INTIMATE PARTNER VIOLENCE AND CHILD GROWTH: THE EFFECT OF DOMESTIC ABUSE ON CHILDREN LENGTH-FOR-AGE Z-SCORES

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i. Abstract

This paper looks at the long-term health effect of domestic violence on children's growth in Egypt. Most often, the literature focuses on the psychological effect on the children with a few exceptions that focus on physical health. This being said, studies that look at the effect on children's nutritional status are scarce and do not draw out the causal relationship between both variables. Using data from the Egyptian Demographic Health Survey (EDHS) of 2014, the objective of this paper is to provide causal evidence for domestic violence's impact on children's development and growth through an instrumental variable: female genital cutting. Given that domestic violence questionnaires are available for a subsample of the population, we focus on a reduced form model where we look at the effect of mother's female genital cutting on children's physical health. We find evidence of a statistically significant causal effect of female genital cutting on long-term malnutrition in Egyptian children under five. Having a mother who has had a genital cutting reduces mean z-scores of length-for-age by 0.47 standard deviation. We also provide evidence that female genital cutting increases the probability of being a victim of domestic violence in a significant way. Thus, the impact of female genital cutting on children's physical health flows through domestic violence. To provide evidence that goes beyond the average effect, we conduct a distributional analysis. Our distributional analysis suggests that, at z-scores less than -2, the difference in the treated (mothers who are victims of genital mutilation) and untreated groups is due to differences in characteristics between both groups, however at z-scores equal or higher than -2, the differences between the treated and the control group are not explained by differences in characteristics. This means that female genital cutting has a negative impact on children physical health but not to the extent of increasing the probability of stunting.

1. Introduction

Although violence against women is globally recognized as a fundamental human rights violation, the World Health Organization (WHO) estimated that one in three women in the world has experienced physical and/or sexual assault at some point in her life (WHO, 2013). The consequences of domestic violence are substantial and range from the physical and mental harm of women and their children to economic losses at the community and national levels. Being a victim of physical violence is associated with having poor health, depressive symptoms, substance abuse problems, and developing chronic diseases and mental illnesses in both developing and developed countries (Coker et al., 2002; Ackerson and Subramanian, 2008; Ellsberg et al., 2008).

The WHO also showed that intimate partner violence has non-negligible economic costs as it leads to an increase in health expenditures, loss of income, decreased productivity in the workforce as well as reduced human capital formation (WHO, 2013). In the United States, the cost of intimate partner violence was estimated at $5.8 billion per year, an estimate that includes the cost of medical services and the cost of lost productivity (CDC, 2003). Ribero and Sánchez (2005) estimated the cost of domestic violence due to lost labor earnings of Colombian women to 7.1 billion pesos ($2.5 million USD) or approximately 3.2% of the country's GDP in 2003. Estimates such as the ones presented above are more likely to represent a lower bound of domestic violence's true economic cost given that domestic violence is often under-reported and that these studies do not account for indirect costs such as those entailed by behavioral problems of children who witness domestic violence or the fact that those children are more likely to grow up to have less successful economic outcomes.

Being the primary caregivers, women's physical and mental safety is paramount when it comes to her child's health, whether it be through a safe pregnancy, early life development of the

child or via the women's capacity to take proper care of the household (Ludermir et al., 2008; Ishida et al., 2010, Grépin et al., 2015, Panico et al., 2019; Sangalang et al., 2017). Early childhood is a critical period that shapes possible life outcomes. For instance, malnutrition in the first years of life has adverse consequences throughout the life course. The United Nations Children's Fund (2013) has estimated that, in poor countries, addressing malnutrition in children could grow GDP by as much as 3.0%, making it a subject of interest when it comes to reducing inequality. Malnourished children have a weaker immune system, higher mortality rates, decreased physical capabilities, poorer school performance which subsequently leads to lower employment opportunities and lower income (United Nations Children's Fund, 2013). Moreover, exposure to domestic violence is linked with lower birth weight, lower IQ scores, and increased emotional and behavioral problems (Sternberg et al., 1993; Koenen et al., 2003; Wolfe et al., 2003; Aizer, 2011). For children who suffer from social and emotional problems caused by domestic violence, spillover effects can often happen, such as a decrease in the academic achievement of classroom peers (Carrell and Hoekstra, 2010).

Knowing that the consequences go beyond the localized physical impact on the mother and spillover on children, understanding the link between domestic violence and children malnutrition could help improve human capital quality and stimulate economic growth. The mother's health, mental state and social situation all impact the child prenatally (if exposed to violence when pregnant) and, being the main caretaker, it will impact the child and interfere in his development. Although the consequences of domestic violence have been documented, causal impacts are difficult to draw out as one can easily conceive many scenarios where violence and children's health outcome can simultaneously be impacted. Also, there is minimal evidence about channels through which domestic violence could be reduced.

As this paper focuses on the Egyptian context, it is essential to understand the social and economic context to which women are exposed and how it can affect the prevalence of domestic violence as this may point us to channels that could allow us to tease out causality. One characteristic particular to the Egyptian tradition that is also a type of gender-based violence is the high prevalence of female genital cutting. For example, in 2014, 89.7% of 15 to 49-year-old ever-married Egyptian women were victims of female genital cutting (EDHS, 2014). The WHO defines female genital cutting as 'any procedures involving partial or total removal of the external female genitalia or other injury to the female genital organs for non-medical reasons.' These practices have no known health benefits and, on the contrary, are known to be harmful in many ways (WHO, 2008). Both being domestically abused and having undergone female genital mutilation are reflective of strong inequalities between women and men and are deemed as barbaric habits. Excising a young woman could be associated with having more chances of being exposed to domestic violence later on in life. As female circumcision of the mother does not directly affect the child's nutritional status, this leads us to believe that female genital cutting can be used as an instrumental variable for domestic violence.

In this paper, we study the effect of being a victim of domestic violence on children's health outcomes. Intimate partner violence is a multidimensional and complex issue that is usually categorized into physical, psychological and sexual violence. For the purpose of this study, we concentrate on women who have experienced any type and any combination of the said types of domestic violence. By using an instrumental variable, female genital cutting, we are able to establish a causal relationship between domestic violence and children's health. The long-term effect on children's nutritional outcome, stunting, will be measured using length-for-age z-scores based on the WHO 2006 standards. This paper contributes to the literature by providing evidence

of a causal impact between intimate partner violence and poor health in children. To our knowledge, there is no paper that examines this relationship that was able find causality between length-for-age z-scores of children and domestic violence. Findings suggest that domestic violence reduces mean z-scores of length-for-age by 0.47 standard deviation.

This paper is structured as follows. Section 2 presents the literature review. We describe my empirical identification strategy in Section 3. In section 4, we briefly describe the data and provide summary statistics of the sample. Section 5 provides the main results and the analysis of the relationship between domestic violence and the outcome of interest. Section 6 concludes.

