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# The Impact of Cleft Lip/Palate and CLP Surgical Intervention On the Social Integration of Adolescents in India

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Abstract: Cleft Lip/Palate, a congenital orofacial anomaly, carries an incidence rate of approximately 1 in every 1000 births. In addition to the stigma associated with the condition, the varying levels of cleft severity might result in lower life outcomes which could include lower cognitive ability, physical and psychological well-being, social and behavioral outcomes of adolescents. This paper focuses on the social integration element of life outcomes, which is composed of the social inclusion and prosocial behavior of the adolescent. Despite the affordability of restorative surgeries, patients in rural areas of Low and Middle-Income Countries (LMICs) such as India face accessibility and affordability constraints. Nevertheless, efforts by NGOs in providing free CLP restorative surgeries exist in LMICs. The literature on the impact of CLP and its correction through surgeries lacks causally identified evaluations, which this study provides. In this paper, using a difference in differences method with household fixed effects, we estimate the impact of CLP and receiving CLP reparative surgeries on the social Integration of adolescents in India. Our results indicate that the average level of cleft severity carries a statistically significant negative impact on social integration of patients. The estimate is mainly driven by the negative effect of CLP on the social inclusion. Utilizing a Directed Acyclical Graph framework, we find that speech impediment mediates the relationship between CLP and social inclusion, while CLP indirectly affects prosocial behavior through its relationship with social inclusion.

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# 1. Introduction

One out of 500-1000 children is born with Cleft Lip/Palate. CLP is a craniofacial abnormality, with a prevalence rate varying across geographical areas, ethnic and socioeconomic groups, and genders (Murray, 1995; Berk & Marazita, 2002; Mossey et al, 2002). Corrective surgeries are typically affordable and are operated on the patient during the first couple of months when the negative impacts related to CLP had not occurred yet. However, the main hurdles facing poor regions in LMICs (Low to Middle-Income Countries) are the limited availability of surgical care and scarcity of skilled surgeons (Farmer et al., 2015). These factors often lead to treatment delays causing large backlogs of untreated patients. For example, in India, the estimated backlog is between 233 thousand and 1 million (Singh, 2009; Poenaru, 2013). Naturally, higher fertility rates allude to higher incidents of CLP, which helps to explain the large backlog in India. If not treated in infancy, CLP can have an adverse impact on life outcomes of the patient, especially in adolescence when essential social development takes place. Thus, assessing the impact of correcting this anomaly on social integration can provide us with useful evidence for further investment in the treatment. Generally, there is a lack of causally identified assessment of the impact of correcting congenital anomalies, including CLP. By estimating the impacts of CLP and CLP surgeries, this paper fills in this gap. Specifically, this paper estimates the impact and correction of CLP on the social integration of adolescents in India.

To help alleviate the constraints facing poor communities in developing nations, several NGOs have been operating in multiple locations worldwide to provide CLP surgeries free of charge to those in need. For example, our partner organization Operation Smile is an NGO that specializes in providing CLP surgeries to patients free of charge across the world, particularly in LMICs. Their primary strategies include training local surgeons, establishing local surgery centers, and short term surgical missions where surgeons are flown in from across the world to operate on patients (Farmer et al., 2015). Moreover, in the locations where the study is being conducted, surgical missions are the primary services Operation Smile provide at their project sites. They began providing surgical missions in India in 2002 (Operation Smile, n.d.). Since their first medical mission in 2002, they have operated in and around 24 different cities, including Kolkata, Vijayawada, Raipur, and Bengaluru where the research is taking place(see Figure 1). Throughout that period, Operation Smile has performed CLP surgeries on almost 33,000 patients (Operation Smile, n.d.).

