due to multiple hypothesis testing. More research would be needed in order to confirm this finding.

It is important to bear in mind that obesity-related treatments were not covered during the first years of Seguro Popular, which are covered by our data. The programme's nutritional performance may have improved after 2009, when more and more obesity-related treatments were included into the catalogue of free health services, and obesity-related examinations were integrated into the regular check-ups offered to the insured. Moreover, it should be underlined that the findings of this paper are only applicable to Seguro Popular's target population, i.e. low-income, informal sector households which previously did not have any access to health insurance.

Overall, our paper underlines the finding that health insurance does not automatically improve nutrition-related diseases such as overweight and obesity. Moreover, based on the study we cannot discard the concern that free health insurance may even exacerbate obesity, e.g. through an increase in disposable income or moral hazard. Including obesity-related treatments and check-ups into health insurance plans should therefore be considered a policy priority in order to allow the health care and health prevention effects of insurance to prevail.

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Appendix

Table 3.A1: Impact estimates of Seguro Popular based on alternative instruments (robustness check)

	IV: Coverage in municipality (t-1) as percentage of target population (individuals covered after complete rollout in 2011)				IV: Coverage in municipality (t-1) as a percentage of eligible individuals as per census conducted in 2000				IV: Coverage in municipality in the present year (t), as percentage of total population in municipality (t)			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Obesity	0.0717	0.0685	0.0897	0.108	0.790	0.486	0.476	0.490**	0.0250	0.00640	0.0510	0.0452
	(0.156)	(0.143)	(0.223)	(0.230)	(1.220)	(0.566)	(0.339)	(0.248)	(0.0566)	(0.0558)	(0.0611)	(0.0698)
Overweight	-0.00319	0.0157	0.0612	0.0586	0.142	0.148	0.183	0.124	0.0182	0.0231	0.0870	0.0845
	(0.169)	(0.161)	(0.216)	(0.194)	(0.314)	(0.255)	(0.165)	(0.125)	(0.0613)	(0.0643)	(0.0620)	(0.0704)
Underweight	-0.00156	-0.00070	-0.00046	7.23e-05	-0.00156	-0.00070	-0.00046	7.23e-05	0.00322	-0.0033	-0.0197	-0.042*
	(0.00381)	(0.00367)	(0.00365)	(0.00372)	(0.00381)	(0.00367)	(0.00365)	(0.00372)	(0.0209)	(0.0215)	(0.0195)	(0.0240)
BMI	-0.154	-0.0731	0.419	0.774	5.515	2.583	2.914**	3.039***	0.370	0.170	0.893	1.037
	(2.153)	(2.046)	(2.940)	(2.849)	(7.353)	(2.439)	(1.287)	(1.128)	(0.635)	(0.643)	(0.701)	(0.803)
Individual-level controls	x	x	x	x	x	x	x	x	x	x	x	x
Household-level controls		x	x	x		x	x	x		x	x	x
Municipality-level controls			x	x			x	x			x	x
Health infrastructure in municipality				x				x				x
State-level fixed effects	x	x	x	x	x	x	x	x	x	x	x	x
Number of observations	5,445	5,445	5,445	5,199	5,445	5,445	5,445	5,199	5,445	5,445	5,445	5,199

Note: Standard errors are clustered at the municipality-level. All regressions include a linear time trend. The controls in the first three columns are as in table 5 of the paper (main results). The controls for the health infrastructure are nurses per 1000 inhabitants and doctors per 1000 inhabitants (the inclusion of hospitals per 1000 inhabitants and nurses per 1000 inhabitants does not change the main coefficients, but was not included in the final specifications to avoid multicollinearity).

Table 3.A2: Robustness checks related to the sample of analysis (2SLS estimates)

	Unbalanced sample				Sub-sample of individuals who were overweight at baseline				Subsample of individuals over the age 45			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Obesity	-0.0311	0.0158	0.0592	0.0414	0.146	0.147	0.153	0.146	0.0672	0.0475	0.160	0.122
	(0.0502)	(0.0549)	(0.0598)	(0.0684)	(0.0916)	(0.0926)	(0.103)	(0.122)	(0.0882)	(0.0865)	(0.0997)	(0.105)
Overweight	-0.0448	-0.0212	0.0447	0.0718	-0.00765	-0.0132	-0.0164	-0.0154	0.0354	0.0184	0.0528	0.00161
	(0.0607)	(0.0665)	(0.0706)	(0.0758)	(0.0232)	(0.0242)	(0.0232)	(0.0237)	(0.0532)	(0.0545)	(0.0575)	(0.0616)
Underweight	0.0112	0.00568	-0.0158	-0.0326	-0.00034	0.00171	0.00247	0.00254	0.000303	0.00124	0.00609	0.00261
	(0.0210)	(0.0202)	(0.0193)	(0.0227)	(0.00429)	(0.00434)	(0.00431)	(0.00446)	(0.0103)	(0.0118)	(0.0112)	(0.0127)
BMI	-0.618	-0.213	0.368	0.467	0.523	0.450	0.873	1.323	0.688	0.307	1.111	0.618
	(0.568)	(0.594)	(0.647)	(0.687)	(0.970)	(1.002)	(1.094)	(1.220)	(0.685)	(0.702)	(0.848)	(0.837)
Individual-level controls	x	x	x	x	x	x	x	x	x	x	x	x
Household-level controls		x	x	x		x	x	x		x	x	x
Municipality-level controls			x	x			x	x			x	x
Health infrastructure in municipality				x				x				x
State-level fixed effects	x	x	x	x	x	x	x	x	x	x	x	x
Number of observations	8,267	5,831	5,831	5,569	3,543	3,543	3,543	3,407	2,818	2,818	2,818	2,719

Note: Standard errors are clustered at the municipality-level. See table A2 for a detailed list of included control variables. All regressions include a linear time trend. *** p<0.01, ** p<0.05, * p<0.1.

Table 3.A3: Probit regression results on Seguro Popular and overweight/obesity using 2-stage-residual-inclusion

	2 SRI regressions			
	(1)	(2)	(3)	(4)
Obesity	-0.404	-0.274	-0.409	-0.417
Bootstrapped Standard Error	(0.268)	(0.273)	(0.370)	(0.329)
Average marginal effect	-0.129	-0.087	-0.129	-0.131
Overweight	-0.172	-0.0639	0.111	0.110
Bootstrapped Standard Error	(0.237)	(0.273)	(0.298)	(0.312)
Average marginal effect	-0.0550	-0.0203	0.0353	0.0348
1st stage residual	x	x	x	x
Individual-level controls	x	x	x	x
Household-level controls		x	x	x
Municipality-level controls			x	x
Health infrastructure in municipality				x
Linear time trend	x	x	x	x
Municipality-level fixed effects	x	x	x	x
Number of observations	5545	5545	5545	5545

Note: Standard errors are clustered at the municipality-level. Standard errors are bootstrapped based on 500 replications. Marginal effects are evaluated at the mean. The first stage residuals are included in all regressions following the approach suggested by Terza (2008) For a detailed list of the included control variables, see the note on table A2 or table 3.

Table 3.A4: Regression coefficients after controlling for health infrastructure in municipality

	OLS	2SLS with state FEs	2SLS with municipality FEs
Obesity	-0.0118	0.0514	-0.105
	(0.0119)	(0.0682)	(0.0758)
Overweight	0.00391	0.0578	0.0596
	(0.0134)	(0.0764)	(0.0766)
Underweight	0.000244	-0.0216	-0.0154
	(0.00373)	(0.0207)	(0.0222)
BMI	-0.0192	0.562	-0.0483
	(0.0996)	(0.674)	(0.484)
Individual-level controls	x	x	x
Household-level controls	x	x	x
Municipality-level controls	x	x	x
Doctors per 1000 & Clinics per 1000 in municipality	x	x	x
Observations	5445	5445	5445

Note: Summary of the regression coefficients on Seguro Popular treatment (individual level) for the four nutritional outcomes of interest (obesity, overweight, underweight, BMI). All regressions include a linear time trend. Standard errors are clustered at the municipality-level. *** p<0.01, ** p<0.05, * p<0.1.

4. The Weight of Patriarchy? - Gender Obesity Gaps in the Middle East and North Africa (MENA)

By Joan Costa-Font and Mario Gyori

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Abstract

The worldwide obesity epidemic has impacted women more heavily than men. These gender-based differences are particularly pronounced in the Middle East and North Africa (MENA) region where gender obesity gaps on average exceed 10 percentage points. This paper examines one of the explanations, namely the role of female empowerment on gender gaps in obesity. We study the effect of female labor market participation and the share of female members of parliament on gender obesity gaps over a time span of 41 years (1975–2016) in a sample of 190 countries. We document that after controlling for a number relevant controls, gender obesity gaps are associated with these proxies of female empowerment in the MENA region but not worldwide. Our results show that a one percentage point increase in female labor market participation (female MPs in national parliament) predicts a 0.2 (0.09) percentage point decrease in gender gaps in obesity in the MENA region.

Keywords: Female overweight, Obesity, Female empowerment, Female labor market participation, MENA region, Female political participation

1. Introduction

The burden of obesity worldwide falls overwhelmingly on women (Kanter and Caballero, 2012). However, in no other world region are the gender-based differences as pronounced as in the Middle East. Women in the Middle East are on average 10.3 percentage points more likely to be obese than men, compared to approximately 4 percentage points worldwide. There are a number of potential explanations for these comparatively large gender gaps in obesity, including gender-based differences in physical labour, body-type preferences, alongside cultural norms regarding the priorization of family members when calories are scarce. This paper investigates on the role of women empowerment, i.e. the decline of "patriarchic" norms, on gender obesity gaps. Women empowerment is the ability of women to access the constituents of development (Duflo, 2012), which include more prominently earning opportunities by participating in the labour market, political participation and equal rights and non-discrimination, including in the household. Empowerment can influence autonomy and agency, self-confidence and self-efficacy, which impact on health decision making, and as we show in this paper on overweight.

Gender-based differences in overweight and obesity are an important concern to policy makers interested in improving gender equality and public health in general. Overweight and obesity substantially increase the risk of several chronic diseases such as high blood pressure, high cholesterol, type II diabetes, cancer, heart disease and arthritis (Di Cesare et al. 2016, A.E. Field et al. 2001, Sturm 2002). A higher prevalence of obesity among women today will therefore almost inevitably lead to a higher prevalence of heart disease, diabetes and other obesity-related comorbidities in the future, along with adverse impacts on labour market outcomes, mortality, and general wellbeing.

Nonetheless, evidence on the gender-specific determinants of overweight and obesity is scarce. Power and Schulkin (2008) discuss biological differences in the fat metabolism between men and women which can partly explain gender obesity gaps. Kanter and Caballero (2008) cite lower levels of physical activity among women due to contextual factors as a reason for gender-based differences in overweight. Azizi et al.

(2005) also refer to the importance of gender differences in diets, documenting a higher sugar and snack intake among women. Other explanations might be related to sociocultural factors and different body-type preferences. For the MENA region, a number of studies have documented preferences for plump body shapes and/or overweight among women but not among men (Rguibi and Belahse, 2006, Naigaga et al. 2018, Musaiger et al. 2004). This might result from excess weight being perceived as a positive trait linked to maternity, prosperity and good health (Ichinohe et al., 2005; Mokhtar et al., 2001).

So far there is only very limited evidence on the relationship between women empowerment and nutritional outcomes and most of the related literature focuses on undernutrition. Malapit and Quisumbing (2015), show a positive association between women's financial empowerment and nutritional diversity, but not with BMI in Ghana. Malapit et al. (2013) find that women empowerment in agricultural households can increase both the nutritional diversity and BMI of women in Nepal (the baseline BMI of the sampled women was relatively low, suggesting that the finding reflects a decrease in undernutrition). Moreover, there is evidence that children of more empowered women are less likely to be undernourished (ibid, Cunningham et al., 2014). Regarding overnutrition, Mabry et al. (2010) argue that restrictions to the freedom of movement of women incentivizes more sedentary behaviour as it prevents women from egaging in both active and passive exercise.

The two papers which are most closely related to our study are Wells et al. (2012) and Garawi et al. (2014), which provide evidence for a negative association between women empowerment and obesity differentials between men and women in a worldwide sample of countries. However, below we document that most of such association is driven by Middle Eastern countries alone. Furthermore, they do not investigate on the mechanisms behind these associations, nor do they provide any evidence on the direction of causality, which we both aim to address in this paper.

The contribution of this paper is threefold. First, we document the rise of gender obesity gaps in the Middle East, as compared to other world regions. Secondly, we investigate to what extent the worldwide association between measures of women empowerment and obesity gaps documented in other papers, is driven by developments in the MENA region[25]. Third, we provide an initial assessment on the direction of causality between women empowerment and gender obesity gaps by estimating fixed effects regressions.

We use historical data on overweight and obesity over a time period of 41 years in 190 countries, 17 of which are in the MENA region, which allows us to describe trends in male and female obesity in the Middle East and benchmark them against other countries. We document that while average worldwide gender differences in obesity have remained stable since 1975, female obesity in the Middle East has increased at a much faster pace than male obesity, leading to a substantial gender obesity gap.

Second, we study to what extent gender obesity gaps correlate with different proxies of women empowerment, both worldwide and in the MENA region. In our study we mainly draw on two proxies for women empowerment, namely female labour market participation and the share of female members of parliament (MPs). These proxies are chosen as they are consistently available for a large number of countries and over a long time span, yet we show that our results also hold for composite measures of female empowerment, as e.g. the UN's Gender Development Index (GDI). Our results show that the worldwide association between these variables and gender obesity gaps is entirely driven by the MENA region. Within the MENA region, the association is robust to the inclusion of a number of controls including socio-economic status, education, demographic controls alongside time fixed effects. The effect is suggestive that increasing female agency (in several domains such as employment, politics and the household) affects health decision making, and more specifically the within country gender gaps in obesity.

Third, given the potential of omitted variables and/or reverse causality confounding the effect, we draw on causal inference methods to gain additional evidence on the direction of causality. In particular, we implement fixed effect regressions to control for potential omitted variables. These estimates indicate that

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[25] MENA region (Algeria, Bahrain, Djibouti, Egypt, Iran, Iraq, Israel, Jordan, Kuwait, Lebanon, Libya, Morocco, Oman, Qatar, Saudi Arabia, Somalia, Syria, Tunisia, United Arab Emirates, West Bank and Gaza, and Yemen).

causality runs from female labour force participation and the share of female MPs to gender obesity gaps. Indeed a one percent increase in female labour force participation (share of female MPs) decreases gender obesity gaps by 0.2 (0.09) percentage points in the MENA region. The effects are mainly explained by rising obesity rates among men once the female employment rate increases.

Section 2 of this paper summarizes the previous literature relevant to our analysis of gender obesity gaps, as well as gender-specific factors which may influence such gaps. In sections 3 and 4 we discuss our data sources and methods. Next, section 5 presents three stylized facts on gender-based differences on overweight and obesity in the MENA region, and describes a phenomenon which we determine the region's "gender obesity gap". Then, sections 6 investigates a number of possible explanations of these patterns and also presents a number of robustness checks. A final section concludes.

2. Related Literature

Overweight and obesity arise when an individual's caloric intake is higher than their caloric expenditure (Cutler, Glaeser, and Shapiro 2003; Lakdawalla and Philipson 2009). The underlying factors for such an imbalance can be structural or the results of individuals choices and lifestyles. Over recent years, changing lifestyles have intensified these caloric imbalances. On the one hand, the share of individuals engaging in physical labor has been declining and more people pursue sedentary activities for living. On the other hand, the daily intake of calories has increased in most high and middle income countries (Costa-Font and Mas 2016).

There are a number of explanations for the increased consumption of calories. Technological progress in both agriculture and industrial food processing has led to a decrease in the relative prices of food. Cutler et al. (2003) show that this led to an increase in the consumption of calories, particularly through more frequent meals and snacking. Another explanation is related to the improved labour market perspectives for women. This led to an increase in the opportunity cost for cooking and hence an increase in the consumption of industrially processed food, as well as restaurant meals including fast food. As the latter options often have a higher caloric density than home cooked food, this has also contributed to rising obesity levels (Chou, Grossman and Saffer 2004).

However, it is not immediately clear why any of these factors should affect women differently than men. Evidence from biology and the medical sciences suggests that the body mass of women on average contains a higher proportion of fat than the body mass of men (Power and Schulkin 2008). These biological factors can explain why women are more affected by obesity on average, but not why these gender gaps differ between world regions.

A literature review on gender-specific explanations of obesity by Kanter and Caballero (2012) point to the possibility of gender-specific changes to physical activity patterns over recent years. In some world regions, manual tasks that were traditionally carried out by women may have been automatized more quickly, leading to a decrease of physical activity among women. Other explanations relate to culture and body type preferences in different societies. In some cultures, female weight is associated with high social status, maternity and nurturing, leading to a preference for high body weight. Moreover, cultural or religious norms may restrict the possibility for females to exercise in public (ibid.).

On a more general level, there is evidence that female empowerment is conducive to wider political participation, employment and education, and health (Mahlotra et al, 2002, World Bank, 2011, Hindin, 2000). In theory, it is therefore well conceivable that empowerment also affects nutritional outcomes. More empowered women may e.g. be less affected by a social pressure to comply with certain body type preferences. Moreover, there may be indirect effects through employment (higher incomes among more empowered women) and education which can increase "nutritional literacy".