2. Literature review

It is an established fact that economic growth has a bidirectional relationship with poverty, lack of opportunity, welfare and gender inequality (Duflo, 2012). Amartya Sen argued that economic development is not only about increased incomes but about expanding freedom and addressing inequality. Investing and promoting gender equality are of the utmost importance when it comes to sustainable economic development. In other words, the empowerment of women can accelerate development especially when giving them access to health, education, earning opportunities, rights, and political participation (Duflo, 2012). Previous literature supports the theory that gender inequality increases poverty, decreases other welfare measures, and reduces economic growth (Knowles et al., 2002; Klasen, 2004).

Domestic violence is a social illness and is a human right violation that affects all class status. It also reflects women's low bargaining power and widens the disparity between men and women (Aizer, 2010). While women are the primary victims and their health is directly impacted, the effects of such a violence is far reaching and is not without spillovers on children who are often indirect victims of this abuse. Such violence may impact the child's development and nutrition prenatally and during early years through the decay of the mother's mental and physical health. Thus, domestic violence and infant malnutrition are linked by biological and behavioural paths. On one hand, impairment of prenatal maternal health might disturb fetal development. For instance, distressed pregnant women have higher chances of giving birth to underweight newborns (Valladares et al., 2009), a condition that can persist as they grow up (Saigal and Doyle, 2008). On the other hand, disrupting maternal postnatal health could hinder the child's growth by impairing his stress-response (Yount et al., 2011). These detrimental effects have long lasting impacts on

child educational outcomes and future labour market outcomes (Cunha and Heckman, 2009; Doyle et al., 2009; Heckman, 2006).

In a systematic review concerning domestic violence, and child growth and nutrition, Yount et al., (2011) bring to light the different pathways of influence through which children's development can be altered by domestic violence. Understanding these pathways is key to producing a research that targets often encountered problems when working on domestic violence such as endogeneity. Through the review of a variety of papers with different publication dates, regions, study designs, sample sizes and more, they identify some firsthand and secondhand pathways that influence the prevalence of malnutrition in children and intimate partner violence. Using these identified pathways, they develop a conceptual framework of the relationship between domestic violence and malnourishment of children, which is summarized in figure 1. As seen below, they found several studies linking the family's socioeconomic context with the prevalence of domestic violence, which influences the child's health indirectly through his stress-responsive biological regulatory systems (pathway A in figure 1). Many papers they reviewed also point out the fact that domestic violence may instigate maternal mental, physical and nutritional symptoms which lead to risky prenatal and postnatal behaviour as well as hampers fetal growth (pathways B, C, D, E in figure 1). The child's own attributes also contribute to his nutrition behaviour while community context influences both domestic violence and child development.

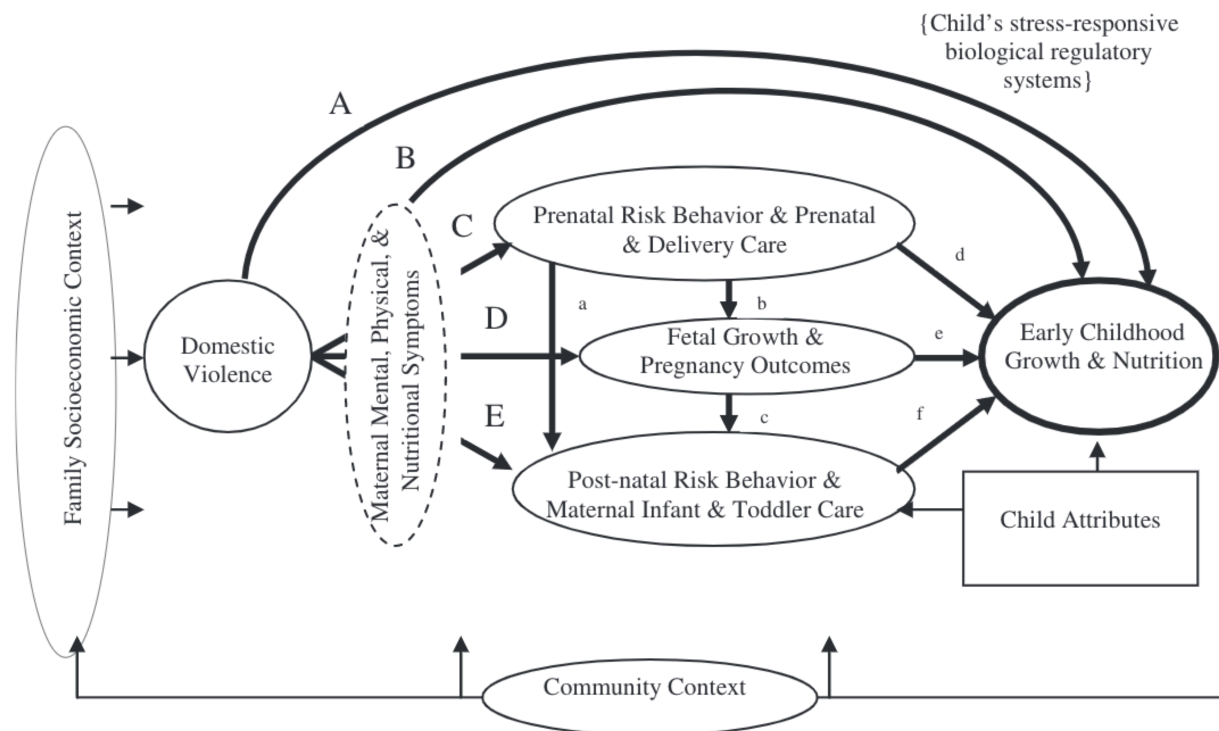


Figure 1. Adapted from 'Impacts of domestic violence on child growth and nutrition: A conceptual review of the pathways of influence', by K. M. Yount et al., 2011, *Social science & medicine*, *72*(9), 1534-1554

From the beginning of the pregnancy, the child can be directly and indirectly affected by domestic violence *in utero*; directly through blunt trauma, and indirectly through exacerbation of pre-existing chronic illnesses (e.g. diabetes, hypertension, asthma), elevated stress, meager prenatal care, risky behaviours (e.g. smoking) and poor maternal nutrition (Newberger, et al. 1992). Therefore, it is relevant to examine previous literature linking domestic violence and birth outcomes such as birth weight, duration of gestation, and infant and foetal mortality. A study by Aizer (2011) showed the relationship between domestic violence during pregnancy and newborn health in the United States. Using data on maternal hospitalizations in the year prior to birth and natality data, which is not subject to self-reporting bias, the author first estimated the effect of hospitalization for an assault while pregnant on newborn health (birth weight, fetal death, infant

death) by ordinary least squares (OLS) regressions with a wide range of controls. The author then corrects for selection on the unobservables of women into violent relationships through the standard Heckman correction, using a latent index of underlying violence. Moreover, to estimate parameters by taking into account selection on the observables, the author also presents results for the matching of women who were not hospitalized prior to birth to women who were by matching them on characteristics such as marital status, race, insurance, education, age, county, year of birth, paternal race, paternal education and whether paternal information was available. Aizer found evidence that poor, less educated, minority women are more likely to be victims of an assault that requires medical attention while pregnant. The author found a decrease in birth weight of 189 grams when applying only OLS regressions and controls, a decrease in birth weight of 163 grams when applying controls and the Heckman correction, and a decrease in birth weight of 159 grams when applying matching as an identification strategy.