CLP can be syndromic (part of other major anomalies), or non-syndromic. Nevertheless, two-thirds of CLP conditions were identified as being non-syndromic (Mossey et al, 2002; Dixon et al. 2011). CLP can be generally classified into two groups; cleft lip with or without cleft palate (CL/P), and isolated cleft palate (CP). Cleft lip can be complete, where the cleft on the upper lip reaches into the nose, and incomplete, where the cleft impacts the upper lip but does not reach into the nose. CL can also be Unilateral (i.e. affecting one side of the upper lip), or bilateral (i.e. affecting both sides of the upper lip). CP can also be complete (affecting the soft and hard palate), or incomplete (affecting only the soft palate). Another type of CP, which might be difficult to locate, is the submucous CP, affecting the uvula and the soft and/or hard palate (Mossey et al, 2002; Zajac et al, 2017). These conditions differ in their severity, with unilateral cleft lip being the least severe to complete bilateral CLP being the most severe.

Infants with cleft palate can have feeding difficulties which in some instances leads to malnutrition and thus issues related to delayed development. They can also develop speech and hearing complications (Zajac et al, 2017). With the presence of CLP, a range of potential issues can occur including educational and cognitive, psychological, social, and behavioral. According to the WHO, congenital anomalies account for a 57.5 million DALYs (Disability-Adjusted Life Years) lost (World Health Organization, 2013).

The current research studies the social integration element of life outcomes by causally estimating the impact of CLP and CLP surgeries on the social experience of the patient. Social integration refers to the outcomes associated with the patient's social experience as perceived by the patient, including her perceived functioning in society or lack thereof. In this paper, the social integration element is composed of the degree of social inclusion of the patient, as well as how she behaves in social settings. The orofacial disabilities and aesthetic side effects of CLP can result in wider social distance (Meyer-Marrcotty et al., 2010), higher reporting of bullying incidence (Hunt et al., 2006, Hunt et al., 2007), and a diversion in the morphology of the volume and size of the VFC (Vortex Frontal Cortex), the part of the brain responsible for social functioning (Boes et al., 2007; Plas et al., 2013). In a place like rural India, social exclusion can be accentuated by the cultural stigma associated with CLP (Lei et al., 2013).

Our results indicate the cleft severity has an overall negative impact on social integration. CLP patients are more likely to be socially excluded. On the other hand, CLP surgeries positively affects social inclusion. The main driver of the social inclusion outcome is the incidence of

bullying. Additionally, the relationship between CLP and bullying is mediated by the speech impediment resulting out of CLP. In contrast to social inclusion, CLP does not impose a direct negative effect on the prosocial behavior of the patient. Nevertheless, utilizing Directed Acyclical Graphs, we demonstrate an indirect effect of CLP on prosocial behavior.

Given the lack of casually identified effects of the impact of CLP and CLP surgeries in the literature, this study acts as a baseline for future studies assessing the impact of CLP and correcting it in different contexts. Furthermore, by estimating the extent to which the surgery is able to restore life outcomes of the patient to near normalcy, this paper will aid policymakers, such as NGOs working on addressing the issue, as well as ministries concerned about health and education outcomes, in allocating resources more efficiently.

This paper will proceed as follows. I will provide attempts from the literature of social psychology, medicine, and neurology to pin down the differences in outcomes between CLP patients (treated and untreated) and non-CLP adolescents. Then, I will discuss the data and the sampling strategy. I will follow that with the description of the estimated model, as well as the assumptions undertaken. Finally, I will discuss the results and conclude my findings with the policy implications that the results can yield.

## 2. Literature Review

Although there are no studies in the literature that causally identify the impact of receiving CLP surgeries on life outcomes of adolescents with this congenital anomaly, there are studies that look at the cost-effectiveness of CLP surgeries in developing nations in terms of DALYs lost. Those studies utilize data on surgery costs in developing nations, as well as mortality rates. They assess the cost-effectiveness of CLP surgeries (Poenaru, 2012; Farmer et al, 2015), estimating the cost-benefit ratio at between 12-42 (i.e. every dollar spent in the surgery has an expected return of US\$12 - US\$42) (Alkire et al. 2015). Furthermore, multiple studies from the field of social psychology, medicine, and neuroscience look at the differences across CLP patients and non-CLP adolescents in terms of social traits and behaviors such as social withdrawals, the likelihood of initiating conversations and other psychosocial outcomes (Hunt et al, 2006; Stock and Feragen, 2016). All of these studies are important in providing a theoretical framework for understanding the impact of having CLP and/or correcting it on social integration. Overall, the

literature points towards an observable diversion in psychosocial functioning and the development of social skills between cleft and non-cleft subjects. This result, however, is inconclusive, possibly due to the minimal size of the samples, the sampling methods, and/or the use of different measurement tools.