This is also confirmed by empirical evidence. Jones et al (2020) differentiate three domains of women's empowerment namely asset ownership, intrinsic agency (power within household), and instrumental agency (power to influence in household decision-making) and show that the latter two contribute women's nutritional status in East Africa. Other studies examining women empowerment status (draw on measures of decisions making, violence attitudes and experience) find evidence of an association with women's nutritional status (Yaya 2020). Consistently, Kunto and Bras (2018, 2019) as well as Imai et al. (2014) provide a life course explanation showing that the empowerment of mothers also improves the nutritional status of their adolescent children, in particular for girls. Patel et al. (2006) show that limited empowerment is the main predictor of poor health among Indian women. Moreover, a growing body of evidence from psychology suggests that an individual's empowerment, by improving individual's agency and self-efficiency, eases the process of searching for solutions to health specific conditions such as diabetes which relate to individuals overweight and obesity (Wong *et al*, 2016; Nishita *et a*l, 2013). A study examining individuals with type II diabetes found evidence of a reduction of stress, systolic blood pressure and Body Mass Index (BMI) following empowerment interventions (Tucker et al, 2014). However, this intervention targeted both, men and women.

A recent paper by Atkin, Sihra and Shayo (2019) also underlines the importance of cultural and religious factors in shaping food consumption preferences. They show that changes in the status of a religious or ethnic group in a society have implications for both the degree to which members identify with this group, and the consumption of identity goods and adherence to consumption taboos (e.g. Hindus not consuming beef). Moreover, they find that conflict may increase the identification with one's own group and lead to a higher consumption of identity goods (e.g. Hindus consuming pork).

This paper contributes to the literature in the following way. First, we describe what we refer to as a "gender obesity gap" in the Middle East, namely a rising disparity in obesity rates between men and women. This pattern has not yet received any attention in the development and health literature so far. Therefore, we first provide a cross-country analysis of gender-based differences in obesity in the MENA region and worldwide to document such a phenomenon. Secondly, we contribute to the increasing literature on gender health gaps, and the macro-institutional determinants of health, especially empowerment theories which suggest that expanding individual agency exerts an effect on individual's health. Third, we investigate on a number of explanations for the gender obesity gap, particularly drawing on literature on women empowerment. In particular, we assess to what extent the economic and political participation of women (measured by female labour market participation and the share of female MPs in national parliaments) can explain gender obesity gaps. Finally, we investigate on the channels through which empowerment influences gender obesity gaps, and particularly the underlying changes to male and female obesity rates.

3. Data

We use country-level panel data on BMI, overweight and obesity from the World Health Organisation's (WHO) Global Health Observatory. This dataset contains complete information on nutritional outcomes by sex for 190 countries worldwide, out of them 17 countries in the Middle East, over a time span of 41 years (1975-2016).

This data has been merged with two different proxies for female empowerment that were obtained from the World Bank Open Data database: the percentage of women in a country's labour force as a measure of female labour market participation, and the share of female MPs in national parliaments as a measure of women's political participation. These variables are used as the primary proxies of female empowerment in our analysis, given that they have been consistently recorded for a large number of countries (176) and over a long time period (1990-2016). This large number of more than 4,000 observations gives us the necessary statistical power to investigate on the heterogeneities between MENA and other world regions, and to add a larger number of control variables.

While we acknowledge that these indicators do not reflect all dimensions of female empowerment, they are able to capture at least economic and political participation. As a robustness check, we use the more comprehensive UNDP's Gender Development Index as a proxy of female empowerment. In the time period between 1990 and 2010, this index is only available in 5 year-intervals, leading a smaller sample size and therefore less precise estimates of the regression coefficients (see below).

Moreover, we draw on the *World Bank Open Data* database for constructing control variables on the socioeconomic situation of all countries, as well as the demographic composition of their populations. The World Bank data has more gaps and for some countries a number of variables are not available at all. We use linear interpolation in order to fill data gaps between two available data points for the control variables.

Overall this provides us with 4,423 observations from 181 countries for which we have data on nutritional outcomes, GDP per capita and the country's demographic composition (dummy variables for the share of different age-groups in the total population) , female labour market participation and the share of female MPs in national parliaments. For 3,183 observations we also have additional control variables such as unemployment, the size of the services sector, and the country's total fertility rate. Descriptive statistics are provided in table 4.A1 in the appendix.

4. Methods

We run fixed effects regressions in order to assess the associations between obesity and overweight and two proxies of female empowerment, namely a.) female labour market participation, and b.) the share of female MPs in national parliaments. It is important to acknowledge that we can only identify the impact of these proxy variables, and not of female empowerment as such. Female empowerment is a multi-dimensional construct which cannot be expressed in a single number. Therefore we opt for investigating on the impact of proxy variables, which capture different dimensions of female empowerment.

In all regression models, we interact the main independent variable, e.g. female employment, with a MENA region dummy variable. This allows us to disentangle the worldwide association between the independent variable and gender-obesity differences, from the region-specific association in the Middle East. The regression models take the form

$$Y_{it} = \alpha + \beta_1 X_{it} + \beta_2\, MENA_i + \beta_3\, (X_{it}\; x\; MENA_i) + \gamma\, W_{it} + \vartheta_i + \varepsilon_{it}$$

where Y_{it} is a nutritional outcome for country i at time t (either the gender obesity gap, or female or male obesity), X_{it} is our independent variable (i.e. a proxy of female labour market participation, or of women empowerment), $MENA_i$ is a binary variable indicating whether the country is part of the MENA region (this dummy is dropped in all fixed effect models due to de-meaning), W_{it} is a vector of control variables, ϑ_i is a country-specific fixed effect, and ε_{it} is a serially uncorrelated random error term. Our main parameters of interest are β_1 and β_3. β_1 measures the association between a proxy for female empowerment and gender-obesity differences worldwide, while β_3 measures the same association for the MENA region in particular. Moreover, all regressions include a linear and quadratic time trend in order to capture any long-run developments, which are independent of the world region, but may be correlated with the treatment variables.

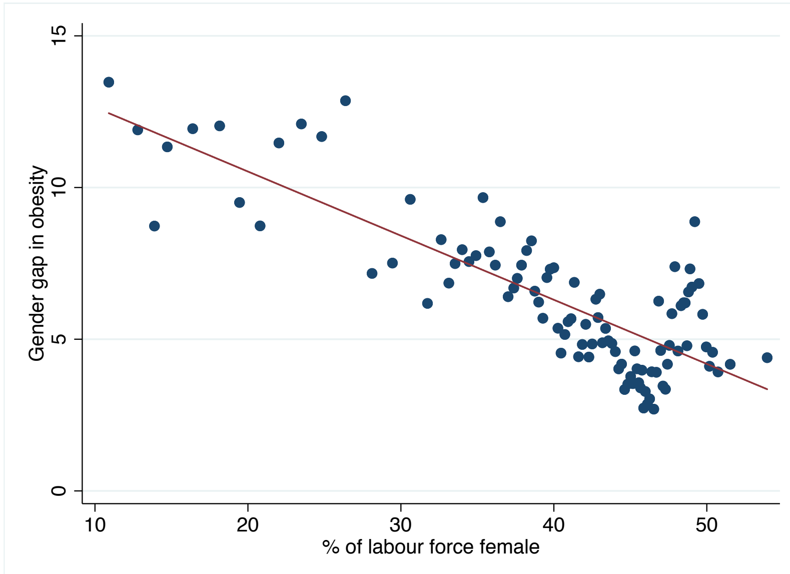
Table 4.A1 in the appendix illustrates that the independent variables feature sufficient variation over time which is crucial for our fixed-effects estimation. In the MENA region female labour force participation increased by 5.7 percentage points between 1990 and 2015 (a 27 percent increase compared to the baseline mean) and the share of female MPs increased by 9 percentage points (a 280 percent increase). In the rest of the world, labour force participation increased by 2.21 percentage points (4.4 percent increase compared to baseline) over the study period and the share of female MPs by 10.7 percentage points (a 102 percent increase).

It is important to acknowledge that this approach has a number of limitations. First, fixed effect models allow us to control for time-invariant unobservable factors, but not for unobservables which can change over time. Second, as the main interest of this paper are gender obesity gaps in the MENA region, we do not interact our treatment variables with other regional dummies. We therefore compare the MENA region to the rest of the world, without taking into account possible heterogeneities between other regions.

5. Stylised facts

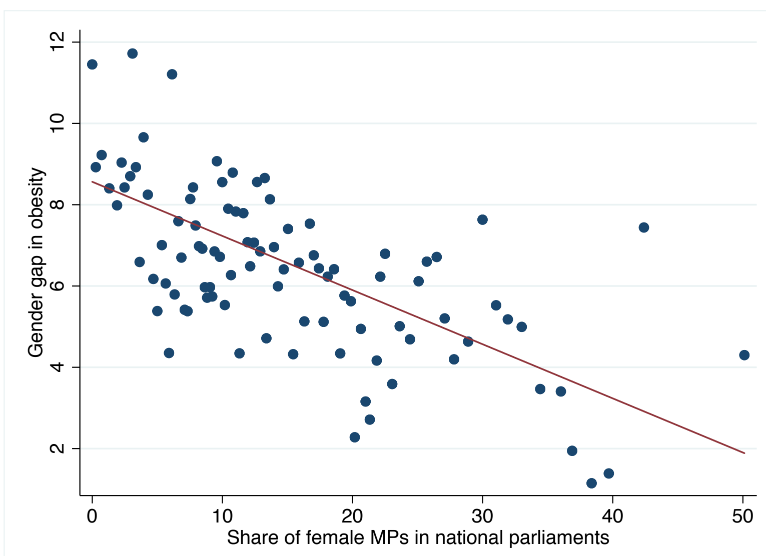
Descriptive evidence reveals that there is indeed a negative correlation between our measures of female empowerment and gender obesity gaps. More specifically, Figure 1 shows evidence suggestive that higher levels of female male labour market participation negatively correlate with gender obesity gaps. Similarly, Figure 2 shows a negative correlation between the share of female MPs in national parliament and gender differences in obesity.

Figure 4.1: Gender obesity gaps and female labour force participation



Note: This figure displays the correlation between country specific differences in obesity across genders and the proportion of women in the labour force. The figure is own elaboration based on WHO data 1975-2015. Bin scatter plot (n=100).

Figure 4.2: Gender obesity gaps and share of female MPs in national parliaments



Note: This figure displays the correlation between country specific differences in obesity across genders and the proportion of female members of parliament (MP) in national parliments. The figure is own elaboration based on WHO data 1975-2015. Bin scatter plot (n=100).

Figures 3 and 4 illustrate the development of gender-based inequalities in different world regions[26]. Three main conclusions can be drawn from these graphs. First, the worldwide prevalence of obesity among women is on average 4 percentage points higher than the prevalence of obesity among men. This difference has remained constant over a long time period, in spite of substantial overall increases in overweight/obesity. The results are consistent with some structural factors driving the association.

Second, the constant world average masks important regional differences in the development of gender-based obesity differences. There are two world regions where obesity among women has grown much faster than obesity among men: sub-Sahara Africa and the MENA region. In the remainder of this paper we describe this pattern as the growing “gender obesity gap”. In the MENA region, gender-based differences in obesity had already surpassed the world average at the beginning of our data series in 1975 (6.4 percentage points). Since then, the gender obesity gap has grown rapidly over the 1980s and 1990s, reaching 9.6 percentage points in the year 2000. This growth also continued between the year 2000 and 2016, although at a slower pace reaching 10.3 percentage points in 2016. In sub-Sahara Africa, gender obesity gaps were still below the world average in 1975, but since then have been growing even more rapidly than in the MENA region, reaching 9.6 percentage points in 2016.

On the other hand, gender-based differences in obesity in Europe have steadily decreased over our period of interest, from 6.4 percentage points in 1975 to 2.6 percentage points in Europe. Lastly, in the Americas, Southeast Asia, and the Western Pacific region, gender obesity gaps have remained fairly constant over time.

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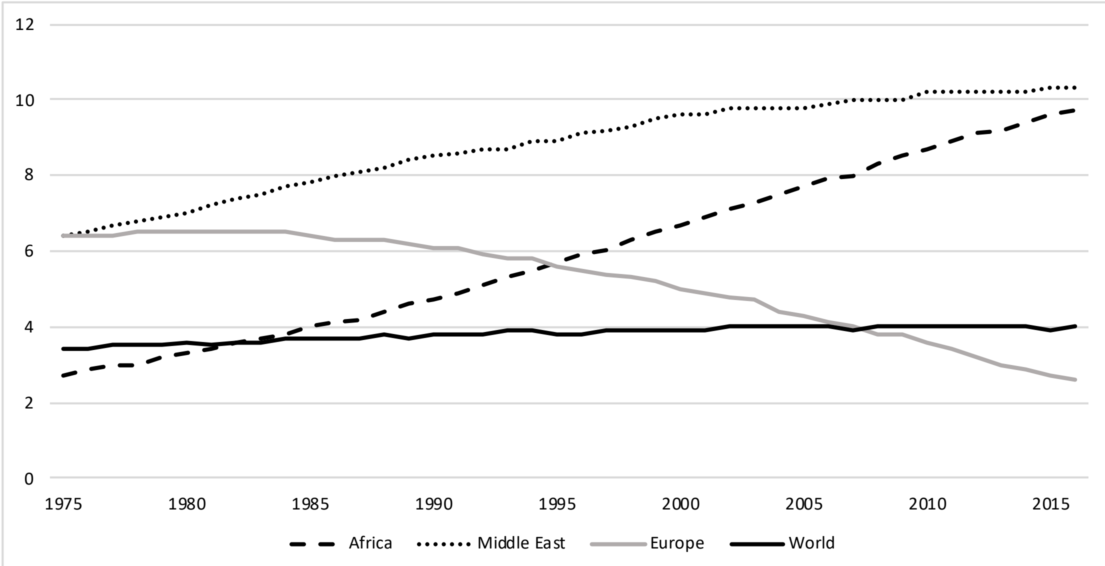
[26] We are using the WHO classification of world regions for all graphs presented in this section. For details, see: https://www.who.int/healthinfo/global_burden_disease/definition_regions/en/

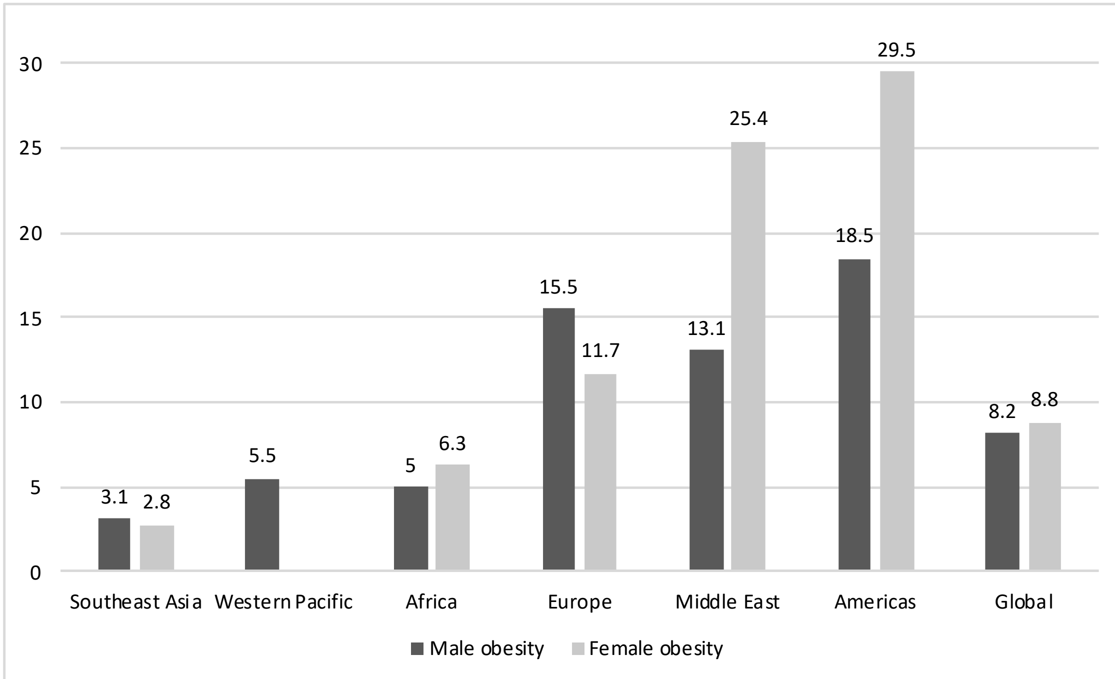
Figure 4.3: Gender obesity gaps for selected world regions over time (% point differences between women-men)



Note: This figure displays the differences in obesity across genders across different world regions. The figure is own elaboration based on WHO data 1975-2015. Bin scatter plot (n=100).

Third, it is important to note that even male obesity in the MENA region grew more rapidly than the world average over the study period. This implies that the growing gender obesity gaps cannot be explained by constant or decreasing male obesity rates, but by an extraordinarily rapid increase in female obesity. This is also confirmed by Figure 3 which summarizes female obesity trends by WHO world region. It shows that today the Middle East is the region with the second highest female obesity rate worldwide, only surpassed by the Americas. Figure 4 reports the overall change in obesity prevalence in different world regions between 1975 and 2016. Although obesity in the American region was still higher than the MENA region in 2016, we document that the MENA regions exhibits the largest change in obesity (92% change compared to 53% in the American region).

Figure 4.4: Growth in male vs. female obesity across world regions (1975-2016, in percentage points)



Note: This figure displays the obesity rates across genders across different world regions in 1975 and 2016. The figure is own elaboration based on WHO data 1975-2015. Bin scatter plot (n=100).

6. Explaining the gender obesity gap

6.1 Fixed Effects estimates

Table 1 presents Fixed Effects (FE) estimates which report how the two proxies of female empowerment (female labor market and the share of female MPs in the national parliaments) predict gender obesity gaps across countries. The left panel of the table (columns 1-3) suggests that female employment worldwide does not have an impact on gender-based obesity differences, after including country-level fixed effects and controlling for a number of country characteristics. In contrast, we find that, it does reduce the gender obesity gap in the MENA region. The estimates show that a 1 percentage point increase in female employment in the MENA region is associated with an average decrease of 0.22 to 0.29 percentage points in the gender obesity gap. While this effect size is quite large, it would still be very difficult to eliminate the gender obesity gap through increased employment alone. Assuming a linear relationship, an increase in the female labor force participation rate by 40 percentage points would eliminate the gender obesity gap, an increase by 25 percentage points in the labor force participation rate of women could bring the gender obesity gap down to the worldwide average of 4 percentage points (the cross-country average of female labor market participation in the MENA region amounts to 27 percent in 2016). This suggests that other factors which are unrelated to female employment or empowerment have also contributed to the existing gender obesity gap.