As the child grows up, the repercussions of domestic violence on his health remain non-negligible (Rico et al., 2011; Chai et al. 2016; Sobkoviak et al. 2012). Considering that being a woman victim of domestic violence is endogenous, previously applied control variables and econometric methodologies can be informative for the selection of our controls and model. Rico et al. (2011), Chai et al. (2016) and Sobkoviak et al. (2012) analysed the connection between intimate partner violence and children's nutrition using logistic and/or linear regressions, controlling for many variables in both cases. Sobkoviak et al. (2012) analysed the effect of domestic violence on child nutrition in Liberia. Using data from the 2007 DHS, they used the z-scores for the child's weight-for-height, weight-for-age, and length-for-age as a determinant of their nutritional status. Weight-for-height provides an outlook on recent health as it is a more sensitive measure, if the child's z-score is less than two standard deviations below the median

weight-for-height then the child is considered wasted. Weight-for-age gives an overall picture of nutritional status according to age, if the child's z-score is less than two standard deviations below the median weight-for-age then the child is considered underweight. Length-for-age reflects more long-term nutritional status from in utero to early childhood, if the child's z-score is less than two standard deviations below the median length-for-age then the child is considered stunted. Controls used include types of domestic violence (physical, sexual, emotional), household characteristics (number of household members, number of other children under five, wealth quintile, region), mother characteristics (body mass index, age, marital status, education) and child characteristics (gender, age, birth order). After running both linear and logistic regressions, they concluded that the relationship between anthropometric measures in children less than five and sexual domestic violence is significant and most evident for underweight and stunting of children. The OLS regression shows that the children of mothers who reported being victims of domestic violence had a 0.41 lower mean weight-for-height and a 0.48 lower mean length-for-age z-score and the logistic regression shows 2.6 times higher odds of underweight and 2.2 times higher odds of stunting for said children.

Rico et al. (2011) ran logistic regressions and used similar controls as Sobkoviak et al. (2012) but also control for the duration of breastfeeding, having received BCG vaccination, having proper antenatal care, having had a skilled delivery, and having received the tetanus toxoid vaccination. They found a statistically significant association for moderate child stunting (z-score is less than two standard deviations below the median measure) in Kenya, with an adjusted odds ratio of 1.36 (95% confidence interval of 1.16 to 1.61) if the respondent was exposed to any type of domestic violence. More applicable controls were uncovered by Chai et al. (2016) who used data from the DHS of 42 different countries and further controlled for maternal employment status,

use of contraception and partner's education. They found that maternal exposure to any intimate partner violence increased the odds of stunting by 11%.

Because domestic violence is a by-product of low bargaining power and therefore low empowerment of women, previous literature on the link between low empowerment and poor health outcomes of children can provide useful insights and strengthen the belief that accounting for women's empowerment when studying domestic violence is necessary. This relationship is unveiled in a research by Imai et al. (2014) as they identify the effect of women's empowerment measured via her education attainment relative to the father's, being a victim of domestic violence, and her autonomy on children's nutritional status in India. Variables of women empowerment include ratio of schooling years (mother/father), whether a husband beats his wife if she is unfaithful, and whether a wife is allowed to go to the market without her husband's permission. They find that the share of mother's schooling years over father's schooling years is positively and significantly associated with z-scores concerning short-term measures of nutritional status of children.

As might be expected, domestic violence and children malnutrition are both embedded in a cultural and social context that can differ from country to country. Research done with Egyptian data can shed light on covariates that are particular to this region and its norms. Controls such as the woman's ability to go places without permission, her financial independence, her husband being a blood relative, having a male offspring, and having discussed family planning with said husband are taken into consideration by Diop-Sidibé et al. (2006) when probing domestic violence in Egypt. In parallel, El Maqsoud et al. (2011) find an odds ratio of 3.2 for the effect of a positive history of female genital mutilation on intimate partner violence. They also controlled for a woman's exposure to physical violence during childhood, her own mother's exposure to domestic

violence and having a jealous husband. As for children malnutrition, Rashad and Sharaf (2016) address the issue using Egyptian DHS data. Controls used in the context of Egypt include child's sex, being a twin, mother being malnourished, and being born in a risky birth interval. They reported that, in 2008, 29% of children under five were stunted, 7.2% were wasted, and 6% were underweight that is respectively, z-scores for length-for-age, weight-for-height and weight-for-age lower than -2 standard deviations.

Authors of previously mentioned papers have often attempted to identify consequences of intimate partner violence in similar ways; through controls and using either logistic or linear regressions. Aizer (2011) was able to find a causal relationship between birth weight and domestic violence. Along the same lines, this paper seeks to assess the causal impact of domestic violence on children's long-term growth while using a comprehensive set of controls and doing it in a novel way that will account for selection on the observable and unobservable characteristics.

3. Identification strategy

Following Rico et al. (2011), Chai et al. (2016) and Sobkoviak et al. (2012), this paper will investigate the impact of domestic violence on children's nutritional status. Our treatment group is therefore children whose mothers were victims of domestic violence and our control group is children whose mothers were not victims of domestic violence. As this paper is a first step of a more elaborate research project, only the last-born child will be considered for the time being[1].

Teasing out the causal relationship between domestic violence and children's nutritional outcome is difficult and presents two main identification issues. First, when looking at married households one has to consider the issue of assortative matching: people who are alike tend to get married. For instance, one may think that people with violent tendencies would get married together. Thus, a violent man who beats his wife would be married to a violent wife who in turns beats/mistreats her children which in turn would lead to lower children physical and psychological health. One common way to address this assortative matching issue is to assume that selection into marriage is made based on observed characteristics or time invariant characteristics. In the context of this paper, we will assume that matching (or selection into marriage) is made based on observed characteristics (e.g, age, education, wealth, religion) and that unobserved characteristics such as personality traits do not play a role. Thus, by controlling on observed characteristics this assortative matching issue is taken care of. We believe that this assumption is reasonable in a conservative country where intimacy is at a very low level before marriage. More specifically, in the Egyptian culture, arranged marriages are far from uncommon. Indeed, in this society where even premarital friendship is frowned upon, arranged marriages, or 'salon marriages' as Egyptians call them, are a way to look for a suitable husband, while preserving one's reputation. The

[1] This paper is an exploratory work in collaboration with Paul Makdissi and Myra Yazbeck and part of their larger research project on children nutrition in the MENA region.

appellation comes from the fact that the couple usually have their first meeting in the sitting room under the supervision of the families. The woman or man is usually recommended by a matchmaker or a certain trusted middle-person. The middle-person will take into account preferences which are often based on looks, education, religion, age and wealth. After both parties have given their consent, no time is wasted, and the couple is usually married in a matter of months (Fayed, 2014). This narrative supports the idea behind controlling for observed characteristics which are reported in the EDHS such as education of both spouses, religion, age and wealth. The list of preferred characteristics given to the middle-person is similar to the covariates we control for with the exception of looks ('beauty'). If we assume that beauty is randomly distributed among the population, we are in a framework where we can assume uncondfoundedness for the marriage match.