## *2.1 Social Inclusion*

Social Inclusion, which refers to how the patient is treated in her environment, for example in home, school, or community, has been studied in a vast array of papers in relation to CLP (Feragen and Stock, 2016). The literature provides varying results when looking at the difference between CLP patients and non-cleft controls. For example, a study found that, relative to their non-cleft counterparts, CLP patients enjoyed normal relationships with their parents, as well as normal levels of social anxiety (Cheung, Loh, & Ho, 2007). Another study observed no significant difference in the scores of psychosocial functioning tests (Including Child Behavior Checklist, and the Social Competence Scale) between cleft patients and non-cleft control (Colett et al, 2012). There are multiple aspects to the social inclusion element of CLP patients. The outcomes of social inclusion of patients can stem, for example, from the repeated incidence of bullying, which can be as a result of the aesthetic or functional abnormality (i.e. eating, speaking...etc.). Thus, the literature also assesses the public perception of CLP patients. Analyzing both aspects can provide us with a better understanding of the potential mechanism in which CLP impacts social inclusion.

### *2.1.1 Bullying*

For CLP patients bullying can occur as a result of aesthetic side effects of the condition, or the speech impediment appearing mostly in CP patients (Feragen & Hunt, 2016). Although the authors find no significant relationship between language, speech, and reading on one side and bullying on the other, Feragen et al. observe general trends that are consistent with the hypothesis (Feragen et al., 2017). In another paper, patients pointed to their general facial appearance, including their nose and lip, in addition to speech, as reasons for the repeated occurrence of bullying (Semb et al., 2005). Several studies investigated the incidence of bullying post-repair finding a persistent pattern of bullying incidence, which in some cases have decreased

after the surgery (Hunt et al., 2006; Hunt et al., 2007; Noor & Musa, 2007; Lorot-Marchand et al., 2015). The relationship between bullying and self-reported facial appearance potentially suffers from endogeneity. Nevertheless, one study observed that bullying fully mediates the relationship between cleft visibility and satisfaction of appearance (Feragen & Borge, 2010). This result showcases the potentially far-reaching effects of bullying. The significance of investigating the role of bullying lies in its relationship with psychosocial resilience in the short term (Feragen et al., 2009), as well as the psychological and economic long term impact of childhood bullying (Wolke and Lereya, 2015; Brimblecombe et al., 2018).

### *2.1.2 Perception of CLP patients*

The relationship between satisfaction of appearance and bullying sheds a light on the role of aesthetic side effects of CLP on social inclusion. The literature investigates both the self-reported satisfaction of facial appearance and the rating of CLP patients' appearance as perceived by the community (Meyer-Marcotty et al., 2010, 2011; Versnel et al., 2010). For example, a study compares the self-rating of oral functioning and aesthetic of CLP patients against that of a panel of experts. The authors show that although patients and experts rated oral functioning equally, patients' evaluation of their appearance was lower than that of the experts (Sinko et al., 2005). Similarly, when compared to the normal population and subjects with acquired facial disfigurement, CLP patients reported higher levels of fear of negative perception (Versnel et al., 2010). In another context, although lacking a comparison group, patients reported positive outcomes in regards to their orofacial functioning and aesthetics (Munz et al., 2011). Further investigation of the public's perception of CLP patients revealed the importance of the asymmetry of the cleft on the rating of unilateral cleft lip patients' facial appearance (Meyer-Marcotty et al., 2011). To gauge the perceived social distance of CLP patients, a couple of experiments were performed, by showing subjects pictures of CLP patients and asking the community to rate the perceived social distance\* between them and the patients (Tobiasen and Heibert, 1993; Meyer-Marcotty et al., 2010; Pausch et al., 2015). Despite the persistent negative perception of CLP patients, data shows an improved outlook in the past 50 years (Pausch et al., 2015). Side effects

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\* Social distance refers to the level of separation between groups

of CL not only affect satisfaction with appearance but can also impact peer relationship, especially for girls with a visible cleft (Feragen and Stock, 2016).