The right panel of the table (columns 4-6) illustrates that female representation in parliament is associated with a higher gender obesity gap worldwide, but with a lower gender obesity gap in the MENA region. The coefficients for the MENA region range between 0.085 and 0.0986, implying that a one percentage point increase in the share of female MPs predicts a 0.09 percentage point decrease in the gender obesity gap. We interpret this as a rather small coefficient, in particular compared to the coefficients on female employment. The numbers suggest that, all else equal, an increase in the share of female MPs by 65-67 percentage points would be needed in order to reduce the MENA regions's gender obesity gap to the world average.

Table 4.1: Gender obesity gaps and female empowerment (Fixed effects estimates)

	(1)	(2)	(3)		(4)	(5)	(6)
		Gender obesity gap				**Gender obesity gap**	
Female labour force participation	-0.0109 (0.0204)	0.0282 (0.0190)	0.0223 (0.0227)	Percentage of female MPs in national parliaments	0.0256*** (0.00924)	0.0239*** (0.00877)	0.00383 (0.00862)
Female labour force participation x MENA	-0.297*** (0.0698)	-0.282*** (0.0696)	-0.243** (0.1000)	Percentage of female MPs x MENA	-0.0939** (0.0398)	-0.0980** (0.0415)	-0.0871** (0.0420)
GDP per capita		-0.00014*** (4.86e-05)	-0.000172*** (4.40e-05)	GDP per capita		-9.95e-05* (5.34e-05)	-0.000154*** (4.70e-05)
(GDP per capita)^2		3.19e-10 (3.50e-10)	5.61e-10 (3.42e-10)	(GDP per capita)^2		0 (4.15e-10)	5.33e-10 (3.61e-10)
Size of services sector (% of GDP)			-0.0150 (0.0111)	Size of services sector (% of GDP)			-0.0135 (0.0112)
Unemployment rate			-0.0654*** (0.0196)	Unemployment rate			-0.0667*** (0.0197)
Total Fertility Rate			-1.547*** (0.357)	Total Fertility Rate			-1.692*** (0.338)
Linear and quadratic trend	x	x	x	Linear and quadratic trend	x	x	x
Controls for demographic composition	x	x	x	Controls for demographic composition	x	x	x
Observations	4,747	4,482	3,326		4,747	4,482	3,326
Number of countries	176	172	161		176	172	161

Note: Cluster-robust standard errors (country-level) in parentheses. *** denotes statistical significance at the 10% level, ** significance at the 5% level, and * significance at the 1% level

However, it is important to note that both the political representation of women and female employment, two proxies of female empowerment do predict lower gender obesity gaps consistently with the predictions of empowerment theory. These results are consistent with studies that suggest an association between measures of gender inequality and obesity.

6.2 Channels

As a next step, we present evidence on the potential channels which affect the gender obesity gap, in particular whether the associations between female employment, female MPs and the gender obesity gap are driven by changes in male or to female obesity. Table 2 illustrates that the negative association between female employment and the gender obesity gap, is mainly to be explained by rising obesity rates among men once the female employment rate increases. Female obesity in turn is by and large unaffected by female employment.

A stronger representation of women in national parliaments is associated with both higher obesity rates among men and women. However, the growth in male obesity rates in response to female representation is stronger than for women, explaining the overall negative association between gender obesity gaps and female MPs in the MENA region. We show that both measures of empowerment have different effects on gender gaps in the Middle East than elsewhere. In the Middle East it seems that female employment increases male obesity and has no effect on obesity among women (negative but insignificant coefficient). Similarly, a larger share of female MPs increases obesity in men almost three times that of women.

Table 4.2 - Channels: Are the findings driven by changes to female obesity, male obesity, or both?

	(1)	(2)	(3)	(4)	(5)	(6)
Independent variable: female labour force participation	**Female obesity**			**Male obesity**		
Female labour force participation	0.0525**	0.0678**	0.0518**	0.0634**	0.0396	0.0295
	(0.0259)	(0.0273)	(0.0241)	(0.0276)	(0.0266)	(0.0238)
Female labour force part. x MENA	-0.115**	-0.0566	-0.0737	0.182*	0.226**	0.170
	(0.0528)	(0.0674)	(0.0773)	(0.100)	(0.102)	(0.113)
Independent variable: percentage of female MPs in national parliaments	**Female obesity**			**Male obesity**		
Percentage of female MPs	-0.0131	-0.0130	-0.00576	-0.0387***	-0.0369***	-0.00959
	(0.0123)	(0.0123)	(0.0113)	(0.0134)	(0.0135)	(0.0109)
Percentage of female MPs x MENA	0.0836***	0.0791**	0.0736*	0.177***	0.177***	0.161***
	(0.0304)	(0.0321)	(0.0398)	(0.0297)	(0.0292)	(0.0319)

Note: The table presents the coefficients from three different fixed effects regression specifications, using female and male obesity as outcomes instead of gender gaps. Control variables across specifications are analogous to tables 1 and 2. Standard errors are clustered at the country-level.

6.3 Heterogeneity: Arab Spring

One potential variation in the effect of empowerment comes from shocks that increase the instability of the MENA region countries. The Arab Spring stands as a shock which influenced by social norms along the lines of traditional values amidst the temporary election of the Muslim brotherhood 2012-2013 (Gallup, 2019) which we argue it exerted an impact of health behaviours, and overweight. Weight gain can respond to psychological pain and psychological and emotional traumas insofar as food is one of the easiest means for humans to escape traumas. Consistently, table 3 presents the results of regressions with triple interaction terms of our independent variables with both a MENA dummy and a post-Arab-Spring dummy. These results illustrate that after the Arab Spring the negative association between female labour market participation and gender obesity differences have become even stronger. On the other hand, the association between female representation in national parliaments and the gender obesity gap has not been affected by the Arab spring.

Table 4.3 - Heterogeneity: Changes after the Arab Spring (fixed effects estimates)

	(1)	(2)	(3)		(4)	(5)	(6)
	Gender obesity gap				**Gender obesity gap**		
Female labour force participation	-0.0126	0.0276	0.0212	Percentage of female MPs in national parliaments	0.0255***	0.0238***	0.00378
	(0.0203)	(0.0188)	(0.0225)		(0.00927)	(0.00879)	(0.00865)
Female labour force participation x MENA	-0.233***	-0.235***	-0.201**	Percentage of female MPs in national parliaments x MENA	-0.0940**	-0.0990**	-0.0911**
	(0.0705)	(0.0768)	(0.100)		(0.0372)	(0.0434)	(0.0442)
Female labour force part. x MENA x post-Arab spring	-0.0101	-0.0954*	-0.0451	Percentage of female MPs x MENA x post-Arab spring	0.000708	0.00247	0.0196
	(0.0634)	(0.0558)	(0.0636)		(0.0162)	(0.0175)	(0.0166)
Post Arab spring (dummy)	-0.0381***	-0.0253**	-0.0312*	Post Arab spring (dummy)	-0.0468	-0.0865*	-0.0965*
	(0.0133)	(0.0125)	(0.0161)		(0.0485)	(0.0473)	(0.0579)

Note: The results in this table are bassed on separate regressions with either female labour force participation or percentage of female MPs as independent variables. Control variables across specifications are analogous to tables 1 and 2. Standard errors are clustered by country.

Table 4.4: Gender obesity gaps and the Gender Development Index (robustness check)

	(1)	(2)	(3)	(4)	(5)	(6)
		RE estimates			**FE estimates**	
Gender Development Index (GDI)	5.052	4.367	7.140*	4.400	3.472	4.735
	(3.852)	(3.205)	(3.984)	(3.559)	(2.567)	(4.248)
GDI * MENA	-14.52**	-8.042	-5.623	-14.7**	-9.21*	-7.17
	(6.812)	(5.530)	(6.535)	(6.840)	(5.376)	(7.208)
MENA	17.17***	14.74***	12.92**	-	-	-
	(6.070)	(4.990)	(5.634)			
GDP per capita		-0.000133***	-0.000142***		-0.000163***	-0.000168***
		(3.79e-05)	(4.28e-05)		(4.35e-05)	(5.04e-05)
(GDP per capita)2		1.21e-10	3.44e-10		2.64e-10	4.85e-10
		(2.45e-10)	(3.32e-10)		(2.70e-10)	(3.58e-10)
Size of services sector (% of GDP)			-0.0201			-0.0273**
			(0.0123)			(0.0125)
Unemployment rate			-0.0410**			-0.0515**
			(0.0204)			(0.0210)
Total Fertility Rate			-1.548***			-1.625***
			(0.318)			(0.428)
Linear and quadratic trend	x	x	x	x	x	x
Controls for demographic composition	x	x	x	x	x	x
Observations	1,498	1,472	1,190	1,498	1,472	1,190
Number of countries	159	157	148	159	157	148

Note: Cluster-robust standard errors (country-level) in parentheses. *** denotes statistical significance at the 10% level, ** significance at the 5% level, and * significance at the 1% level

6.4 Composite female empowerment index as independent variable

The proxies for female empowerment presented above mainly reflect economic and political empowerment but may neglect other dimensions. We therefore investigate whether our results are consistent if a composite woman empowerment index is used as a proxy. As discussed above, the main drawback of these composite measures is that they are not available for as many countries and/or time periods as our primary measures. Table 3.4 presents both fixed and random effect regressions, where empowerment is measured by the UNDP's Gender Development Index (GDI). This index is available in five-year intervals during our period of interest (1990-2016). The results of these regressions largely confirm our initial results, namely a negative correlation between the proxies for women empowerment and gender obesity gaps. It should be acknowledged that in the specification with the full set of control variables, this association loses its statistical significance. However, we interpret this as a consequence of the lower statistical power in these models with less than a third of the original sample size, rather than as an inconsistency with the original results.

7. Conclusion

This paper studies the effect of female labour market participation and the representation of women in national parliaments on gender obesity gaps, with a special focus on the MENA region. Drawing on fixed effect estimates, we document a robust negative effect of these variables on gender obesity gaps in the MENA region. This suggests that improving women's economic and political participation can also reduce gender-based inequities in nutritional outcomes.

It is important to note that the worldwide association between women empowerment and gender obesity differences is entirely driven by the MENA region. Once the MENA region is partialled out, the worldwide association between empowerment and obesity disappears. These results are robust to the inclusion of fixed effects, as well as controls for time-varying country characteristics. In particular, we document that a one percentage point increase in female labour market participation in the MENA region reduces gender gaps in obesity by 0.2 percentage points. Similarly, an increase in the share of female MPs by one percentage point in the region reduces gender gaps by 0.09pp.

While our results indicate that female labour market participation and representation in parliaments can reduce gender obesity gaps, it is important to note that this reduction can mainly be explained by an increase in obesity among men, rather than a decrease in obesity among women. This finding is largely unexpected and merits further investigation.

Based on our initial findings around gender obesity gaps, we outline a number of extensions. First, it would be important to establish whether the cross-country relationships which we have documented in this paper, also hold at the individual or household level. Secondly, based on our results, it would be important to test whether empowerment also influences gender gaps in other measures of health, such as diabetes, hypertension and other diseases which correlate with obesity. Similarly, it seems important to document to what extent political and economic empowerment result in differences in stress, and more specifically mental conditions. Third, additional evidence on causality based on microdata will also be essential for a better understanding of gender obesity gaps.

Our results can be interpreted as revealing that progress in the empowerment of women (proxied by labour market participation and the share of female MPs) can reduce gender-based health inequities in obesity. At the same time, it is important to note that the main driver of this effect has not been a decrease in obesity among women, but rather an increase among men. Overall, our findings illustrate that gender equality may give rise to returns beyond observable measures, such as income or employment, but also to less tangible measures such as health and nutrition.

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Appendix

<u>**Figure 4.A1: Male and female obesity by world region – 1975 vs. 2016**</u>

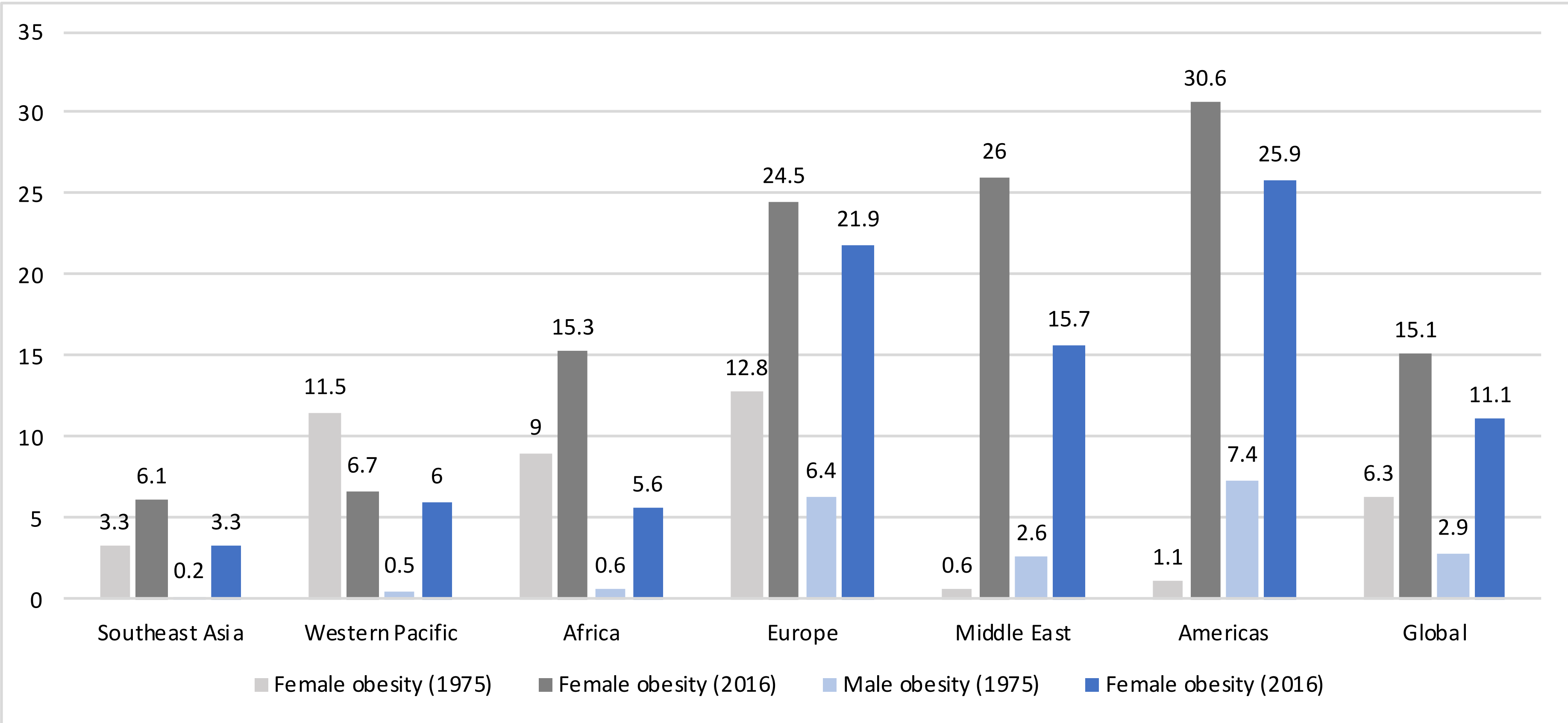

Table 4.A1: Descriptive statistics for treatment and control variables in the MENA region and the rest of the world (ROW)

	MENA 1990		MENA 2015		Change 1990-2015 MENA	ROW 1990		ROW 2015		Change 1990-2015 ROW
	Mean	SE	Mean	SE		Mean	SE	Mean	SE	
Female labour force participation (in percent)	21.20	6.46	26.89	15.51	5.69	50.64	1.04	52.86	0.78	2.21
Share of female MPs in national parliaments	3.29	1.28	12.78	6.85	9.49	10.55	0.40	21.35	0.53	10.79
GDP per capita	14,264	28,543,579	33,426	72,024,318	19,162	6,723	298,795	18,165	1,559,662	11,442
Size of services sector (in percent)	42.48	14.25	53.16	7.69	10.69	45.72	0.96	56.53	0.66	10.81
Unemployment rate	10.37	5.00	7.83	2.60	-2.54	7.35	0.29	8.44	0.28	1.08
Poverty rate	5.78	1.64	0.63	0.11	-5.14	27.53	10.00	8.50	2.21	-19.04
GINI index	39.13	2.51	34.70	5.84	-4.43	42.29	2.44	37.44	0.67	-4.84

Note: Own calculations based on data from the World Bank open database (2020).