Second, the relationship between domestic violence and children's nutritional outcome can also be due to unobserved characteristics of the husband that may affect both violence and the length-for-age z-score. For instance, if we think of an impulsive man with lack of control, we can assume that this same person may both be violent and have difficulty managing their finances. This will increase at the same time both the odds of domestic violence and the odds of food insecurity and will lead to a spurious relation between domestic violence and children's nutrition status.

As mentioned earlier, understanding the social context of the studied country can steer us towards a better identification of the causal relationship. In the case of Egypt, the prevalence of female genital cutting in 2014 was of 89.7% among 15 to 49-year-old ever-married women (EDHS, 2014). Since having a mother who has undergone female genital cutting cannot directly impact the child's health outcome, it is a variable of choice for an instrumental variable regression.

Indeed, the instrument satisfies the assumptions behind an instrumental variable: exclusion restriction, relevance, monotonicity of the instrument and exogeneity. Exclusion restriction stipulates that the instrumental variable cannot have a direct impact on the outcome variable: considering that female genital cutting is a decision taken by the maternal grandparents, it cannot directly impact the child's health but can indirectly affect him/her through domestic violence. Also, the mother female genital cutting decision is not linked with unobserved heterogeneity of the father, the mother or the children since neither of them took part in the decision to excise the mother. Under the relevance assumption, there exists an association between female genital cutting and domestic violence (the instrument satisfies this condition). The monotonicity assumption requires that, in defining women who are not battered whether they are circumcised or not and women who are battered whether they are circumcised or not, we assume that no same woman is battered if not circumcised but would not have been battered if she had been circumcised. As for exogeneity, the extensive set of controls used makes it highly unlikely that the instrument is correlated with the error term in the main regression. Moreover, we assume that the grand-parent's choice to excise is orthogonal to the mother's beauty and the father's heterogeneity (impulsivity and other). Another important assumption here is that there is no reverse causality: a child's nutritional status is not the cause of intimate partner violence between his parents. The same assumption was made by Rico et al. (2011) since it is improbable.

3.1 First part of the estimation strategy

To estimate the relationship between intimate partner violence and children's health outcome, we will estimate the reduced form equation by using female genital cutting as a perfect predictor of domestic violence and observe the average effect on the z-scores of length-for-age of children. We have the following instrumental variable model:

$$Health_{ijkl} = \alpha + \beta_1 Violence_j + \delta_1 X + \varepsilon_{ijkl} \quad (1)$$

Where,

$$Violence_j = \lambda + \gamma_1 FGC_j + \eta_j \quad (2)$$

Here, $Health_{ijk}$ represents the z-score of length-for-age of child i, of mother j and father k, in household l. $Violence_j$ is a dummy variable that indicates if the mother is a victim of domestic violence, whether it be verbal, physical or sexual. $Violence_j$ is instrumented with female genital cutting (FGC_j) in equation (2). As for X, it reflects child-level, mother-level, father-level and household-level controls.

However, considering that the first-stage of the instrumental variable regression has a binary dependent variable (violence), we are not able to estimate the standard instrumental variable regression since it is a *forbidden regression*. In addition, the domestic violence questionnaire is only given to a sub-sample of the population which will reduce our sample size by more than 50%. For these two reasons, we will instead estimate the reduced form equation by posing:

$$Violence_j = FGC_j \quad (3)$$

Giving us:

$$Health_{ijkl} = \alpha + \beta_1 FGC_j + \delta_1 X + \varepsilon_{ijkl} \quad (4)$$

With the reduced form effect strategy, the treatment group is not composed exclusively of women who have in fact been exposed to domestic abuse and, in the same order of ideas, the untreated group is not composed exclusively of women who have in fact never been exposed to domestic abuse. Indeed, we have four possibilities. There are the women who would have been victims of domestic violence whether or not they suffer female genital cutting (1), there are women who would have never been victims of domestic violence whether or not they suffer female genital cutting (2), there are women who are victims of domestic violence if they have undergone female

genital cutting and are not victims of domestic violence if they have not undergone female genital cutting (3), and finally there are women who are victims of domestic violence when they are not excised but would have not been victims of domestic violence had they been excised (4). Our monotonicity assumption rules out the former possibility. As no woman is observed in the first two groups, we cannot build the theoretical construction mentioned above. Group (3) however allows us to infer that the proportion of women who are victims of domestic violence and are in the treated group (excised women) is larger than the proportion of these women in the untreated group (women not excised). We assume that, conditional on X, the probability of being a woman of type (1), (2) or (3) is the same in the treatment and no treatment groups. This assumption permits us to identify the impact based on the women of group (3) which is just a proportion of women of group (3) mixed with others of groups (1) or (2) depending on which treatment group we are looking at. In order to understand the impact of this mix, we consider what it means to have women victims of domestic violence in the untreated group and having women not victims of domestic violence in the treated group. Having women victims of domestic violence in the untreated group would lower the z-scores of this group while having women who are not victims of domestic violence in the treated group would raise the z-scores of this group. Seeing that the two effects move the z-scores of the two group closer to each other, if we still capture an effect based on the women of group (3), it then means that this is a lower bound of the impact of domestic violence.

As women who are victims of domestic violence are inherently different from women who are not (Aizer, 2010; Yount et al., 2011), we want to take into consideration selection bias. An instrumental variable reduced form can account for unmeasured confounding variables but controlling for characteristics of the mother, the father, the child and the household will bring us closer to a causal relationship by accounting for observed confounding variables.

Explanatory variables

The main explanatory variable captures maternal domestic violence. We want to look at the impact of any type of domestic violence on her last-born child and will incorporate any woman who answered the domestic violence portion of the survey. As for female genital cutting, it was assessed through the main EDHS questionnaire.

Outcome variable

For the outcome variable, we will be looking at stunting in children under five years old as it has a high prevalence in Egyptian children (21.4%) and was the health outcome where previous literature found the most impact (Rico et al., 2011; Chai et al. 2016; Sobkoviak et al. 2012). To do so, we use length-for-age z-scores which reflect long-term cumulative linear growth. Z-scores are generated by taking the child's length-for-age, subtracting the median length-for-age of the reference population and then dividing by the standard deviation of length-for-age of the reference population. The reference population's standards were developed by the WHO in 2006. They are international growth standard statistical distributions which describe the growth of children under five living in an environment that supports optimal growth of children, in six countries throughout the world. Moreover, z-scores under -6 and over 6 are flagged as they are considered unrealistic. Children with z-scores of length-for-age that are under -2 are considered stunted. Failure to reach linear growth potential is associated with suboptimal nutrition conditions, poor socioeconomic conditions and increased risk of exposure to illness (WHO, 2019).