#### *2.1.2.1 Cultural Attitude Towards CLP and CLP Patients in India*

Public perception can also be shaped by the specific cultural context of the patient. For example, in the sub-Himalayan Garhwal region of India, people with CLP are referred to as 'Khandu' which translates to 'incomplete'. In the same region, the belief that CLP is 'a curse of God' is still prevalent (Dvivedi & Dvivedi, 2012). This belief, although differs by region and religion, is also notably wide-spread in rural areas where this study is conducted, as observed during my fieldwork. Another belief lays the blame on the mother, citing chance events, such as a solar eclipse at the time of pregnancy as the reason for such condition. Such beliefs intensify the social stigmatization faced by CLP patients.

#### *2.2 Prosocial behavior*

In contrast with social inclusion, prosocial behavior points to the functioning of the patient in social settings, for example among peers in school, family members in gatherings, or with strangers. In one setting, CLP patients reported higher levels of social withdrawal and reduced levels of social experience (Berger and Dalton, 2011). For example, when assessing interactions in a social setting, CLP patients tend not to initiate conversations. (Kapp-Simon and McGuire, 1997; Slifer et al., 2006). Equivalently, CLP patients score poorer in social competency tests (Ha et al., 2013). Compared to non-cleft controls, low levels of social skills proved to be the primary predictor of poorer psychosocial adjustments in CLP patients (Kapp-Simon et al., 1992). In another context, 41% of parents of unilateral CLP patients reported behavioral problems above the clinical threshold (Millar et al., 2013). CLP and non-CLP subjects demonstrated significant difference when tested for hyperactivity and inattention, with the former group exhibiting abnormal levels (Conard et al, 2014). Similarly, CLP patients recorded higher levels of internalizing and externalizing behaviors (Hunt et al. 2007). While Wehby et al. found no statistically significant difference in rates of aggressiveness (Wehby et al, 2011), in Western China, boys with CLP scored above clinical rates of aggressiveness (Ha et al, 2013).



### *2.3 Morphology of the Brain*

Aside from social psychologists and medical professionals, neuroscientists have also been investigating the neurological repercussions of CLP, specifically in relation to social integration (Nopoulos et al., 2005; Boes et al., 2007; Plas et al., 2013). One of the first studies in the topic observed no difference in the social functioning of CLP and non-CLP, both groups sampled non randomly, but showcased a positive correlation between the size of the VFC\* (the part of the brain responsible for social functioning) and the score in a social functioning test (Nopoulos et al., 2005). While observing a diversion in social functioning scores between CLP and non-CLP subjects, the relationship between the size of the VFC and social functioning was confirmed in another study (Boes et al., 2007). The above studies provide us with a framework for understanding the potential mechanism by which CLP biologically impacts social integration outcomes.

### *2.4 Gaps in the Literature*

All the aforementioned studies in the literature review were efforts in the field of social psychology and medicine to understand the relationship between CLP and social outcomes of the patient. However, those studies do not provide a causal identification of the said relationship, which this paper provides. Additionally, the majority of papers in the literature take place in what is termed WEIRD (Western Educated Industrialized Rich Democratic) societies (Henrich et al., 2010). The lack of diversity in the literature limits the external validity of the results while providing no applicable evidence for communities in developing nations on the relationship between CLP and social outcomes. The few studies that utilizes non-western subjects are done in China (Cheung et al., 2007 ; Ha et al., 2013), Malaysia (Nour & Mousa, 2007), Turkey (Demir et al., 2011), Greece (Gkantidis et al., 2013,2015), Nigeria (Umwani et al., 2009), and Chile (Avarena et al., 2017). This study thus provides a different angle by focusing on rural Indian communities.