Table 4.A2: Gender obesity gaps and female employment (Random effects estimates)

	(1)	(2)	(3)
	Gender obesity gap		
Female labour force participation	-0.0153	0.0205	0.0160
	(0.0192)	(0.0182)	(0.0210)
Female labour force participation x MENA	-0.29***	-0.271***	-0.217**
	(0.0677)	(0.0686)	(0.0970)
MENA	10.97***	14.48***	14.12***
	(2.305)	(2.785)	(3.441)
GDP per capita		- 0.0001***	- 0.000155***
		(4.65e-05)	(4.14e-05)
(GDP per capita)2		2.72e-10	4.74e-10
		(3.37e-10)	(3.31e-10)
Size of services sector (% of GDP)			-0.0119
			(0.0111)
Unemployment rate			-0.0607***
			(0.0196)
Total fertility rate			-1.654***
			(0.295)
Linear and quadratic trend	x	x	x
Controls for demographic composition	x	x	x
Observations	4,747	4,482	3,326
Number of countries	176	172	161

	(4)	(5)	(6)
	Gender obesity gap		
Percentage of female MPs in national parliaments	0.0256***	0.0240***	0.00398
	(0.00922)	(0.00877)	(0.00860)
Percentage of female MPs x MENA	-0.0930**	-0.0986**	-0.0855**
	(0.0396)	(0.0416)	(0.0418)
MENA	5.005***	7.544***	8.297***
	(0.880)	(1.200)	(1.155)
GDP per capita		-9.42e-5*	-0.00015***
		(5.15e-05)	(4.45e-05)
(GDP per capita)2		-0	4.70e-10
		(4.02e-10)	(3.53e-10)
Size of services sector (% of GDP)			-0.0106
			(0.0112)
Unemployment rate			-0.0618***
			(0.0197)
Total fertility rate			-1.689***
			(0.283)
Linear and quadratic trend	x	x	x
Controls for demographic composition	x	x	x
Observations	4,747	4,482	3,326
Number of countries	176	172	161

Note: Cluster-robust standard errors (country-level) in parentheses. *** denotes statistical significance at the 10% level, ** significance at the 5% level, and * significance at the 1% level

5. Does social learning contribute to the adoption of healthy nutrition behaviours? - Evidence from rural Mozambique[27]

Mario Gyori[28]

[27] Funding for this study has been provided by the United Nations World Food Programme (Mozambique country office) and the United Nations Development Programme (International Policy Centre for Inclusive Growth)

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Abstract: What determines the adoption of preventive health behaviours? Social learning has been a key driver for behaviour change and technology adoption in the fields of agriculture and finance in developing countries. This paper investigates whether social learning also influences adoption decisions regarding cheap and cost-effective health prevention technologies. In particular, the study assesses the impact of a social and behaviour change intervention in Mozambique's Manica province on a.) young mothers who participated in the intervention, b.) mothers from neighbouring households which did not participate in the intervention but were exposed to social network effects, and c.) a control group of mothers from neighbouring villages which were not covered by the programme. The data for the study was collected through a dedicated survey in January-March 2017, covering a representative sample of 1,680 mothers from the three groups. The empirical analysis draws on an inverse-probability-weighting approach to measure the intervention's impact on health knowledge and the uptake of key health technologies. The results confirm that in treated villages, social learning has contributed to the uptake of preventive health technologies, such as latrine usage, handwashing with soap, and exclusive breastfeeding up to the age of 6 months. However, treatment effects are consistently lower in the social learning group as compared to the directly exposed group, suggesting that updating processes are not complete. The results suggest that social learning effects should be taken into account in both the design and the cost-benefit assessments of behaviour change interventions.
Keywords: social learning, malnutrition, network externalities, health behaviours, health technologies, Mozambique

1. Introduction

Social learning is a crucial determinant for the adoption of new technologies in agriculture (see e.g. Bandiera and Rasul 2006, Conley and Udry 2010), and microfinance (Banerjee et al. 2013). However, apart from the landmark paper by Miguel&Kremer (2003) on deworming, there is few evidence whether social learning also determines the uptake of simple and live-saving health technologies. A number of authors have pointed out that preventive health technologies like mosquito bed nets, Oral Rehydration Solution (ORS), or exclusive breastfeeding for infants younger than 6 months are underused in many contexts (Banerjee & Duflo 2012, Casabonne & Kenny 2012). In the context of this study in rural Mozambique, only 33 percent of children under 5 sleep under an insecticide-treated bed net and only 50 percent of children who experience diarrhoea are treated with ORS according to the latest DHS survey (2011). This study investigates whether intra-communal social learning can improve health and-nutrition related behaviours among mothers of young children, particularly with regards to malaria prevention, WASH, child feeding and maternal health.

Often malnutrition, infectious diseases and related cases of death could be avoided by using these cheap (often free) and widely available health technologies. In Mozambique, the under-5 mortality rates amounts to 72 per 1,000 life births and 43 percent of the children under 5 are affected by chronic undernutrition (UNICEF 2019). Undernutrition, caused by low caloric intake, lack of dietary diversity, and/or infectious diseases in turn causes approximately 45 percent of all child deaths in sub-Sahara Africa (WHO 2019).

The reasons for the seemingly paradoxical low adoption rates of cheap health technologies in these contexts have not been fully understood yet. Possible explanations include an incomplete knowledge about the costs and benefits of these technologies, signalling effects where low prices suggest a low effectiveness to consumers, traditional beliefs that are not underpinned by scientific evidence, as well as psychological factors, such as time-inconsistent preferences and present bias (Banerjee and Duflo 2012). Neoclassical economics may only provide a partial understanding of the related explanations and behavioural insights may need to be taken into account. This paper will specifically focus on social learning processes and how they can improve the adoption of cheap health technologies by improving knowledge and creating social incentives for technology adoption.

Although there is a growing body of literature on Social and Behaviour Change Communication (SBCC) campaigns in the fields of health and nutrition, most of these studies have focused on the overall impact of these programmes and not disentangled the respective importance of changes to the individual knowledge and the subsequent peer effects at the community-level. The latter effects are the main focus of this paper. SBCC interventions usually use either mass-media broadcasting or community-based strategies in order to disseminate information about the benefits of one or several health technologies and/or behaviours. Evaluations of community-based interventions have shown their potential in e.g. promoting exclusive breastfeeding, improving handwashing practices and reducing diarrhoea (see e.g. Luby et al. 2018, Menon et al. 2016). The evidence on mass-media interventions for child health has been less conclusive and several studies were unable to detect any impact of the evaluated campaigns (Naugle & Hornik 2014, Head et al. 2015)

This article expands on the existing literature by investigating whether there is any evidence for social learning / spillover effects to take place in the context of an SBCC intervention. Social learning models underline that individual agents may have incentives to learn from their neighbours in situations with uncertain payoffs about different courses of action (e.g. using a mosquito net or not). One would therefore expect that a SBCC intervention does not only positively affect households which were directly exposed to such an intervention, but that there are also spillover effects on untreated households in municipalities where the treatment is offered.

However, in spite of the theoretical predictions of social learning models and the encouraging empirical evidence from the fields of agriculture and microfincance, there may be additional obstacles for social learning to materialise in health and nutrition. First of all, the health and nutrition practices of one’s network members are not as easily observable as e.g. crop adoption decisions in the field of agriculture. Social learning for health and nutrition therefore may involve higher communication costs. Secondly, health and nutrition practises may be considered more personal and private, making people more reluctant to openly share their views and opinions with their neighbours. Third, unlike in the case of a new agricultural crop, people may presume that they *ought to* know about good health and nutrition practices for their children. Seeking information would therefore imply revealing one's own ignorance about a certain topic. Avoiding stigma and shame may therefore be another barrier towards information seeking (see Chandrasekhar et al. 2017). Hence, it is important to gather empirical evidence on the presence of social learning effects in the fields of health and nutrition. Quantifying social learning effects can also help to improve cost-effectiveness estimates on BCI interventions.

As this paper draws on concepts from both economics and public health, it is important to define some key terms from both fields and put them in relation to each other. The term "social learning" is widely used in the economics literature and can be defined as learning "through observation of other people's behaviours" (Bandura 1971: p.2) or more generally "aggregating information from others" (Chandrasekhar et al. 2015: p.1). It is therefore a more narrow concept than "spillover effects" which also encompass effects which are unrelated to cognitive processes, e.g. a lower risk of contracting an infectious disease due to a lower disease prevalence among other community members. The term should neither be confounded with "Social and Behaviour Change Communication" (SBCC), which is a public health concept referring to the "strategic use of communication approaches to promote changes in knowledge, attitudes, norms, beliefs and behaviors" (USAID 2021). SBCC campaigns usually target different barriers to social change, among them individual factors (knowledge, skills), but also community-level factors (e.g. peer influence). Investigating on social learning within an SBCC intervention therefore may help to disentangle the relative importance of different channels through which these programmes achieve their impact.

This study focuses on social learning effects in the context of a SBCC campaign implemented by the United Nations World Food Programme in rural areas of Mozambique's Manica province in 2017/2018. The SBCC project aimed at improving the health and nutrition of children during the first 1000 days of their life (from conception up to their second birthday) by strengthening knowledge and improving practices about key health and nutrition topics. The four priority areas of the intervention were:

- Malaria (prevention & treatment)
- Water, Sanitation and Hygiene (WASH)

- Infant and Young Child Feeding (IYCF)
- Maternal care and nutrition

The intervention drew on 90 community-level health committees (HCs) which were trained by WFP programme staff and equipped with training material on the four above-mentioned topics. Afterwards the HCs were expected to organize training sessions for pregnant women, mothers with children aged 0-2, as well as their husbands. The health committees were instructed to approach *comunidades* (i.e. small rural settlements, literal translation "communities", usually consisting of 20-100 households) in their geographical proximity and invite all women who are either pregnant or had a child aged 0-2 to participate in the trainings. Details on the timeline of the intervention and its contents can be found in tables A1 and A2 in the appendix.

The assignment of treatment was not randomised, but based on logistical considerations (limitation of the intervention to 5 out of 9 districts in Manica province, so that 5 district capitals could be used as hubs for the intervention), as well as previously existing contacts to local health authorities of the WFP and its local partners (governmental and non-governmental institutions operating in Manica province).

Given the lack of randomisation, this study uses two strategies to estimate the intervention's impact. First, the sampling design drew on census data so that comparison areas with very similar characteristics than the (non-randomly selected) treatment areas could be included in the survey. Secondly, propensity-score-based methods are used to balance treated and comparison households in their observable characteristics. The particular method chosen is inverse probability weighting with regression adjustment, which unlike most other propensity score techniques allows for the comparison of more than two groups at the same time: (1.) Treated households, 2.) Untreated households living in treated areas, 3.) Untreated households living in untreated areas). It is important to acknowledge that the households in group 2 do live in municipalities where the trainings were offered, but for some reason did not participate in the trainings themselves. They are thus non-compliers. Qualitative evidence from the field suggests that in most cases this is due to absence from the village, on the day(s) on which the trainings were conducted (e.g. due to agricultural work). In some cases, these households may also have actively opted against participating in the trainings. Our control strategy allows us to adjust for observable differences between treated households and “spillover households”, but cannot account for any potential unobservable differences.

Three main results can be drawn based on this analysis. First the health committees were effective in improving health/nutrition-related knowledge and practices among the women who participated in their trainings. Second, women who did not participate in these trainings, but who live in treated areas, also improved knowledge and practices about key indicators – this can be interpreted as evidence of social learning effects. Third, treatment effects are consistently larger for the group of women which were directly exposed to the intervention than for the indirectly exposed group. This suggests that not all women in the indirectly exposed group benefit from social learning and/or that there is information loss.

The paper is structured as follows: section 2 reviews both the theoretical and empirical literature related to social learning and behaviour change interventions, with a particular focus on developing countries. Section 3 describes the data which is used as a basis for this paper, as well as the sampling strategy and data collection process for the household survey that has been conducted as a basis for this study. Section 4 presents the research methodology, section 5 discusses the results and section 6 concludes.

2. Literature

2.1. Modelling Social Learning

Interventions which aim at inducing social learning and behaviour change need to accomplish two crucial steps (Banerjee et al. 2019):

1. **Information dissemination**: they need to deliver the relevant information (e.g. the benefits of using a mosquito bednet) to their target audience
2. **Information aggregation**: they also need to ensure that the target audience actually updates their beliefs and behaviours based on the new information (e.g. to internalise the benefits of mosquito nets and use them more frequently)

Information dissemination depends on the costs and expected benefits of seeking information for an individual (ibid.). An individual will seek information (e.g. attend a meeting organised by health committees) if she expects that the benefit of seeking information is higher than the related monetary and non-monetary costs, including opportunity costs. Interventions like the SBCC project in Mozambique can be expected to increase the supply of information, thereby lowering its costs and ultimately increase the number of people who seek information. Moreover, recent evidence suggests that information campaigns can also lead to demand side responses. Banerjee et al. (2018) show for example that depending on their design, information campaigns can decrease barriers related to information seeking, in particular the stigma and shame an individual suffers by revealing his ignorance about a certain issue. If certain individuals in a community are known to have received a piece of information which was not accessible to others, e.g. health committee members, this can reduce the stigma and shame of approaching these individuals.

Information aggregation processes are most commonly modelled through Bayesian or DeGroot learning models (Banerjee et al. 2019). These models provide a theoretical basis to understand why individuals do or do not change their behaviours based on new information. Bayesian learning models assume that individuals form beliefs about the right choice of behaviour in each time period t (i.e. the behaviour yielding the highest life-cycle payoffs) based on a personal prior and a number of neighbourhood signals received from other agents. In its simplest form, the Bayesian updating model can be written as

$$\pi_{it} = w_{itp}\, p_{i,t-1} + \sum_{n=1}^{m} w_{itn}\, s_{i,t-1,n}$$

where an individual i's guess about the correct behaviour in period t, π_{it}, is a function of the indvidual's prior beliefs, $p_{i,t-1}$, and a weighted average of neighbourhood signals from the previous period $s_{i,t-1,n}$. Neighbourhood signals are independent and identically distributed in Bayesian learning models, and individuals apply weights w_{itn} to all signals, reflecting the precision/noisiness they attribute to each of them (see e.g. Alatas et al. 2016). Bayesian agents will be aware if they receive one and the same signal from several sources and will not double-count signals. Under these assumptions, it has been shown that social learning will occur asymptotically, leading to a situation where all agents converge in their beliefs towards the correct decision (Acemoglu et al. 2011, Gale & Kariv 2003).

Another approach to modelling social learning processes are DeGroot learning models. In these models, agents base their decision about the optimal behaviour on a simple average of the opinions of all other agents in their network, and their own opinion. This implies that agents may double-count the same signal if received from different neighbours. Moreover, individuals only receive a private signal once, at time t=0 (see Chandrasekhar, Larreguy & Xandri 2018). Even in these models behaviours will asymptotically converge towards the correct decision, yet convergence is much slower than in Bayesian learning models. Under certain conditions, agents may even be trapped in wrong beliefs for an infinite number of time periods (Chandrasekhar et al. 2015). Indeed, empirical evidence has shown that De Groote models describe real-world social learning processes more adequately than the Bayesian learning models which presuppose much more sophisticated updating processes (ibid. ; Chandrasekhar et al. 2018).

Banerjee et al. (2019) have developed a generalised version of this model which may be particularly useful for this study. In their *Generalised DeGroot Model,* (GDG) a number of agents may be completely uninformed at the beginning, i.e. not have received any priors. In this case, agents will only average across the beliefs of all *informed* neighbours in order to reach an own conclusion about the state of the world. As long as no one in the agent's network is informed, the agent would hold an empty belief set $\emptyset$. Banerjee et al. express the updating process as

$$\pi_{it} = \begin{cases} \emptyset & if\ J_i^t = \emptyset \\ \frac{\sum_j^J s_{i,t-1,j}}{J_i^t} & if\ J_i^t \neq \emptyset \end{cases}$$

where the set of informed neighbours of individual i at time t is denoted as J_i^t.

What are the predictions of these models with regards to the SBCC intervention in Mozambique? Under Bayesian learning, the information disseminated by health committees would influence the subsequent updating processes in the social networks exposed to the intervention. If health committee members are considered a well-informed and credible source (i.e. the "noisiness" of the transmitted signals is deemed low by recipients), the target audience would attribute a high weight to the new information and the intervention would help the treated communities to converge to the correct behaviours more quickly. Under the GDG model, the success of the intervention would depend on the network structure.

As the updating in the GDG model only involves a simple averaging of others' opinions, the relative success of the intervention would be dependent on the number of exposed individuals, as opposed to those individuals who hold contrary beliefs. The social networks would only converge towards the correct belief if the correctly informed individuals outnumber the incorrectly informed individuals when t grows towards infinity.

2.2. Related Literature

This study contributes to two strains of empirical literature: 1.) the literature around social learning about new technologies and 2.) the literature about the effectiveness of community-level Social and Behaviour Change Communication interventions in the fields of health and nutrition.

2.2.1 Social learning and technology adoption

Much of the empirical literature on social learning is related to the introduction of new technologies in the fields of agriculture and finance. Bandiera and Rasul (2006) have shown that social networks are a crucial determinant of the diffusion of a hitherto unknown crop (sunflowers) in central Mozambique. Moreover, they show that more informed farmers are less sensitive to the adoption decisions of others than less informed farmers. Conley and Udry (2010) show that individual decisions about fertiliser usage among farmers using a new crop (pineapple) in Ghana are driven by the observed strategies of others in a farmer's network as well as the respective payoffs which others receive from a particular strategy. Banerjee et al. (2013) show that social networks have also played a crucial role in the diffusion of microfinance in India. They find that both microfinance participants and non-participants have informed others about the availability of microfinance, with participants being more likely to inform others.

Chandrasekhar, Golub and Yang (2017) provide more detailed insights on who in a social network is likely to engage in social learning and can benefit from it through a lab experiment in the field in India. They show that the shame and stigma caused by revealing one's own ignorance about a topic may be an important barrier towards seeking information, especially for low-skill individuals. This implies that those individuals who would be most in need of information may not seek it, leading to what the authors call a "signaling poverty trap". Creating a more private learning environment may therefore be one solution to ensure that low-skill individuals can benefit from social learning.

There are only very few studies on social learning for health and nutrition that were conducted in developing countries. Miguel and Kremer (2003) analyse how information about deworming drugs through one's social network affects individual uptake. They reach the unexpected conclusion that the larger the number of adopters in one's network, the smaller the individual probability to take up the drug. The authors interpret this as an indication for actual social learning, rather than simple imitation, as individuals learn that the private benefits of deworming are not high enough to justify a shift from traditional behaviours and beliefs (in the study setting in Kenya worms were considered important for digestion).