Controls

Based on previous research, we want to adjust our findings for household, maternal, paternal and child characteristics. For the household controls, we include the wealth factor, living in an urban/rural region, number of children under five in the household and number of people in

the household. For the child's controls, we look at his sex and whether the child is a twin. For the maternal controls, we use the mother's religion, age, education, whether she is employed, whether she has given birth to sons and the age at which she began cohabiting with her husband. As for the paternal controls, we take into account the father's age and his education.

A priori, we expect to see that children whose mothers where victims of domestic violence have lower z-scores than their counterparts.

3.2 Second part of the estimation strategy

As domestic violence instrumented by female genital cutting can have an effect on mean z-scores of length-for-age, it is also important to probe the distribution of z-scores and examine the variation of the impact across the 25th, 50th and 75th quantiles using conditional quantile regression estimation (Koenker and Bassett, 1978). If there are differences in the impact over the different quantiles, we proceed with a distributional analysis under the same assumptions as before.

We will denote z-scores of length-for-age as Y and X as the relevant characteristics of the mother, father, child and household highlighted in the first part of the estimation strategy. Keeping our reduced form effect strategy, the treated group, women who have undergone female genital cutting, is referred to as 1 whereas their counterparts are referred to as group 0. Following Chernozhukov et al. (2013), we estimate a model of $F_{Y|X}(y \mid x)$ that describes the stochastic assignment of z-scores of length-for-age with characteristics x for groups 0 or 1. We only observe $F_{Y_1|X_1}(y \mid x)$ and $F_{Y_0|X_0}(y \mid x)$, therefore we need a counterfactual to draw out the difference in child health between both groups that is due to the fact that the mother has undergone female genital cutting. A counterfactual can be created in the following way:

$$F_{Y<i,j>}(y) = \int_{x_j} F_{Y_i|X_i}(y \mid x) \, dF_{x_j}(x) \quad (5)$$

And:

$$Q_{Y<i,j>}(\tau) \coloneqq F^{-1}_{Y<i,j>}(\tau) \quad (6)$$

Where,

$$F^{-1}_{Y<i,j>}(\tau) = \inf \{ y: F_{Y<i,j>}(y) \geq \tau \} \quad (7)$$

Here, i,j are the untreated/treated group. Using the constructed counterfactual, we can carry out a decomposition in the style of Oaxaca-Blinder which will allow us to isolate the effect of violence on children's z-scores that is not explained by the characteristics and therefore purely due to being in the treatment group:

$$\underbrace{Q_{Y<1,1>}(\tau) - Q_{Y<0,0>}(\tau)}_{\text{Total effect}} = \underbrace{Q_{Y<1,1>}(\tau) - Q_{Y<0,1>}(\tau)}_{\text{Structural effect}} + \underbrace{Q_{Y<0,1>}(\tau) - Q_{Y<0,0>}(\tau)}_{\text{Composition effect}} \quad (8)$$

The structural effect is the portion of the difference in z-scores between the treated and the untreated group that are attributable to having undergone female genital cutting whereas the composition effect is the difference in both groups that is attributable to differences in characteristics. We run 999 bootstrapped replications (Chen et al., 2016). The model is defined on all u in [ε, 1-ε]; for our empirical estimation we have chosen a grid of 100 points in [0.05,0.95]. The quantile regression estimator of the conditional distribution is calculated in the following way:

$$\hat{F}_{Yj|Xj}(y \mid x) = \varepsilon + \int_{\varepsilon}^{1-\varepsilon} 1 \left\{ x' \hat{\beta}_j(u) \leq y \right\} du \quad (9)$$

Where,

$$\hat{\beta}_j(u) = arg \min_{b \in \mathbb{R}^{dx}} \sum_{i=1}^{n_j} \left[u - 1\left\{ Y_{ji} \leq X'_{ji}\, b \right\} \right] \left[Y_{ji} - X'_{ji}\, b \right] \ \forall\, u \in [\varepsilon, 1-\varepsilon] \quad (10)$$

4. Data and descriptive statistics

The data is taken from the Egyptian DHS of 2014, which is the most recent survey with a domestic violence portion available for the country. The available data consists of 21,762 women who were ever-married of ages 15 to 49. The DHS is a comprehensive survey that includes questions about household characteristics, women's status, anthropometry, maternal health, family planning, disability, health conditions, health insurance, early childhood development and education. It occurs every few years in Egypt but does not always have the same sections nor the same content. The Egypt DHS is a four-stage stratified cluster sample and weights have been assigned in order to be representative of the population. The implementation was done under the supervision of the Ministry of Health and Population. We will focus our attention on women who have a last-born child under five years old. Finally, observations that were deemed unrealistic were excluded from the sample (length-for-age z-score under -6 and over 6).

Table 1 presents the descriptive statistics for the full sample of mothers who have a last-born child under five and who's z-score was neither missing nor flagged, and for the same sample restricted on whether the mother was selected or not for the domestic violence portion of the survey. We find no major differences in characteristics between the three groups.

Table 1. Sample descriptive statistics

	All Sample					Not selected for domestic violence survey					Selected for domestic violence survey				
	Obs	Mean	Std.Dev.	Min	Max	Obs	Mean	Std.Dev.	Min	Max	Obs	Mean	Std.Dev.	Min	Max
Female genital cutting dummy	10622	.886	.317	0	1	7255	.883	.322	0	1	3367	.895	.307	0	1
Wealth factor	10625	-.092	.816	-6.405	1.673	7258	-.103	.823	-6.405	1.673	3367	-.069	.801	-5.227	1.625
Household size	10625	5.284	2.433	2	31	7258	5.415	2.639	2	31	3367	5	1.884	2	22
Number of children under 5	10625	1.519	.819	0	9	7258	1.531	.855	0	9	3367	1.491	.735	0	7
Age at which mother cohabited with a man	10625	20.261	3.85	9	44	7258	20.251	3.861	9	44	3367	20.283	3.826	10	37
Religion	10615	.965	.184	0	1	7253	.964	.187	0	1	3362	.967	.178	0	1
Rural region	10625	.586	.493	0	1	7258	.59	.492	0	1	3367	.579	.494	0	1
Mother employed	10606	.13	.336	0	1	7245	.13	.336	0	1	3361	.129	.335	0	1
Mother has sons	10625	.788	.409	0	1	7258	.783	.412	0	1	3367	.799	.401	0	1
Mother does not have any education	10625	.168	.374	0	1	7258	.171	.377	0	1	3367	.161	.368	0	1
Father does not have any education	10625	.121	.326	0	1	7258	.122	.327	0	1	3367	.118	.323	0	1
Age of father	10625	35.285	7.579	14	90	7258	35.18	7.53	14	89	3367	35.513	7.68	18	90
Age of mother	10625	29.061	5.88	15	49	7258	29.024	5.857	15	49	3367	29.141	5.929	15	48
Sex of child	10625	.473	.499	0	1	7258	.475	.499	0	1	3367	.469	.499	0	1
Whether the child is a twin	10625	.021	.144	0	1	7258	.022	.147	0	1	3367	.019	.137	0	1

5. Results

Keeping in mind previous literature on the matter (Rico et al., 2011; Chai et al. 2016; Sobkoviak et al. 2012), we investigate the relationship between stunting and domestic violence. Although we find no statistically significant effect on the mean between the binary variable of stunting and domestic violence, there is a statistically significant mean effect on the continuous form of the variable, the length-for-age z-score. As seen in table 2, there is no marginal effect of domestic violence that indicates increased odds of being stunted, but we observe that children whose mothers are victims of intimate partner violence have on average a 0.14 lower z-score with p=0.056. We also note that, as expected, wealth, the education of the mother and her age show a statistically significant positive correlation with length-for-age z-scores. Since we have a correlation with the continuous variable, we will proceed with the analysis by focusing on the z-scores only as we have no evidence that violence has an effect on stunting.