2.2.2. Social and Behaviour Change Communication for health and nutrition

Secondly, there is a growing body of literature on community-based behaviour change interventions, often referred to as Social and Behaviour Change Communication (SBCC) programmes, which are also implemented with the aim of improving health and nutrition practices. In many cases, these programmes do not only work towards changes at the individual level, but aim at inducing peer effects or changes in community-level norms or attitudes.

This is reflected in a number of theoretical SBCC models, which often serve as a basis for the design of SBCC interventions. The behaviour change wheel (Michie, van Stralen and West 2011) proposes that individual behaviour change requires three conditions: capability (an individual's skills), opportunity (the context of an individual's action), and motivation (brain processes that trigger a certain behaviour). These three factors at the heart of the behaviour change wheel are commonly referred to as the COM-B system.

It is important to acknowledge that "opportunity" in the COM-B model is defined by an individual's social environment and their interaction with other community members. Altering the social environment may thus be an important strategy in order to change individual behaviour. This is why an SBCC intervention may, consciously or unconsciously, also induce social learning. Some studies have also made an explicit link between social learning and SBCC interventions (Briscoe & Aboud 2012). This theoretical argument is also reflected in handbooks/toolkits for SBCC practitioners and can thus be expected to inform the design of such programmes in practice (see e.g. USAID 2021, Health Communication Capacity Collaborative 2021). In line with the theoretical models, an empirical review on the most common methods for SBCC interventions identifies “social support” as a commonly employed strategy (Briscoe & Aboud 2012).

However, although behaviour change models like COM-B do underline the importance of social learning in behaviour change processes, most impact evaluations of SBCC programmes and other behaviour change inteventions, have not attempted to “partial out” the effect of social learning, but rather assessed their aggregate effects.

Menon et al. (2020) summarise the evidence from different randomised controlled trials evaluating the SBCC programmes within the “Alive and Thrive” initiative, which specifically focuses on improving nutritional outcomes among infants and young children. They find that the SBCC initiatives led to an improvement in complementary feeding in all studied countries (Bangladesh, Vietnam, and Ethiopia), and in breastfeeding in Bangladesh and Vietnam. The programme entailed interpersonal counselling, mass media and community mobilization. Results from RCTs reported in Menon et al. (2016) show that the programme increased self-reported exclusive breastfeeding rates in the 24 hours before the interview by 36.2 percentage points in Bangladesh, and 27.9 percentage points in Vietnam. In Ethiopia, an evaluation of the same intervention (Kim et al. 2019), suggested improvements in children’s dietary diversity and a reduction in stunting, but no significant changes regarding breastfeeding.

Luby et al. (2018) and Null et al. (2018) describe randomised controlled trials evaluating an intervention to reduce diarrhoea among children through intensive counselling about handwashing, sanitation, and/or appropriate child nutrition to mothers by community promoters (individuals with secondary education who live in walking distance to the intervention areas). In Bangladesh, this intervention was effective in reducing the diarrhoea prevalence among children by 1.7 to 2.3 percentage points, depending on the treatment arm, as compared to a baseline prevalence of 5.7 percent (Luby et al. 2018). Moreover, the intervention also leads to improvements in height. Length-for-age z-scores increased by 0.13-0.25 points for two of the treatments (nutrition counselling & combined WASH+nutrition counselling), compared to a baseline value of -1.79. The very same intervention was also implemented in Kenya, where it did not lead to any reductions in diarrhoea prevalence, but also improved length-for-age z-scores by 0.13 to 0.16 points, as compared to a baseline value of -1.54 (Null et al. 2018). This result illustrates that the effectiveness of a certain intervention can vary substantially depending on its implementation context. Luby et al. (2005) studied an initiative to promote handwashing in Pakistan. The intervention included the distribution of free soap and weekly visits by fieldworkers to encourage handwashing. The authors find a 50% reduction in the prevalence of pneumonia and a 53% reduction in diarrhoea (from approximately 4.06 to 1.93 episodes of diarrhoea per 100 person-weeks). However, when households were revisited two years after the end of the intervention, soap purchases and diarrhoea prevalence in the treatment group were not significantly different from the control group anymore (Luby et al. 2009).

In general, Menon et al. (2020) point out that similar interventions may differ in their impact, depending on the context of implementation, with the reach of an intervention and the chosen platforms of delivery being major determinants of a programme's effectiveness. However, previous studies on the pathways to impact of SBCC evaluations have used qualitative methods (Avula et al. 2013, Henry 2015), and if using quantitative methods, have not attempted to quantify the importance of social network effects (Kim et al. 2018). Quantifying social network effects in the context of SBCC interventions is mainly important for two reasons: First, it is important to know if SBCC interventions also reach non-compliers (i.e. those who live in treated areas, but for some reason are not directly exposed to the intervention), and to what extent the intervention is effective for them. Secondly, gaining an understanding of the importance of direct exposure vs. indirect exposure to SBCC interventions may be important to inform programme design in the future, e.g. to decide whether SBCC programmes should more actively attempt to induce social effects.

Probably, the study which is most closely related to this paper is Hoddinot et al. (2017) who show that a behaviour change intervention in Bangladesh aiming to improve child nutrition has created spillovers to non-participants. They find that non-participants who are neighbours of participants increased their knowledge on a standard set of IYCF questions by 0.17 standard deviations, were 13.8 percentage points more likely to meet the WHO's guidelines for minimum dietary diversity, and children aged 0-6 months were 7.1 percentage points less likely to ever have consumed water-based liquids. However, in the Hoddinot et al. study, non-participants simultaneously received a food or cash transfer, which may alter the impacts as compared to a pure social learning intervention.

2.3. Contribution of this study

A number of conclusions can be drawn from this literature review. First of all, there is substantial evidence for the existence of intra-communal social learning processes in developing countries. Most of this evidence comes from the fields of agriculture and finance. Secondly, although there is a large literature on behaviour change interventions in relation to health and nutrition, this literature review has only found one study providing evidence on the spillover /social learning effects of such interventions to non-participants in Bangladesh (Hoddinot et al. 2017). Third, the available literature suggests that health behaviour change interventions so far have had lower treatment effects in Africa than in Asia or Latin America. It is therefore important to further explore under which circumstances behaviour change interventions can be successful in Africa and to what extent they can trigger social learning processes.

This paper makes two main contributions to the existing literature. First, it explores to what extent there are intra-communal social learning processes in the fields of health and nutrition in the context of a health behaviour change campaign. Given that most of the existing evidence on social learning from developing countries is from the fields of agriculture and finance, it is important to test whether the existing knowledge also applies to health and nutrition. The question is also very policy-relevant, as the existence of spillovers would substantially increase the cost-efficiency of community-based health interventions, making them a more sensible policy option in many contexts.

Secondly, it adds to the literature on the effectiveness of SBCC interventions. Much of the encouraging literature on behaviour change interventions cited above, is based on interventions implemented in Latin America or Asia. However, behaviour change interventions have often performed differently in Africa as compared to other world regions and this study may further contribute to the exploration of context-specific policies. Likewise, the external validity of this study is most likely limited to rural areas in Africa and programme impacts might differ in urban areas, other continents and possibly even different countries.

3. Data

The data for this study has been collected through a dedicated household survey with 1,661 households in different districts of Manica province where the SBCC project was implemented. The survey took place approximately one year after the start of the project, between January and March 2018.

3.1 Sampling

A two-stage random sampling process was performed treating the Mozambican localities[29] as Primary Sampling Units (PSU) and the enumeration areas (EAs)[30] defined by Mozambique's National Institute of Statistics (INE) as Secondary Sampling Units (SSU). Given that treatment assignment for the SBCC intervention was not randomised, a major objective of the sampling design was to draw a sample of comparable households from areas that were exposed to the intervention and similar areas that were not exposed to the intervention and could therefore be used as a comparison area. Pre-intervention census data[31] was used in order to identify 36 enumeration areas spread across 9 localities[32] with similar pre-intervention characteristics.

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29 A locality is the smallest administrative unit in Mozambique. The contries' administrative divisions are (in descending order): province (*província*), district (*distrito*), administrative post (*posto administrativo*), localities (*localidade*).

30 Enumeration areas comprise approximately 80-100 households and are defined by the National Institute of Statistics for the organisation of the census. In rural areas they often correspond to small villages / settlements and/o are defined using natural geographical boundaries, like rivers, roads, forests, etc. However, enumeration areas are not administrative divisions.

31 The latest available census data at the time of the sampling was the 2007 census. The following variables collected during the census were used for the selection of sampling areas: Share living in households with poor structure, Share living in households that own a radio, Share living in households that own a computer, Share living in households that own a car, Share of recent mothers (women who had children within 12 months before the research) with low education level, Share of illiterate recent mothers, Share of recent mothers that are employed.

32 During the fieldwork, 5 of the 36 selected enumeration areas proved inaccessible for the enumerators: two EAs were affected by an armed conflict and considered unsafe by local authorities, one EA was part of a community which had completely migrated to another area due to lack of water, one EA could not be properly localised by the enumerators due to accuracy issues with the EA's official map, and one EA had become

All households living in the selected EAs who met the eligibility criteria (having at least one woman who is either pregnant or the mother of children younger than 3) were invited to participate in the household survey. All 2,454 households in these areas were visited during a short screening survey. If there was a child under 3, the child's mother (or main female caretaker) would be invited to participate in the survey interview. In households with more than one eligible woman, enumerators would randomly select one of the eligible women on the spot. In total, this yielded a sample of 1,678 women. The sample can be considered as representative for the target population of the SBCC project in Manica province.

3.2. Survey questionnaire

The core of the survey consisted of approximately 50 questions on knowledge, attitudes, risk perceptions and practices covering the four priority areas of the SBCC intervention in Manica (malaria, WASH, infant nutrition, maternal care/nutrition), i.e 10-14 questions per topic. Knowledge questions included for example open-ended questions on the causes of malaria and diarrhoea, as well as the recommended duration of exclusive breastfeeding. Practices questions covered e.g. self-reported mosquito bed net usage, observed availability of soap to wash hands, as well as a detailed questionnaire on the youngest infant's intake of foods and liquids in the 24 hours before the interview.

Based on these questions, a number of indexes were constructed as aggregate measures on child health and nutrition practices. The overall knowledge index covers 4 key knowledge questions for each of the 4 topic areas (16 questions in total), and the practices is based 4 questions on health and nutrition practices per topic, excluding maternal health due to the short follow-up period between trainings for this topic and the household survey (12 questions in total). Moreover, knowledge and practices indexes were also created for each single topic area, based on the very same questions used for the overall indexes. A respondent would earn index points for a certain question, when she responds to a question correctly, i.e. when the answer is in line with recommended practises. Each question is weighted equally

inaccessible after a bridge collapsed due to heavy rainfalls. All these EAs have been replaced by another randomly selected EA in the same locality.

when constructing the index, and all indexes are brought to a scale from 0-100 to facilitate the interpretation of the results.

The survey also included approximately 50 questions on demographic and socioeconomic characteristics of the household, as well as its exposure to the health committee trainings. This information was crucial in order to match treated and comparison households to each other (see section 4). The duration of most interviews ranged between 60 and 90 minutes.

3.3. Descriptive Statistics

Table 1 describes the socioeconomic situation among the women in our sample. It illustrates that education levels are generally low, with only 42.6 percent of the sample being literate and 26.4 percent speaking Portuguese, the official language in Mozambique (the mother tongue of 94 percent of the interviewed women are local languages such as Tonga, Ndau or Shona). 93.9 percent of the respondents are married, and 38.4 percent live in polygamous relationships. For 70.8 percent, agriculture is the main source of income, and the great majority of households do not own basic furniture, such as a table, bed, sofa or lamp. Most of the houses are built out of relatively fragile materials, such as mud or mud bricks, with roofs made of palm leaves or other plant-based material.

Table 5.1: Socioeconomic characteristics – SBCC impact evaluation sample

Variable	Mean	Standard error	Variable	Mean	Standard error
Literacy	0.426	0.012	Time to closest road (minutes)	46.89	1.77
Secondary Education	0.266	0.011	Time to closest hospital (minutes)	115	2.16
Speaks Portuguese	0.264	0.011	Walking = main means of transportation	0.811	0.01
Partner literacy	0.776	0.01	**Asset ownership (household level)**		
Lives with partner	0.88	0.008	Motorcylce	0.12	0.008
Married at time of interview	0.939	0.006	Table	0.46	0.012
Polygamous household	0.384	0.012	Chair	0.597	0.012
Age	26.85	7.04	Bed	0.24	0.01
Number of children	3.44	0.05	Sofa	0.033	0.004
Agriculture is main source of income	0.708	0.011	Lamp	0.104	0.007
Cattle ownership	0.403	0.012	Mobile phone	0.275	0.011
Improved walls (bricks or similar)	0.213	0.01	Computer	0.008	0.002
Improved floor (concrete or similar)	0.177	0.009	Radio access	0.58	0.012

Source: own elboration based on SBCC impact evaluation survey

3.4. Definition of treatment and comparison areas.

In our analysis, an enumeration area is considered as treated if at least 20% of the households in the area reported to have participated in a health committee training. We expect that in all EAs, there are some HHs which are wrongly recorded as having been trained by a health committee, e.g. because of misunderstandings the question, or data entry issues. Therefore, it is unreasonable to categorise an area with only one trained household as a treatment area.

The 20-percent-threshold is motivated by an analysis of the distribution of households in each EA which self-reported to have participated in a health committee training (see figure 1). Indeed, the distribution shows a peak at 0, i.e. for areas where no one reported to be trained, and other peaks around 0.07, 0.1 and 0.15, i.e. areas where very few community members reported to have been trained. However, as health committees had been instructed to invite all eligible households in a certain community to participate in trainings, it is reasonable to assume that these enumeration areas were not in the catchment area of any health committee. Sensitivity analyses show that the results are unaffected by the choice of this threshold. Based on this definition, the sample can be subdivided into three groups which are presented in table 2 and represent the basis for our impact estimates presented in section 4.

Figure 5.1: Distribution of the share of households trained by health committees across enumeration areas

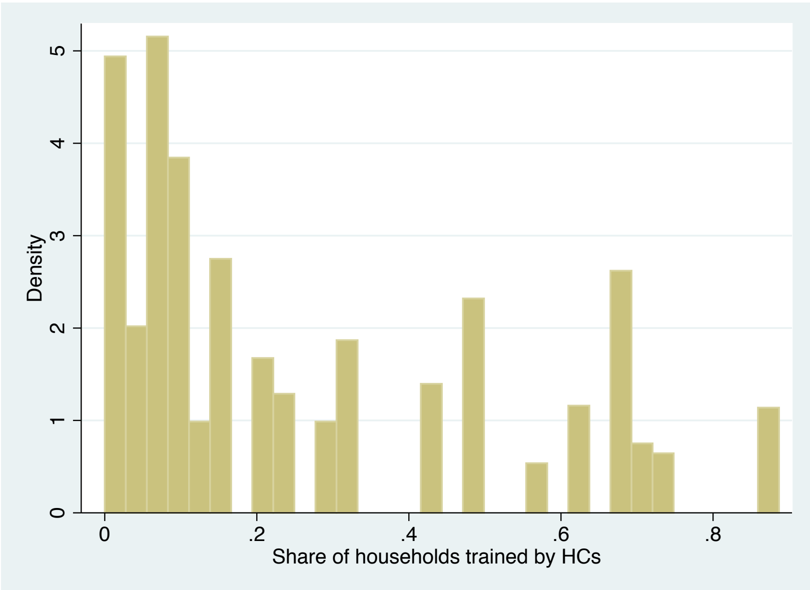


Table 5.2: Distribution of SBCC treatment intensities - based on actual exposure

	Number of observations	Percentage
Group 1: Treatment area & treated by HC	372	22.2
Group 2: Treatment area & not treated by HC	389	23.2
Group 3: Comparison (no treatment)	917	54.65
Total	1,678	100

It should be noted that in a number of enumeration areas, respondents reported to have been trained by health committees who were affiliated to a local NGO the *Fundação para o Desenvolvimento da Comunidade* (FDC), but not by WFP-led health committees. An analysis of the NGO's training material revealed that the topics covered were remarkably similar to the WFP's curriculum as outlined in table A2. This is most likely due to the fact that both curricula were developed in close cooperation with the Mozambican Ministry of Health, which also needs to approve all training materials before they are used in the field. Areas which were trained by FDC-sponsored health committees are therefore also considered part of the treatment group. This implies that the results in this paper do not reflect the treatment effects of the specific WFP intervention, but rather of health committee trainings and subsequent spillover / social learning effects in general.

3.5 Ethical review

The household survey was reviewed by the *Comité Nacional de Bioética para a Saúde (CNBS)*, which is the official review board of the Government of Mozambique in charge of approving studies involving human subjects on Mozambican territory. The CNBS has approved the household survey on the 10th of October 2017.

4. Methods

As the treatment for the SBCC intervention was not randomly assigned, this study uses inverse-probability-weighted (IPW) regressions in order to balance the observable characteristics between treatment and comparison groups and subsequently estimate the treatment effects. IPW estimators have been proposed by Hirano and Imbens (2001), Hirano et al. (2003) or Imbens and Wooldridge (2009). Unlike standard propensity matching techniques (e.g. nearest neighbour matching, radius matching) which only allow simple treatment-control comparisons, IPW allows for the comparison of more than two groups and is therefore particularly attractive for this study.

In an IPW setting, the following steps need to be implemented in order to estimate the treatment effects: First propensity scores are estimated for all treatment levels simultaneously, using a multinomial logit model. Secondly, an area of common support is determined, defined by the area in which the density functions of the propensity scores for all three treatments is non-zero. Third, weights are calculated for the subset of observations which are on common support. These weights correspond to the inverse of the predicted probability of being in a certain treatment group. Fourth, balancing checks are performed in order to ensure that the groups do not differ in any observable characteristics. Fifth, OLS regressions weighted by the inverse of the probability of being treated are estimated in order to determine the treatment effects for the different groups. In case the balancing checks in step 4 revealed that balancing could not be achieved for a subset of variables, these variables can be included as controls in the IPW regressions (inverse-probability-weighted regression adjustment).

Table presents the results of the multinomial logit regressions which were used to predict the propensity scores for comparison 1 and 2 respectively. In order to select the variables that are included in the model, the guidance provided by Caliendo & Kopeinig (2005) has been followed. Starting with a parsimonious model, additional covariates were included one-by-one and retained if they were statistically significant in predicting at least one of the treatments at 5% significance level. Subsequently squares and interaction terms between variables were also added to the model which improved its fit and balancing (see below).

The regressions show that distance to the closest road is positively associated with all treatments, suggesting that health committees were successful in targeting the more remote households (distance to closest hospital is negatively associated to treatment, but the coefficients are much smaller). Moreover, households whose main source of income is agriculture are more likely to be treated, while cattle ownership is negatively associated with treatment. Moreover, having some education, as compared to no education, is negatively associated with treatment. All this would be in line with a pro-poor assignment of treatment where farming families without cattle and less educated individuals are more likely to participate. On the other hand, asset ownership is in most cases positively associated with treatment.

Table 5.3: Multinomial logit estimates on the determinants of direct treatment by health committees vs. indirect exposure

	(1)	(2)		(1)	(2)
	Treated	Spillover		Treated	Spillover
Distance to closest hospital (minutes walking)	-0.00390	-0.00493*	HH owns chair	0.605***	0.261
	(0.00295)	(0.00256)		(0.185)	(0.176)
Distance to closest road available year-round (minutes walking)	0.0258***	0.0150***	HH owns bed	-0.530	-0.0209
	(0.00438)	(0.00459)		(0.327)	(0.298)
Literacy	-0.00142	0.128	HH owns sofa	0.677	-0.182
	(0.223)	(0.199)		(0.445)	(0.486)
Speaks Portuguese	-0.296	-0.417	HH owns lamp	-1.885***	-1.336***
	(0.316)	(0.297)		(0.403)	(0.336)
Number of children	-0.0201	-0.126***	HH owns phone	1.244***	0.773***
	(0.0360)	(0.0361)		(0.165)	(0.161)
Poligamy	1.047***	0.982***	HH has radio access	0.760***	0.721***
	(0.270)	(0.248)		(0.280)	(0.254)
Cattle Ownership	-0.517***	-1.220***	(Distance to closest road available year-round)^2	-2.17e-05***	-1.77e-07
	(0.164)	(0.164)		(8.33e-06)	(7.96e-06)
Walking is main means of transport	-0.327	-0.703**	Distance to hospital x poligamy	-0.00394**	-0.000852
	(0.335)	(0.285)		(0.00196)	(0.00185)
Agriculture is main source of income	0.600**	0.779***	Distance to hospital x Walking is main means of transport	0.00565**	0.00496**
	(0.273)	(0.248)		(0.00262)	(0.00222)
Improved Roof	2.364**	5.356***	Distance to hospital x improved roof	-0.00413	-0.149*
	(1.048)	(1.924)		(0.0105)	(0.0817)
Improved Walls	-1.357***	-0.329	Distance to closest hospital x improved walls	-0.00669**	-0.00950***
	(0.472)	(0.371)		(0.00339)	(0.00284)
Overcrowded	-1.679**	0.672*	Distance to closest hospital x HH owns bicycle	0.00444**	0.00527***
	(0.781)	(0.380)		(0.00198)	(0.00190)
Participated in adult alphabetisation initiative	-0.642***	-0.561**	Distance to closest hospital x HH owns bed	0.00518**	0.00345
	(0.246)	(0.238)		(0.00223)	(0.00212)
Complete first cycle of primary education (5th grade)	-1.270***	-0.450**	Distance to hospital x HH has radio access	-0.00461**	-0.00275
	(0.239)	(0.208)		(0.00194)	(0.00185)
Complete second cycle of primary education (7th grade)	-0.628**	-0.694**	Distance to closest road x agriculture is main income source	-0.0125***	-0.00803*
	(0.287)	(0.277)		(0.00404)	(0.00434)
Complete first cycle of secondary education (10th grade)	-1.248***	-0.851**	Distance to closest road x HH owns fridge	-0.0147	-0.0448**
	(0.464)	(0.418)		(0.0132)	(0.0226)
Complete secondary (12th grade) and higher	-0.604	-0.852	Distance to closest road x HH has radio access	-0.000392	-0.00456**
	(0.593)	(0.612)		(0.00223)	(0.00225)
HH owns bicycle	0.0872	-0.0477	Portuguese speaking x Agriculture main income source	-0.228	-1.038***
	(0.270)	(0.252)		(0.380)	(0.384)
HH owns fridge	1.678***	1.908***	Portuguese speaking x Improved walls	1.024**	0.500
	(0.616)	(0.529)		(0.511)	(0.455)
HH owns motorcycle	0.504**	0.304	Constant	-1.791***	-0.578
	(0.238)	(0.231)		(0.463)	(0.400)
HH owns table	-0.130	-0.0268			
	(0.193)	(0.186)			
Number of observations					1,657
Pseudo R2					0.2081

After estimating the multinomial logit models and predicting the propensity scores, it is important to verify whether there is an overlap in the distribution of the propensity scores for all observations (common support). Following Smith and Todd (2005), the area of common support is defined as the area where the density of the propensity score distribution is non-zero for all three groups, i.e. for each treated observation with a propensity score x, there must also be a control observation with a non-zero probability of being treated. In this analysis, the density of the distribution is considered non-zero if it surpasses the threshold of 0.00001. Based on this criterion, only one observation needed to be trimmed due to lack of common support. However, given the sample size of 1,680, the exclusion of this observation is considered negligible.

Figure 5.2: Density of the propensity score distributions for the propensity of being part of the group of directly exposed households

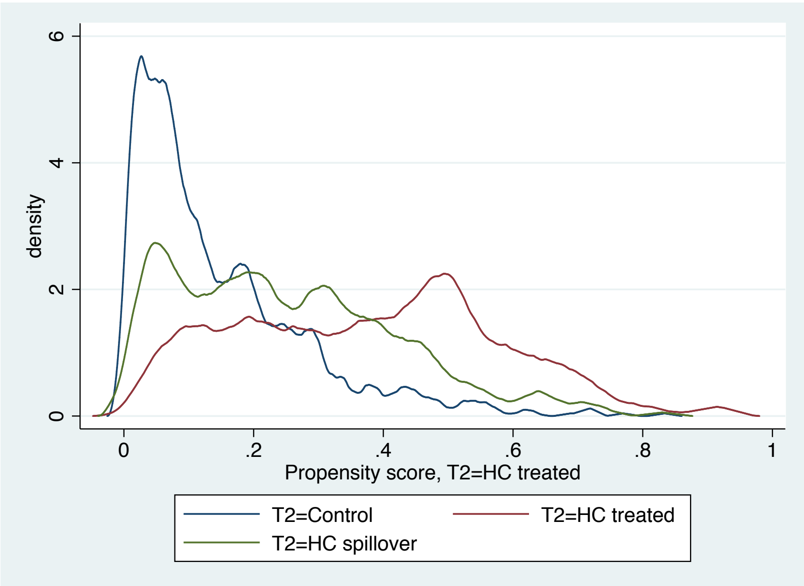
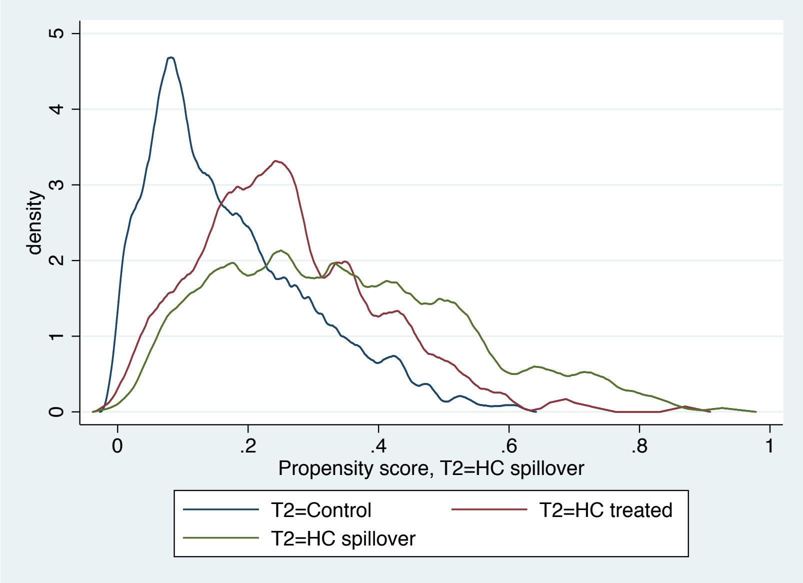


Figure 5.3: Density of the propensity score distributions for the propensity of being part of the group of indirectly exposed households



Subsequently, the inverse-probability-weights for all observations on common support are calculated. Following Hirano and Imbens (2001) and Hirano et al. (2003), the inverse probability weight for individual i, regarding the treatment intensity k (either direct treatment, or indirect exposure through social learning) can be calculated as:

$$\omega_{ki} = D_{ki} + (1 - D_{ki}) \frac{\hat{p}_k (X_i)}{1 - \hat{p}_k (X_i)}$$

where D_{ki} indicates the treatment status of individual i, and $\hat{p}_k (X_i)$ is the estimated propensity score for i regarding treatment k.

Just as for standard propensity score estimators, IPW estimators only yield consistent results if the covariates included in the propensity score estimation are balanced across groups (Rosenbaum & Rubin 1983, Austin&Stewart 2015). This implies that the expected value of all covariates X_i should be equal across groups after conditioning on the propensity scores $\hat{p}_k (X_i)$

$$E[(X_i \mid p_k (X_i), D_{ki} = 1] = E[(X_i \mid p_k (X_i), D_{ki} = 0]$$

In IPW studies, the **balancing property** is most commonly assessed by comparing the standardized differences in the group means of all covariates which were used in the propensity score estimation (Austin & Stewart 2015). A standardized difference which is larger than 0.1 can be considered as an indication for an imbalance between the weighted groups (Normand et al. 2001, Austin et al. 2009). Table 4 presents the results of the balancing tests. The tables indicate that although observable differences between groups have been reduced substantially through the propensity score weighting, for about a third of the variables the standardised difference is larger than 0.1. These variables are additionally included as control variables in the inverse probability weighted regressions.

Following Hirano & Imbens (2001), the treatment effects are estimated through k linear regressions where the inverse of the estimated propensity scores are used as weights. In this case k=2, as there are two "treatment groups": the households which are trained themselves, and those who are potentially exposed through spillovers. We estimate one regression which compares trained households to the comparison group, and another regression comparing households susceptible to spillovers to the comparison group.

$$Y_i = \beta_{k0} + \beta_{k1} D_{ki} + \gamma_k C_i + \varepsilon_{ki} \quad [weight = \omega_{ik}]$$

Y_i is an outcome of interest for individual i. D_{ki} indicates whether i has been part of treatment group k. C_i represents the subset of control variables which are not balanced after conditioning on the propensity score. β_{k1} is the Average Treatment Effect on the Treated (ATT) for being treated with treatment k.

In order to correctly estimate the standard errors of these linear regression coefficients, one also needs to take into account the estimation uncertainty that is created through the estimation of the propensity scores. Both estimations (propensity score estimation and linear regressions) have therefore been conducted in one step, based on a Generalised Methods of Moments approach as suggested by Hirano et al. (2003) and Wooldridge and Imbens (2009)[33]. The standard errors have been clustered at the community level.

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33 The estimations have been implemented through the Stata module *teffects ipwra*.

IPW regressions, just as any propensity-score based estimators, rely on the assumption that selection into treatment is only based on observable variables. Selection on based on unobservables which are not included in the propensity score estimation may bias the results and therefore not yield valid impact estimates. In the context of this study, selection into treatment occurs in two steps: first, a health committee needs to choose an area to be covered by the trainings. Secondly, households within the selected areas need to accept the committee's invitation to participate in the trainings. In order to avoid any bias in relation to the first step, the sampling procedure attempted to select very similar enumeration areas for the survey to be carried out. Moreover, variables on the remoteness of an area (distance to the closest capital and distance to the closest road) have been included in the estimation of the propensity score. In order to control for selection in the second step (households chosing to participate), a large number of control variables on the education, socioeconomic characteristics and demographic composition of the households have been included in the propensity score estimation. However, it is important to acknowledge that we do not have any data on previous knowledge on the contents of the trainings. It might for example be that households which already have a solid knowledge about nutrition are less likely to enrol. If this was the case, our impact estimates for the indirectly exposed group might be upward-biased: we would compare a pre-selection of untreated households in the treatment area which were already better informed before the intervention, with all households in the comparison group.

However, the qualitative information from the formative research does not suggest that there were major knowledge differences between community members: the study indicated that knowledge about the intervention's topics was homogenous and generally very low in the all potential treatment areas (World Food Programme 2015). A robustness check with placebo outcomes does also not suggest that selection into treatment of more/less knowledgeable households has occurred (see section 5.3)

Table 5.4: Balancing of covariates

	HHs trained by health committees (as compared to control)				Untreated HHs in treated areas (as compared to control)			
	Standardized Dfiference		Variance Ratio		Standardized Difference		Variance Ratio	
	Raw	Weighted	Raw	Weighted	Raw	Weighted	Raw	Weighted
Distance to closest hospital (minutes walking)	0.12	-0.11	0.75	0.96	-0.03	0.07	0.75	1.09
Distance to closest road (minutes walking)	0.56	0.07	2.36	1.46	0.31	0.01	2.24	0.96
Literacy	-0.30	0.10	0.89	1.02	-0.21	0.00	0.94	1.00
Speaks Portuguese	-0.33	0.09	0.70	1.08	-0.41	-0.03	0.61	0.97
Number of children	0.13	-0.11	1.00	0.87	-0.10	0.06	0.99	1.13
Poligamy	0.32	0.01	1.17	1.01	0.38	0.00	1.17	1.00
Cattle ownership	-0.09	0.10	0.98	1.01	-0.37	-0.07	0.81	0.98
Walking is main means of transport	0.15	-0.09	0.77	1.14	-0.02	0.06	1.03	0.90
Agriculture is main source of income	0.28	-0.09	0.76	1.07	0.24	0.01	0.80	0.99
Improved roof	0.10	0.04	3.08	1.56	0.11	0.02	3.52	1.26
Improved walls	-0.59	0.14	0.35	1.17	-0.41	0.07	0.55	1.09
Overcrowded	-0.14	0.00	0.25	0.97	0.17	0.00	2.41	1.01
Alphabetisation	-0.22	0.02	0.63	1.04	-0.18	0.02	0.69	1.04
Complete first cycle of primary education (5th grade)	-0.36	-0.04	0.59	0.96	-0.04	-0.03	0.96	0.97
Complete second cycle of primary education (7th grade)	-0.03	-0.16	0.96	0.75	-0.13	-0.05	0.81	0.92
Complete first cycle of secondary education (10th grade)	-0.13	0.25	0.54	2.28	-0.06	0.02	0.77	1.09
Complete secondary (12th grade) and higher	-0.09	0.11	0.56	1.80	-0.09	-0.03	0.53	0.85
HH owns bicycle	0.25	-0.04	1.16	0.97	0.17	-0.09	1.12	0.94
HH owns fridge	-0.04	0.08	0.82	1.35	0.01	-0.05	1.06	0.81
HH owns motorcycle	0.10	-0.09	1.25	0.82	0.05	-0.04	1.12	0.91
HH owns table	-0.03	0.15	1.00	0.99	-0.10	-0.10	0.98	0.98
HH owns chair	0.09	0.15	0.96	0.91	-0.06	-0.12	1.02	1.04
HH owns bed	-0.07	0.16	0.92	1.15	-0.02	-0.03	0.98	0.96
HH owns sofa	0.00	0.34	0.98	2.67	-0.08	-0.10	0.66	0.64
HH owns lamp	-0.41	0.20	0.25	1.51	-0.30	-0.01	0.43	0.98
HH owns phone	0.52	-0.02	1.59	0.98	0.36	0.00	1.48	1.00

Note: table continued on next page

Table 5.4 (continued from last page)

	HHs trained by health committees (as compared to control)				Untreated HHs in treated areas (as compared to control)			
	Standardized Dfiference		Variance Ratio		Standardized Difference		Variance Ratio	
	Raw	Weighted	Raw	Weighted	Raw	Weighted	Raw	Weighted
HH has radio access	0.04	0.06	0.99	0.98	-0.01	-0.03	1.00	1.01
(Distance to closest road)^2	0.33	0.09	5.38	3.46	0.27	-0.01	3.33	0.96
Distance to closest hospital x Poligamy	0.20	0.04	0.93	1.03	0.20	0.04	0.93	1.06
Distance to closest hospital x Walking is main means of transport	0.16	-0.07	0.83	0.97	-0.02	0.12	0.82	1.14
Distance to hospital x Improved Roof	0.09	0.00	3.46	1.05	0.01	-0.03	0.44	0.35
Distance to hospital x Improved walls	-0.47	-0.05	0.16	0.78	-0.42	0.10	0.19	1.29
Distance to hosptial x Bicycle	0.23	-0.01	1.10	0.85	0.14	-0.08	0.94	0.78
Distance to hospital x Bed	0.11	0.01	1.54	1.06	0.08	-0.05	1.20	0.87
Distance to hospital x radio access	0.06	-0.08	0.86	0.88	-0.05	-0.06	0.76	0.91
Distance to road x agriculture main income source	0.47	0.08	2.15	1.43	0.30	0.01	2.24	0.95
Distance to road x fridge	0.07	0.02	5.29	2.16	-0.06	-0.03	0.62	1.30
Distance to road x radio access	0.39	0.00	2.76	1.26	0.12	0.00	1.18	0.82
Speaks Portuguese x agriculture main income source	-0.14	-0.07	0.71	0.85	-0.31	-0.04	0.41	0.92
Speaks Portuguese x Improved Walls	-0.30	0.23	0.34	1.71	-0.22	-0.06	0.51	0.83

5. Results

Tables 5-7 present the results of the inverse probability weighted regressions. For households which were directly exposed to the health committee trainings, both the overall knowledge and practices indexes, as well as the topic-specific indexes improved substantially, with increases in the range of 5.9 to 16.4 index points. The only exception is the IYCF knowledge index where no significant impacts were detected.