To carry the proposed reduced form framework, we must first provide evidence that it is a reasonable way to proceed. We thus assess the presence of a correlation between female genital cutting and domestic violence. Using a probit regression, we find that being a victim of female genital cutting increases odds of being a victim of domestic violence by 6.9 percentage points with p=0.013, which confirms the relevance assumption required in an instrumental variable approach. Although the marginal effect of female genital cutting seems minor, it is the largest out of all statistically significant observed characteristics in the regression and thus the main driver of domestic violence. Wealth decreases the probability of being a victim of domestic violence while the husband having no education increases that probability.

Table 2. Regressions with the dependent binary variable stunting and the continuous dependent variable z-score of length-for age as a function of domestic violence

	Probit with stunting as a dependent variable			OLS with length-for-age z-score as a dependent variable		
	Marginal effect	SE		Coef.	SE	
Domestic violence	-0.001	0.015		-0.143	0.080	*
Wealth factor	-0.026	0.013	**	0.159	0.075	**
Household size	-0.002	0.005		0.018	0.025	
Number of children under 5	-0.016	0.010		0.098	0.059	*
Age at which mother cohabited with a man	0.001	0.002		0.006	0.013	
Religion	-0.028	0.039		0.068	0.241	
Rural	-0.050	0.020	**	0.188	0.122	
Mother employed	0.036	0.021	*	-0.212	0.115	*
Mother has sons	0.043	0.022	*	0.008	0.121	
Mother does not have any education	0.045	0.020	**	-0.302	0.119	**
Father does not have any education	0.041	0.022	*	-0.123	0.132	
Age of father	0.001	0.001		-0.009	0.007	
Age of mother	-0.007	0.002	***	0.023	0.011	**
Sex of child	-0.015	0.017		0.063	0.093	
Whether the child is a twin	0.087	0.048	*	-0.369	0.275	
Constant				-1.184	0.403	***

Mean dependent var	0.210	Mean dependent var	-0.404
SD dependent var	0.408	SD dependent var	2.222
Pseudo r-squared	0.013	R-squared	0.011
Chi-square	43.146	F-test	2.300
Prob > chi2	0.000	Prob > F	0.003
Number of obs	3356	Number of obs	3356

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

Errors are clustered at the geographical cluster level.

Table 3. Probit regression of domestic violence as a function of female genital cutting

Domestic violence	Marginal effects	SE	
Female genital cutting dummy	0.069	0.027	**
Wealth factor	-0.036	0.014	***
Household size	-0.001	0.005	
Number of children under 5	0.020	0.011	*
Age at which mother cohabited with a man	-0.010	0.003	***
Religion	0.079	0.048	
Rural	-0.050	0.021	**
Mother employed	0.039	0.023	*
Mother has sons	-0.051	0.026	*
Mother does not have any education	0.023	0.023	
Father does not have any education	0.054	0.026	**
Age of father	-0.001	0.002	
Age of mother	0.002	0.002	
Sex of child	-0.024	0.019	
Whether the child is a twin	0.005	0.059	
Constant			
Mean dependent var		0.302	
SD dependent var		0.459	
Pseudo r-squared		0.016	
Chi-square		60.033	
Prob > chi2		0.000	
Number of obs		3356	

**** p<0.01, ** p<0.05, * p<0.1*
Errors are clustered at the geographical cluster level.

After having established the correlation between our instrument and domestic violence as well as the correlation between our outcome variable and domestic violence, we proceed with the reduced form OLS regression to observe the average effect of female genital cutting on length-for-age z-scores. The results are reported in table 4. Using female genital cutting as a proxy of domestic violence shows that being a child to a woman who has suffered female circumcision and by extension, domestic violence, lowers z-score of length-for-age by 0.47 standard deviation with p=0.000. Moreover, the mother not being educated has a negative impact on the child's health and

reduces z-scores by 0.25. The same negative association can be made between the child being a twin and his z-score which will be lower by 0.34.

Table 4. OLS regression of length-for-age as a function of female genital cutting

Length-for-age z-score	Coef.	SE	
Female genital cutting dummy	-0.465	0.089	***
Wealth factor	0.092	0.049	*
Household size	0.009	0.013	
Number of children under 5	-0.006	0.031	
Age at which mother cohabited with a man	0.019	0.008	**
Religion	0.260	0.130	**
Rural	0.134	0.092	
Mother employed	-0.209	0.066	***
Mother has sons	0.064	0.070	
Mother does not have any education	-0.246	0.069	***
Father does not have any education	-0.019	0.075	
Age of father	-0.001	0.004	
Age of mother	0.006	0.007	
Sex of child	0.163	0.054	***
Whether the child is a twin	-0.337	0.144	**
Constant	-0.881	0.235	***
Mean dependent var		-0.357	
SD dependent var		2.229	
R-squared		0.011	
F-test		5.598	
Prob > F		0.000	
Number of obs		10593	

*** $p<0.01$, ** $p<0.05$, * $p<0.1$
Errors are clustered at the geographical cluster level.

Subsequent to having observed the average impact, we determine whether the effect seems constant or differs across the distribution of length-for-age z-scores. In table 5, we run three quantile regressions for the 25th, 50th and 75th quantiles using Koenker and Bassett's (1978) quantile regression estimation which yields the conditional quantile effect. At the 25th percentile, female genital cutting reduces z-score by 0.25. The 50th percentile shows a 0.56 reduction in z-

scores and at the 75th percentile, we have a decrease of 0.87. All three coefficients are statistically significant at the 1% level. The impact is heterogenous over the distribution of length-for-age z-scores and further distributional analysis allows us to better interpret the relationship between female circumcision and children's health outcome.