Moreover, the estimates point to the presence of social learning effects for those who live in treated areas, but were not trained by health committees themselves. For these households the malaria knowledge index, maternal care knowledge index and WASH practices index improved in the range of 6.8 to 10.6 index points. For the malaria knowledge index, the estimated spillover effect amounts to 49 percent of the treatment effect of the directly treated group suggesting an information loss of 51 percent during the social learning process. For the maternal care index the spillover effect amounts to 66 percent, and for WASH practices it amounted to 68 percent of the direct treatment effect. However, no statistically significant spillover effects were detected for WASH knowledge, child feeding knowledge, child feeding practices or malaria practices.

Table 5.5: Impact of health committee trainings and spillovers on health knowledge and practices (indexes)

	ATT Participants in health committee trainings	Standard Error	ATT Non-Participants in treatment areas (Spillovers)	Standard Error	Mean control group
Overall knowledge index	10.44***	2.56	3.84	2.89	52.04
Overall practices index	8.55***	1.54	3.77*	2.24	46.31
Malaria Knowledge Index	16.38***	3.92	7.99**	3.40	48.59
WASH Knowledge Index	8.69**	3.56	0.20	3.99	43.65
IYCF Knowledge Index	0.69	2.37	-3.48	3.06	68.75
Maternal Knowledge Index	16.02***	3.91	10.64***	3.81	47.17
Malaria Practices Index	5.99*	3.10	1.49	3.65	64.67
WASH Practices Index	9.80***	1.97	6,75**	3.13	37.36
IYCF Practices Index	10.36***	3.97	2.58	3.95	36.26

Note: *** denotes significance at the 1% level, ** denotes significance at the 5% level, * denotes significance at the 10% level. Standard errors are clustered at the community-level. All indexes are calculated on a scale of 0-100, with 100 being the maximum score which can be achieved.

These findings are also confirmed when considering the single outcomes on which the knowledge and practices indexes are based. For the group of households which was directly trained by the health committees, the regressions showed statistically significant improvements for 19 of the 36 knowledge outcomes (table 6). For the indirectly exposed group, 10 of the 36 knowledge outcomes were statistically significant. With one exception, all of these 10 outcomes also were significant for the directly exposed group. This pattern is much in line with social learning processes in the communities that were exposed to the intervention. The magnitude of the treatment effects in the spillover group on average amounts to 61 percent of the treatment effect in the directly exposed group.

A similar picture emerges when considering the practices outcomes presented in table 8. There are statistically significant improvements for 8 out of the 12 practices outcomes in the group of households which were directly trained by the health committees, and 4 out of 12 for the indirectly exposed households. For those outcomes which do show significant results in the indirectly exposed group, treatment effects on average amount to 96 percent of the effects in the directly exposed group. This suggests that for the practices where social learning does take place (handwashing, latrine usage, exclusive breastfeeding for children under 6 months and dietary diversity for children over 6 months of age), information loss is close to zero.

There are two unexpected findings. First, the results in table 6 show a statistically signicificant reduction in the share of respondents who are able to list at least one water treatment method. Secondly, the regression results suggest that the intervention negatively impacted women's confidence that their own breastmilk contained all necessary nutrients for infants younger than 6 months. An explanation for these paradoxical findings could be that either the intervention itself or the questions as they were phrased in the impact evaluation survey caused misunderstandings regarding these two outcomes. It might for example be that the interventions' focus on nutritional diversity for children *over 6 months* led to the view that children under 6 months also should have a diverse diet. Another explanation is that interviewees were not sufficiently clear that the question referred to children under the age of 6 months only. In any case, it is reassuring that there is a positive impact in the use of recommended child feeding *practices,* as illustrated in table 7.

Overall, these findings are in line with both, the Bayesian updating model and the Generalised DeGroot Model. In both theoretical frameworks, the SBCC intervention can be understood as a new signal provided to a number of seeds in the treated networks. Under Bayesian updating, the seeds would be expected to give a higher weight to the new information than those who are only indirectly exposed to the intervention, as the former are closer to the source and therefore attribute a higher weight to the new information in the updating process (weights in the Bayesian learning model depend on the estimated variance of the signal). This is in line with the consistently higher treatment effects for the directly exposed households as compared to the indirectly exposed households.

However, it is important to underline that those who are indirectly exposed to the intervention also receive the new signal and do engage in updating. Although the treatment effects are lower and we observe fewer statistically significant results for those households, there is clear evidence that those households also benefit from the intervention. This is true for both knowledge and practices outcomes. Overall, the results can be interpreted as evidence of social learning processes in the treated communities which occurs subsequently to the actual intervention.

Table 5.6: Impact of health committee trainings and radio spots on health knowledge

	ATT Health committee trainings	Standard Error	ATT Non-Participants in treated areas	Standard Error	Mean control group
Malaria					
Knows at least 3 malaria symptoms	0.20***	0.05	0.13**	0.05	0.59
Mentions fever as malaria symptom	0.08	0.07	-0.01	0.06	0.63
Mentions feeling cold as malaria symptom	-0.07	0.06	-0.07	0.07	0.48
Mentions other (correct) symptom	0.06***	0.02	0.02	0.03	0.90
Knows at least 3 malaria prevention methods	0.34***	0.07	0.22***	0.08	0.27
Bednet listed as malaria prevention method	0.01	0.03	0.02	0.03	0.88
Keeping house clean listed as malaria prevention method	0.14***	0.05	0.12**	0.05	0.30
Avoiding puddles / stuck water as malaria prevention method	0.22***	0.05	0.06	0.05	0.15
Other methods to deter mosquitos listed as prevention method	0.05	0.07	0.03	0.06	0.35
Knowledge of malaria transmission cause	0.04	0.04	-0.01	0.04	0.84
Has realistic risk perception of malaria	0.08	0.08	-0.02	0.05	0.25
WASH					
Knows at least 3 crucial times for handwashing	0.10	0.07	0.03	0.08	0.31
Handwashing: lists 'after defecation' as crucial moment	0.05	0.05	0.06*	0.04	0.76
Handwashing: lists 'before preparing food' or before eating as crucial moment	0.13***	0.04	0.11***	0.04	0.78
Handwashing: mentions option in relation to childcare	0.06	0.07	-0.05	0.08	0.28
Knows 3 causes of diarrhoea	0.21***	0.08	0.11	0.08	0.29
Diarrhoea causes: mentions contaminated water	-0.16	0.05	-0.04	0.04	0.92
Diarrhoea causes: mentions lack of handwashing/hygiene	0.23***	0.06	0.07	0.07	0.41
Diarrhoea causes: mentions spoiled food	0.11**	0.06	-0.02	0.06	0.42
Diarrhoea causes: mentions contact to other infected people	-0.01	0.01	-0.01	0.01	0.03
Knows at least one water treatment methods	-0.06***	0.02	-0.12***	0.04	0.92
Has realistic risk perceptions of diarrhoea	0.10	0.08	-0.01	0.06	0.22
Infant and young child feeding					
States that breastmilk contains all necessary nutrients <6 months	-0.17***	0.05	-0.16***	0.04	0.86
States that exclusive breastfeeding should be until 6 months	0.11**	0.05	-0.01	0.05	0.74
Knows first breastfeeding within hour after birth	0.09	0.09	0.07	0.08	0.38
Considers complementary breastfeeding until age 2	-0.01	0.05	-0.04	0.04	0.77
Maternal care and nutrition					
Considers important to eat more during pregnancy	-0.05	0.04	-0.06	0.05	0.82
Knows 3 maternal care measures	0.31***	0.07	0.21***	0.06	0.19
Maternal care: mentions extra rest / avoid heavy work	0.12***	0.04	0.07	0.04	0.76
Maternal care: mentions extra meal / diverse diet	0.23***	0.05	0.09*	0.05	0.38
Maternal care measures: take antimalarials	0.00	0.01	0.00	0.01	0.02
Knows 3 pregnancy emergencies	0.18*	0.09	0.15*	0.08	0.16
Pregnancy emergencies: lists bleeding	0.16**	0.08	0.10	0.08	0.29
Pregnancy emergencies: lists fever	0.22***	0.07	0.19***	0.06	0.33
Pregnancy emergencies: lists other correct option	0.15**	0.07	0.07	0.06	0.45
Opinion: At least 3 prenatal consultations necessary	0.21***	0.06	0.13*	0.07	0.72

Note: *** denotes significance at the 1% level, ** denotes significance at the 5% level, * denotes significance at the 10% level. All outcomes are binary (0/1) and treatment effects can thus be interpreted as the increase in the share of respondents who answered the respective question correctly.

Table 5.7: Impact of health committee trainings and spillovers on health practices

	ATT Participants in health committee trainings	Standard Error	ATT Non-Participants in treatment areas (Spillovers)	Standard Error	Mean control group
Malaria					
Mosquito net observed & hanging (not observed = 0)	-0.050	0.043	-0.013	0.048	0.451
Child slept under bednet	0.072***	0.025	0.024	0.032	0.835
Use of mosquito net during pregnancy	0.136***	0.039	0.043	0.045	0.614
Took antimalarials during last pregnancy	0.09**	0.038	0.029	0.045	0.668
WASH					
Closed latrine used for defecation	0.194***	0.037	0.083*	0.044	0.556
Soap was available to wash hands	0.065**	0.035	0.131***	0.040	0.257
Always treats water	0.004	0.019	0.027	0.025	0.071
Mentioned prudent child defecation practice	0.047	0.031	-0.043	0.038	0.777
Washed child's and own hands after child's defecation	0.207***	0.035	0.189***	0.041	0.184
Infant and young child feeding					
Minimumn dietary diversity for infants achieved	0.123***	0.033	0.045	0.035	0.217
FCS is acceptable or borderline	0.065	0.042	-0.020	0.046	0.520
Excl. breastfed (<6mo)/3 recommended foods (>6mo)	0.140***	0.036	0.090**	0.040	0.333

Note: *** denotes significance at the 1% level, ** denotes significance at the 5% level, * denotes significance at the 10% level. All outcomes are binary (0/1) and treatment effects can thus be interpreted as the increase in the share of respondents who answered the respective question correctly.

5.3 Robustness checks

A number of robustness checks have been performed in order to corroborate the results presented above. First, we run the regressions presented in tables 5-7, but using placebo outcomes that should not be affected by the treatment. This test addresses potential concerns that even after propensity score weighting there may have been unobservable differences between the treatment and comparison group which are affecting the results, e.g. due to self-selection into treatment of more/less knowledgeable households. In order to define suitable placebo outcomes, we use the fact that the health committee trainings on maternal care and maternal nutrition had only been conducted very shortly before the endline evaluation survey (see table A1 for an overview on the timing of the intervention). Nevertheless, these outcomes had been included in the survey. While we do expect impacts on the knowledge questions relating maternal care, it is unreasonable to expect any direct impacts on maternal care *practices*, as these would only materialise during the next pregnancy of the affected women. The results of these regressions are presented in table A2. Indeed, we do not find any statistically significant impacts at the 5% level, for neither the directly exposed households nor the untreated households living in treated areas for these placebo outcomes.

A second robustness check was related to the definition of treated and comparison areas based on actual exposure to the intervention (see section 4.2). Instead of using a minimum threshold of 20% of households reporting to have participated in health committee trainings for a certain area to be considered as treated, a minimum threshold of 10% is used as a robustness check. These results are presented in tables A3-A5. The statistical significance and magnitude of the effects are as good as unaffected by this alternative definition of treatment and comparison areas. If anything, the treatment effects for the indirectly exposed households become slightly larger than under the original definition.

6. Conclusion

Three main conclusions can be drawn based on the results presented above.

- First, there is clear evidence that health committee trainings have improved knowledge and practices in the four priority areas of the SBCC intervention among those mothers who were directly exposed to the intervention.
- Secondly, there is also evidence for the existence of social learning effects. Women in treated areas which were not trained by health committees also improved knowledge and practices related to child health and nutrition. This finding confirms the predictions of both a Bayesian learning model and a DeGroot learning model. It shows that social learning processes are not only important in the field of agriculture and finance, but they can also play an important role in the diffusion of technologies to improve child health and nutrition, and alter individual risk perceptions and/or decision-making processes on preventive health behaviours.
- Third, social learning effects were only observed for approximately half of the outcomes which had improved in the directly exposed group. For this subset of statistically significant outcomes, the treatment effects on average corresponded to 61 percent for the knowledge outcomes and 96 percent for the practices outcomes. This suggests that social learning may not work for all health and nutrition topics, and that information loss may occur during the social learning processes.

Overall, interventions like the SBCC project in Mozambique can be considered as a promising option in order to improve the uptake and use of health technologies in poor and relatively uninformed communities. Due to the social learning effects documented in this study, the benefit-cost ratios of such interventions might be even larger than expected, as not only the participants but also their fellow community members benefit. Studies which do not take into account network spillovers may therefore underestimate the true effect of interventions that aim at fostering the uptake of health technologies.

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Appendix

Table 5.A1 - Timeline of the SBCC intervention & household survey

Time period	Project phase
2015	Formative research (qualitative)
2016	Development of Training Material
Febuary - July 2017	Training of health committees in Malaria prevention & WASH
March - August 2017	Training of community members in malaria prevention & WASH
September - December 2017	Training of health committees in Infant and Young Child Feeding (IYCF) and Maternal Care and Nutrition
October - December 2017	Training of community members in IYCF
December 2017 - March 2018	Training of community members in maternal health and nutrition
January - February 2018	Impact evaluation household survey

Table 5.A2: Topics covered through SBCC trainings

Topic	No. of manuals	Sessions	Topics covered	Activities x session	Duration
Maternal health practices	1	6	Health care in the first 2 years of growth and its benefits	2	1 hr.
			Adequate nutrition during pregnancy	4	2 hrs.
			Essential care from the family and the community to the pregnant woman	3	1h30
			Behaviours and negative situations during pregnancy	3	1h30
			Follow-up of pregnancy. Some attentions during prenatal care	3	1h30
			Provide an appropriate environment for pregnant women	1	30 min.
Malaria prevention practices	1	4	The health benefits and essential health care of the child from pregnancy to 2 years of age	5	1h30
			Beginning of breastfeeding in the first hour after delivery, colostrum and exclusive breastfeeding	4	1h20
			Breastfeeding and breastfeeding techniques	3	1h30
			Adequate supplementary feeding for children aged 6-24 months	3	1h40
Sanitation and hygiene practices	1	6	The benefits of health and health care in the first 2 years of growth	2	1h30
			Essential care with sanitation	3	2 hrs.
			Essential moments for washing hands with soap	4	1h10
			The right way to wash your hands: use of tip tap and soap	2	2 hrs.
			Benefits of complying with handwashing correctly	2	2 hrs.
			Treated and safe water	4	1 hr.
IYCF practices	1	6	The health benefits and essential health care of the child from pregnancy to 2 years of age	5	1h30
			Beginning of breastfeeding in the first hour after delivery, colostrum and exclusive breastfeeding	4	1h20
			Breastfeeding and breastfeeding techniques	3	1h30
			Adequate supplementary feeding for children aged 6-24 months	3	1h40
			Food groups suitable for children 6 - 24 months of age and culinary demonstrations	3	2 hrs.
			Food groups suitable for children 6 - 24 months of age and culinary demonstrations	2	1h50

Table 5.A3: Impact of health committee trainings on placebo outcomes

	ATT Participants in health committee trainings	Standard Error	ATT Non-Participants in treatment areas (Spillovers)	Standard Error	Mean control group
Gave birth at a public or private health facility	0.112	0.076	0.013	0.069	0.607
Pregnant at time of interview	0.008	0.021	0.007	0.025	0.047
Took antimalarials pregnancy	0.085*	0.044	0.020	0.052	0.683

Note: *** denotes significance at the 1% level, ** denotes significance at the 5% level, * denotes significance at the 10% level. Standard errors are clustered at the community-level. All indexes are calculated on a scale of 0-100, with 100 being the maximum score which can be achieved.

Table 5.A4: Robustness check - alternative definition of treated and comparison areas (10% cut-off for definition of treatment areas)

	ATT Participants in health committee trainings	Standard Error	ATT Non-Participants in treatment areas (social learning effect)	Standard Error	Mean control group
Overall knowledge index	9.81***	2.22	4.33**	2.15	51.63
Overall practices index	7.16***	1.86	1.45	2.14	47.31
Malaria Knowledge Index	17.95***	3.59	10.89***	2.53	45.82
WASH Knowledge Index	9.86***	3.02	4.21	2.89	41.61
IYCF Practices Index	-2.51	2.56	-4.48	2.76	71.06
Maternal Knowledge Index	13.95***	3.82	6.71*	3.47	48.04
Malaria Practices Index	2.37	3.00	-3.97	3.01	67.77
WASH Practices Index	11.45***	1.99	7.71***	2.70	35.45
IYCF Practices Index	6.53	4.55	-1.48	4.50	39.65

Note: *** denotes significance at the 1% level, ** denotes significance at the 5% level, * denotes significance at the 10% level. All indexes are calculated on a scale of 0-100, with 100 being the maximum score which can be achieved.