Table 5. Quantile regressions of length-for-age z-score as a function female genital cutting

	Q=0.25			Q=0.5			Q=0.75		
Length-for-age z-score	Coef.	SE		Coef.	SE		Coef.	SE	
Female genital cutting dummy	-0.252	0.082	***	-0.563	0.074	***	-0.872	0.107	***
Wealth factor	0.066	0.045		0.066	0.040		0.094	0.058	
Household size	0.004	0.013		0.000	0.011		0.016	0.016	
Number of children under 5	-0.036	0.035		-0.035	0.031		0.003	0.045	
Age at which mother cohabited with a man	0.007	0.008		0.014	0.007	*	0.025	0.011	**
Religion	0.189	0.138		0.380	0.124	***	0.457	0.179	**
Rural	0.195	0.068	***	0.063	0.061		0.057	0.088	
Mother employed	-0.199	0.077	***	-0.130	0.069	*	-0.175	0.100	*
Mother has sons	-0.041	0.080		0.042	0.072		0.097	0.104	
Mother does not have any education	-0.290	0.077	***	-0.185	0.069	***	-0.243	0.100	**
Father does not have any education	-0.138	0.084	*	-0.081	0.075		0.129	0.109	
Age of father	0.001	0.005		-0.003	0.004		-0.010	0.007	
Age of mother	0.014	0.007	*	0.006	0.007		0.007	0.010	
Sex of child	0.138	0.062	**	0.158	0.056	***	0.173	0.081	**
Whether the child is a twin	-0.506	0.178	***	-0.160	0.160		-0.546	0.232	**
Constant	-2.279	0.251	***	-0.784	0.226	***	0.592	0.327	
Mean dependent var				-0.357	SD dependent var			2.229	

*** $p<0.01$, ** $p<0.05$, * $p<0.1$
Errors are clustered at the geographical cluster level.

Finally, we examine the distribution regression model that we posed in the second part of the estimation strategy to show that average impacts may often miss meaningful effects. Figures 2 and 3 illustrate how the model compares to the sample quantile functions for the untreated group (not circumcised) and for the treated group (circumcised). The confidence intervals for the untreated group are wider as the number of women who have not undergone female genital cutting in Egypt is meager.

Having looked at the distributional effects, we perform the decomposition of the effect on the unconditional quantiles by integrating over the distribution of covariates. The results of the decomposition are reported in figure 4. At low percentiles, the differences in z-scores between the untreated and the treated are mostly explained by the characteristics, or composition effect. However, as the percentile increases, the difference in z-scores becomes almost entirely due to the structure effect, therefore due to being a victim of female genital cutting. This points to a stronger impact of violence proxied by female genital cutting at z-scores higher than -2. When we compare the counterfactual and the model for the treated group (see figure 5), it is made clear that the structural effect becomes significant at quantiles for z-scores higher than -2. This result is consistent with a health production that is primarily affected by characteristics on the lower end of the z-score cumulative distribution but, as z-score increases, becomes more and more affected by female genital cutting. If the child's health is poor to begin with, it can only deteriorate by so much following exposure to domestic violence. Meanwhile, children who are not initially stunted see their health worsen when exposed to domestic violence.

Figure 2. Model versus sample quantile function (untreated group)

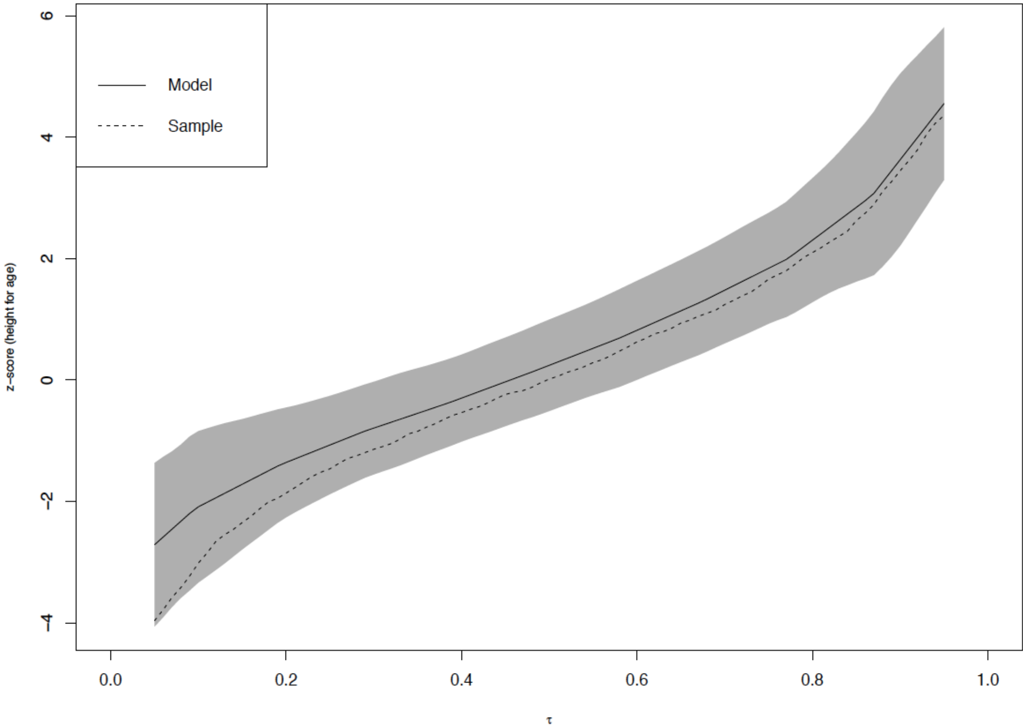


Figure 3. Model versus sample quantile function (treated group)

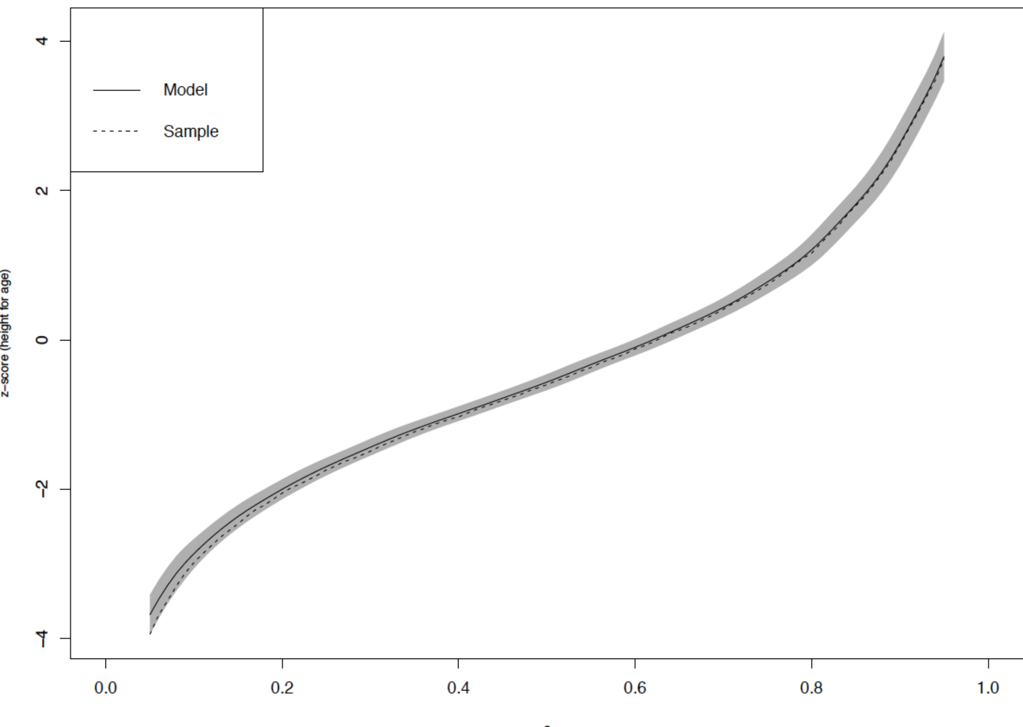


Figure 4. Decomposition of the differences between treated and untreated group

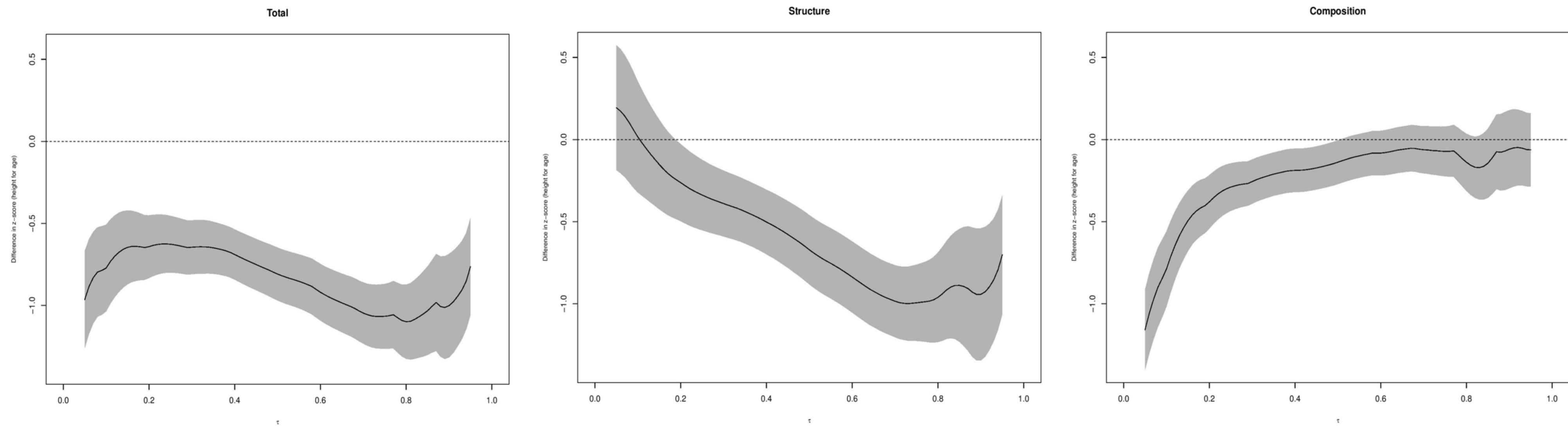
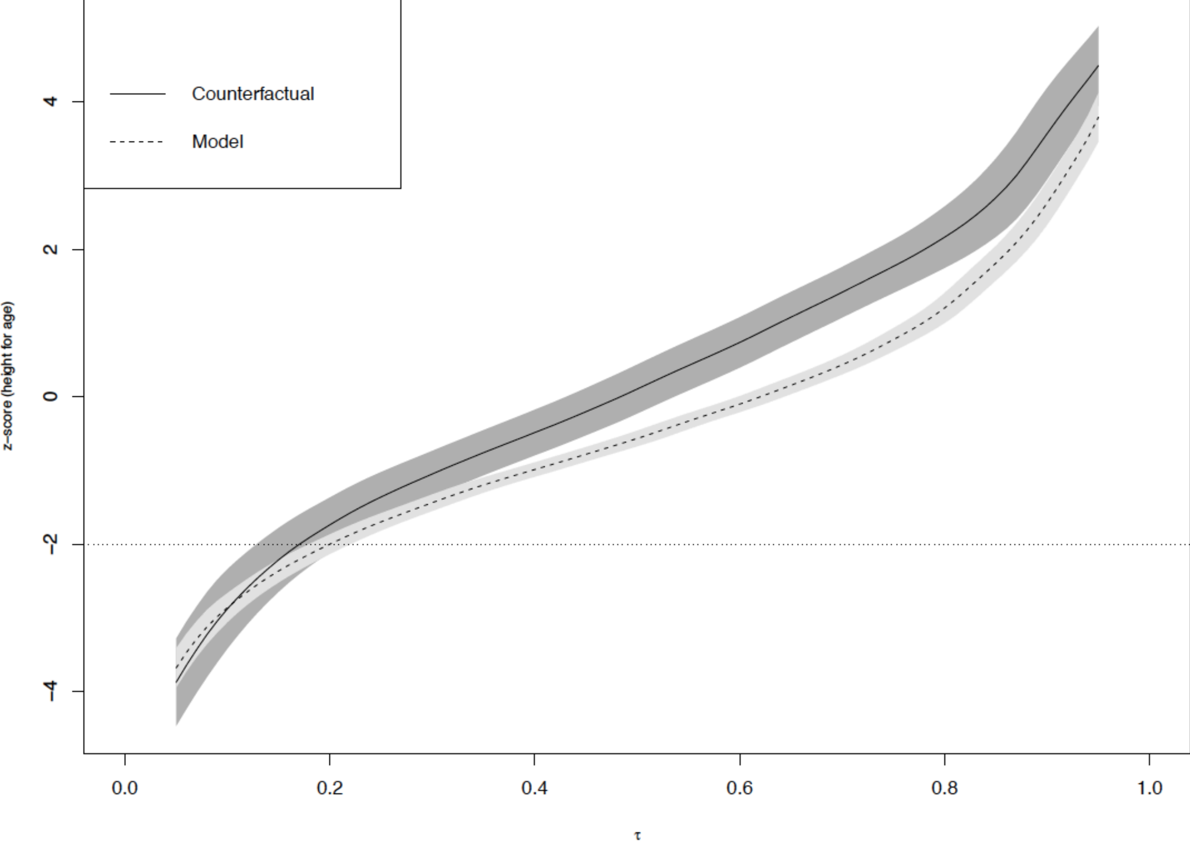


Figure 5. Counterfactual versus model quantile function (treated group)



6. Conclusion

In this paper, we have identified the causal reduced form effect of domestic violence on Egyptian children's health outcome as measured by the length-for-age z-score using female genital cutting as an instrumental variable for domestic violence. The main empirical result that we yielded is that female genital cutting as a perfect predictor of domestic violence decreases length-for-age z-scores of children by 0.47 on average. In addition, analysing the distribution of z-scores and decomposing the effect of having an excised mother on children's health enlightens us on the intricacies of the relationship. We find that, as the percentile increases, the difference in z-scores becomes almost entirely due to having a mother that has undergone female genital cutting (e.g. being in the treatment group).

To conclude, our research has some limitations. We were only able to identify a lower bound of the impact of domestic violence on children's nutritional status as we are using the reduced form equation. As domestic violence is a sensitive subject, self-reporting bias could also have occurred when collecting the data. Furthermore, we are only looking at the last-born child which strips the study of some robustness. In the future, the same exercise could be repeated with all of the women's children under five to compare results. In spite of these limitations, this research has implications for Egyptian health policy and our causal identification strategy can serve as a foundation for succeeding studies.

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