Table 5.A5: Robustness check - alternative definition of treated areas (10% cut-off). Knowledge outcomes

	ATT Participants	Standard Error	ATT Non-Participants (social learning effects)	Standard Error	Mean control group
Malaria					
Knows at least 3 malaria symptoms	0.21	0.05	0.14***	0.05	0.56
Mentions fever as malaria symptom	0.00	0.08	-0.06	0.06	0.70
Mentions feeling cold as malaria symptom	0.03	0.06	0.06	0.07	0.39
Mentions other (correct) symptom	0.052**	0.03	0.03	0.03	0.90
Knows at least 3 malaria prevention methods	0.35***	0.07	0.23***	0.06	0.23
Bednet listed as malaria prevention method	-0.03	0.03	-0.04	0.03	0.90
Keeping house clean listed as malaria prevention method	0.11*	0.06	0.10**	0.05	0.32
Avoiding puddles / stuck water as malaria prevention method	0.20***	0.06	0.06	0.04	0.16
Other methods to deter mosquitos listed as prevention method	0.06	0.07	0.06	0.05	0.32
Knowledge of malaria transmission cause	0.01	0.04	-0.04	0.04	0.87
Has realistic risk perception of malaria	0.14**	0.06	0.10**	0.04	0.18
WASH					
Knows at least 3 crucial times for handwashing	0.09	0.07	0.05	0.06	0.30
Handwashing: lists 'after defecation' as crucial moment	0.03	0.05	0.03	0.05	0.76
Handwashing: lists 'before preparing food' or before eating as crucial moment	0.07	0.04	0.04	0.05	0.82
Handwashing: mentions option in relation to childcare	0.10	0.06	0.06	0.07	0.24
Knows 3 causes of diarrhoea	0.21**	0.08	0.11	0.07	0.28
Diarrhoea causes: mentions contaminated water	-0.03	0.06	-0.01	0.05	0.44
Diarrhoea causes: mentions lack of handwashing/hygiene	0.20***	0.06	0.06	0.06	0.42
Diarrhoea causes: mentions spoiled food	0.10*	0.06	-0.04	0.05	0.42
Diarrhoea causes: mentions contact to other infected people	-0.02	0.01	-0.01	0.01	0.03
Knows at least one water treatment methods	-0.065**	0.03	-0.086**	0.04	0.92
Has realistic risk perceptions of diarrhoea	0.16**	0.07	0.09*	0.05	0.16
Infant and young child feeding					
States that breastmilk contains all necessary nutrients <6 months	-0.23***	0.04	-0.19***	0.04	0.91
States that exclusive breastfeeding should be until 6 months	0.09**	0.04	-0.01	0.04	0.75
Knows first breastfeeding within hour after birth	0.05	0.08	0.04	0.07	0.41
Considers complementary breastfeeding until age 2	-0.01	0.05	-0.02	0.05	0.77
Maternal care and nutrition					
Considers important to eat more during pregnancy	-0.06	0.05	-0.09	0.05	0.83
Knows 3 maternal care measures	0.31***	0.06	0.20***	0.05	0.16
Maternal care: mentions extra rest / avoid heavy work	0.09**	0.04	0.04	0.04	0.78
Maternal care: mentions extra meal / diverse diet	0.26***	0.06	0.13**	0.05	0.35
Maternal care measures: take antimalarials	0.00	0.02	-0.01	0.01	0.03
Knows 3 pregnancy emergencies	0.21***	0.08	0.19***	0.06	0.11
Pregnancy emergencies: lists bleeding	0.13*	0.08	0.05	0.07	0.30
Pregnancy emergencies: lists fever	0.27**	0.06	0.26***	0.06	0.25
Pregnancy emergencies: lists other correct option	0.181***	0.07	0.09	0.06	0.42
Opinion: At least 3 prenatal consultations necessary	0.09*	0.05	-0.04	0.06	0.82

Note: *** denotes significance at the 1% level, ** denotes significance at the 5% level, * denotes significance at the 10% level. All outcomes are binary (0/1) and treatment effects can thus be interpreted as the increase in the share of respondents who answered the respective question correctly.

Table 5.A6: Robustness check - alternative definition of treated and comparison areas (10% cutoff for definition of treatment areas). Practices outcomes

	ATT Participants in health committee trainings	Standard Error	ATT Non-Participants in treatment areas (social learning effects)	Standard Error	Mean control group
Malaria					
Mosquito net observed & hanging (not observed = 0)	-0.04	0.05	0.00	0.05	0.45
Child slept under bednet	0.02	0.03	-0.06	0.04	0.88
Use of mosquito net during pregnancy	0.02	0.05	-0.112**	0.05	0.71
Took antimalarials during last pregnancy	0.095*	0.06	0.02	0.06	0.67
WASH					
Closed latrine used for defecation	0.17***	0.04	0.02	0.05	0.57
Soap was available to wash hands	0.12*	0.06	0.17**	0.07	0.21
Always treats water	0.01	0.02	0.041*	0.02	0.06
Mentioned prudent child defecation practice	0.01	0.03	-0.078**	0.04	0.81
Washed child's and own hands after child's defecation	0.27***	0.05	0.23***	0.08	0.12
Infant and young child feeding					
Minimumn dietary diversity for infants achieved	0.08	0.05	-0.01	0.04	0.26
FCS is acceptable or borderline	0.04	0.05	-0.07	0.05	0.55
Excl. breastfed (<6mo)/3 recommended foods (>6mo)	0.08	0.06	0.03	0.06	0.38

Note: *** denotes significance at the 1% level, ** denotes significance at the 5% level, * denotes significance at the 10% level. All outcomes are binary (0/1) and treatment effects can thus be interpreted as the increase in the share of respondents who answered the respective question correctly.

6. Conclusion

This thesis contributes to the evidence on the effectiveness of different incentives to promote healthy nutrition behaviour.

The first paper investigates on the impact of the Brazilian conditional cash transfer programme Bolsa Familia on food consumption and nutritional outcomes. It shows that Bolsa Familia beneficiaries use the bulk of the cash transfers for additional food purchases. Moreover, there is suggestive evidence that households may have disproportionately increased their consumption of dairy and sweets in response to the cash transfers, although this is sensitive to the choice of the outcome variable. There is suggestive evidence that this has led to an increase in overweight among children, however, this finding is not robust to multiple hypothesis testing. The analysis does not detect any impact of Bolsa Familia on undernutrition.

The second paper assess the nutrition-related impacts of a subsidised health insurance programme for low-income households in Mexico, *Seguro Popular*. While the study does not detect an overall impact of the programme on nutrition-related outcomes, it does document an increase in obesity for those who were already overweight at baseline, suggesting the possibility of a moral hazard effect. Moreover, the paper suggests that beneficiary households may have decreased the relative consumption of carbohydrates and increased the consumption of meat. Overall, the paper does not provide any evidence that health insurance alone can reduce overweight or obesity.

Paper 3 has shown increasing gender-based disparities in obesity, with women being more heavily affected than men. In the MENA region, these “gender obesity gaps” are also significantly associated with low levels of economic participation of women (female labour force participation) and political participation (share of female MPs). However, there is no such correlation in the rest of the world. The study therefore confirms the importance of social incentives and norms in shaping nutritional outcomes, while at the same time illustrating the context-dependence of nutritional incentives.

The fourth paper evaluates the effectiveness of a social and behaviour change communication initiative, and in particular investigated on the presence of social learning effects in covered villages. The paper shows that the provision of trainings on child health and nutrition positively affects related knowledge and practices in a sample of extremely poor households in rural Mozambique. Beyond that, the intervention also had a positive impact on neighbouring households which did not participate in the trainings themselves, suggesting the presence of intra-communal social learning.

1. Discussion of the findings and implications for research

How do the findings of this thesis relate to previous research? The first paper on the nutritional impact of Bolsa Familia in Brazil confirms the first research hypothesis (*H 1.1: The Bolsa Familia conditional cash transfer programme in Brazil has lead to an increase in food expenditure*) and is therefore in line with the well-established finding that social cash transfers lead to an increase in total consumption expenditure, as well as food expenditure (see e.g. Bastagli et al. 2016). This finding is also robust to multiple hypothesis testing. Moreover, the paper provides suggestive evidence for a disproportional increase in the consumption of sweets and dairy products in response to the cash transfers.

However, the paper's second research hypothesis (*H 1.2: The programme has led to a reduction in undernutrition)* is not confirmed. The analysis did not reveal any statistically significant effects on wasting, stunting, height-for-age, weight-for-age or weight-for-height. While this finding is unexpected given the significant increase in food expenditure in response to the programme, it should be noted that a number of previous cash transfer evaluations were also unable to detect any impact on undernutrition. According to Bastagli et al.'s (2016) review, only five out of 13 cash transfer evaluations found an impact on stunting, one out of 5 for wasting, and zero out of seven for weight-for-age z-scores. Possible explanations for the lack of significant (observed) effects include an insufficient follow-up period between intervention and evaluation, as well as the susceptibility of anthropometric data to measurement error. It should be noted that the only impact evaluation of Bolsa Familia which did assess anthropometric outcomes (De Brauw et al. 2010) did not detect an impact on BMI-for-age z-scores, but no effects on undernutrition as measured by stunting, wasting, height-for-age z-scores, or weight-for-age z-scores.

(De Brauw et al. 2010). Their study detects a statistically significant effect on BMI-for-age z-scores among children, but no effect on undernutrition as measured by stunting, wasting, height-for-age z-scores, or weight-for-age z-scores.
to observe the slow changes to height and weight, and the fact that anthropometric outcomes are particularly susceptible to measurement error (especially for younger children). Recent evidence also illustrates that cash transfers are more effective in reducing undernutrition when combined with training sessions, or social and behaviour change communication (SBCC) campaigns (Field & Maffioli 2020).

Lastly the paper provides suggestive evidence that Bolsa Familia has led to an increase in overweight. The third hypothesis tested in the paper (*H 1.3: The programme has led to an increase in overweight and obesity among its beneficiaries)* can at least not be rejected. This finding is in line with the papers from Attanasio et al. 2005, Fernald et al. 2008b, Forde et al. 2012, Leroy et al. 2013 which suggest that cash transfers may increase overweight and obesity. On the other hand, the finding contradicts the studies by Fernald et al. (2008a) and Levasseur 2019 which found that the conditional cash transfer programme *Oportunidades* in Mexico has reduced overweight and obesity. A possible explanation for this, is that the Mexican Oportunidades is already "obesity-sensitive", while Bolsa Familia is not. The Mexican conditionalities include e.g. the regular participation in trainings sessions (*pláticas*) which provide *inter alia* information on healthy diets. Explicitly testing the effectiveness of obesity-related conditionalities, as under Oportunidades, should therefore also be considered a priority for further research. Lastly, it should be noted that all available studies on the issue have been conducted in Latin America. Apart from this paper on Brazil, there is evidence from Mexico, as well as Colombia. Future research projects on the issue could prioritise gathering evidence from other continents, most notably the middle-income countries in Africa and Asia in order to verify the external validity of the Latin American studies.

Paper 2 has not detected any statistically significant evidence for an effect of health insurance on nutritional outcomes, on average. The first hypothesis tested in this paper (*H2.1: The Mexican health insurance programme Seguro Popular has reduced undernutrition among its beneficiaries)* therefore needs to be rejected. Our results suggest that the expansion of health insurance to low-income households in Mexico did not exert an average effect on undernutrition among children in Mexico. This finding is not in line with the findings of Wagstaff & Pradhan (2005) who showed that poverty-targeted health insurance in Vietnam did lead to improved anthropometric outcomes. A possible explanation for the different results may lie in the fact that Vietnam experienced much lower levels of income and a higher prevalence of food insecurity during the survey period.

The second hypothesis (*H2.2: Seguro Popular has reduced overweight and obesity among its beneficiaries)* also needs to be rejected. Our paper did not detect any statistically significant impact on overweight and obesity. This finding contradicts two studies from the US based on data from the 1980s and 1990s which showed that health insurance coverage lead increases overweight and obesity (Bhattarchya et al. 2009, Rashad and Markovitz 2009), possibly due to a moral hazard effect. However, our finding is in line with studies based on more recent data which did not detect any impact on overweight/obesity, or even a reduction in overweight and obesity (Simon et al. 2016, Rhubart 2018). Overall, the more recent studies, including our analysis on Seguro Popular, suggest that health insurance does not improve nutrition-related diseases such as overweight and obesity by itself. Complementary interventions, as e.g. free nutrition-related counselling covered by the health insurance packages, might thus be needed in order to increase preventative efforts.

Laslty, we cannot rule out that our finding of zero impact may also be due to low statistical power or the relatively short time frame between survey waves in our study setting. Additional research based on a larger sample of analysis, e.g. drawing on the forthcoming fourth survey wave of the MxFLS would be important in order to corroborate the results based on the second and third wave of the survey.

Paper 3 has shown based on country-level macro data that the increasing "gender obesity gaps" in the MENA region are associated with low levels of economic and political participation of women (as measured by the female labour force participation and the share of female MPs) – an effect which is also robust to the inclusion of country-level fixed effects. The first research hypothesis for this paper (*H 3.1: The political and economic participation of women leads to lower levels of overweight and obesity among women in the MENA region)* has thus been confirmed. The findings are in line with previous research which showed that the empowerment of women can lead to a reduction of undernutrition (Malapit and Quisumbing 2015, Malapit et al. 2013, Cunningham et al. 2014), as well as the literature indicating a negative association between women empowerment and gender obesity gaps (Wells et al. 2012 and Garawi et al. 2014). The fixed effect estimates in our paper suggest that there is indeed a causal relationship between female economic/political participation and gender obesity gaps.

However, the second research hypothesis for this paper was rejected (*H 3.2: The effect of political and economic participation on overweight and obesity does not differ between the MENA region and other parts of the world.)* Indeed, our paper shows that the worldwide association between women empowerment and gender obesity differences, which was also described by Wells et al. (2012) and Garawi et al. (2014), is entirely driven by the MENA region. Once the MENA region is partialled out, the worldwide association between empowerment and obesity disappears.

As a next step, it would be important to investigate whether this cross-country pattern also holds at the individual or household level. An analysis of microdata could also help to corroborate the initial that the relationship between empowerment and lower gender obesity gaps is indeed causal. Secondly, it would be relevant to test whether empowerment also influences gender gaps in other measures of health. Third, it may be interesting to investigate further why the relationship between empowerment and gender obesity gaps only holds in the MENA region, but not in other parts of the world.

Paper 4 has confirmed the research hypothesis 4.1. (*H 4.1: Social learning has contributed to the adoption of recommended nutrition-practices among non-participants of an SBCC campaign, who live in the proximity of participating households),* and provided empirical evidence that behaviour change campaigns may create spillovers to non-participants. The paper thus confirms that previous findings on social learning from the fields of agriculture (Bandiera & Rasul 2006, Conley & Udry 2010) as well as microfinance (Banerjee 2013), and the initial evidence on social learning and spillover effects regarding preventative health behaviours (Miguel & Kremer 2003, Hoddinot et al. 2017). It also confirms the predictions of theoretical SBCC models (e.g. Michie, van Stralen and West 2011) which underline the importance of social network interactions in the context of behaviour change campaigns. Moreover, it adds to the generally encouraging literature on the potential of SBCC campaigns to change behaviours (e.g. Kim et al. 2019, Luby et al. 2018, Null et al. 2018, Menon et al. 2016), and underlines that these interventions may have a wider reach than among the direct participants of trainings and/or counselling interventions. The social benefit of these interventions is therefore larger than shown in impact evaluations which only focus on the participants of the trainings. It is important to take this into account in both impact evaluations and cost-benefit-assessments of related interventions.

Lastly, hypothesis 4.2 has also been confirmed (*H 4.2* : *Changes in knowledge and practices are more pronounced among individuals who were directly exposed to trainings within the SBCC campaign, as compared to those who were only exposed to spillovers / social learning effects.)* Indeed, the treatment effects among those households who were exposed to the intervention through spillovers are consistently smaller than for those who participated in the trainings themselves. This is also in line with previous studies on social learning (e.g. Bandiera & Rasul 2006, Conley & Udry 2010). For the SBCC literature and models, this implies that social network effects alone cannot be expected to induce health-related behaviour change to the same extent than targeted trainings. The paper also suggests that social learning effects on certain nutrition-related topics are larger than for others. It would be interesting to investigate on the determinants of these patterns, as well as their impact on nutritional outcomes which has not been feasible within this study.

2. Implications for policy

In terms of policy implications, paper 1 shows that social assistance cash transfer programmes increase their beneficiaries' food consumption expenditure, but may also change food consumption choices (increase in spending on dairy and sweets) and potentially contribute to an increase in overweight among children. While the increase in overall food expenditure is intended within these programme's focus on poverty reduction, the latter effect is unintended and might need to be addressed by accompanying measures. Recent papers from Mexico show that cash transfers may reduce obesity if they are linked to nutrition-related information and training. Combining cash transfer programmes with complementary information and education sessions may therefore be a viable option to simultaneously reduce poverty and obesity.

Paper 2 has shown that the provision of free health insurance alone may not be sufficient in order to reduce overweight and obesity among low-income households. It may therefore need to be combined with other supply-side interventions (e.g. offers for regular nutrition-related checkup, counselling, and/or treatment) in order to be effective. Moreover, policy makers should be aware of the risk of moral hazard effects and ideally combine insurance coverage with other measures that may reduce these effects.

Paper 3 has illustrated a negative association between female empowerment and gender obesity gaps. As mentioned above, additional research on the causality of this pattern is required. However, if the initial evidence on causality is corroborated, this implies that policies to empower women can also reduce gender-based obesity gaps and, potentially, reduce other gender-based health disparities.

Paper 4 has shown that social and behaviour change communication campaigns can play an important role in improving both knowledge and practices of parents regarding child nutrition. This is not only true for the direct participants of these programmes, but also for neighbouring households. It should be noted that the evaluated intervention has been implemented in rural communities in Mozambique, which are characterised by extreme poverty and generally low levels of education, where less than half of the interviewed adults are literate. This underlines the potential of interpersonal communication to improve nutrition, even within marginalised populations which may not be easily reached by other interventions (e.g. paper-based information, mass-media campaigns).