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\* Ventral Frontal Cortex

### 3. Data

#### *3.1 Data Collection and sample*

The data collection process has started in the summer of 2017 and is ongoing today. To collect data on patients, and their siblings and guardians, we utilize Operation Smile missions, and the screening camps they run a month prior to the surgeries, to operate our surveys. We also use lists provided by operation smile to survey past patients who have been treated in previous missions, by visiting them in their houses or running surveying days in central locations. Data collection is done in places where operation smile have operated their missions in the past couple of years. This includes primarily the states of West Bengal, Andhra Pradesh, Telangana, Karnataka, and Chhattisgarh (see Figure 1).

Our sample can be generally divided into two groups, cleft households and non-cleft households. The first group is the main group of our study, these are households with a patient who is between the ages of 11 and 19 and have at least one sibling. This group can be further divided into pure control, those who have not received any surgery, and those who have at least received one surgery. The second group are a sample of two siblings between the ages 11 and 19 from 8 randomly surveyed non-cleft households from randomly selected village in regions made of villages from which a surveyed patient have come from. The randomly sampled group of non-cleft households allows us to demonstrate evidence in support of our identifying assumption.

#### *3.2 Social Integration Index*

The main outcome indicator of this paper is an index for social integration. The index is composed of two main elements, social inclusion outcomes, and prosocial behavior outcomes. In order to assess the level of social integration of the patient, we must investigate how the patient is treated by society and how she behaves in social settings. To build the social integration index, we first construct the composite indices. The indices are built per Anderson's (2008) recommendation. Anderson introduced an index-building mechanism that weighs down repetitive signals through the variance-covariance matrix when assessing the impact of policy interventions on life outcomes of adolescents (Anderson, 2008).

### *3.2.1 Social Inclusion Index*

The main outcome indicator in this study is an index for social inclusion. The index is composed of four individual outcomes. Information about these individual outcomes is gathered through the survey. In the survey we ask respondents to indicate, on a 1-5 likert scale, to which degree they agree or disagree with a given statement, or the frequency in which they experience that statement. The statements that regard social inclusion are : "You are bullied often", "You feel you are included in Society" "Overall, you feel that you have good relationships with friends" "Overall, you feel that you are given equal opportunity as others to contribute to your community".

### *3.2.2 Prosocial Behavior Index*

The second is the prosocial behavior index. In accordance with the social inclusion index, the individual outcomes constituting this index are gathered in the survey where subjects are asked to state their level of agreements in a 1-5 Likert scale. The statements that regard prosocial behavior are : "When you have had the chance to meet new people, you have taken it", "You have often chosen to be alone rather than spend time with people of your age", "you have often been helpful when someone is hurt, upset, or feeling ill", "You have often shared with others, for example food, games, toys", and "You have felt nervous when meeting someone for the first time".

## **4. Methodology**

To rigorously analyze the causal impact of CLP and CLP surgeries on social integration we apply a cross-sectional difference in differences method with household fixed effects. In our DiD estimation, we use the siblings of patients as counterfactuals, comparing the patients to their closest age sibling across life outcomes and subtracting the difference from the difference between the comparison group and their siblings. The main estimations, of which the results are discussed later on are DiD regressions using household fixed effects.

We carry a couple of assumptions in our model. First, receiving treatment is random (i.e. those who receive the treatment share the same likelihood of receiving the treatment with those who do not). Secondly, our identifying assumption, which states that the expected difference in

potential outcomes between individuals and siblings in the absence of cleft palate is constant. Thus, only the presence of an anomaly and the level of reparation should be the identifying variation in the model.

#### 4.1 Theory of Change and Model Specification

To understand the potential relationship between CLP surgeries and outcomes, it is important to discuss the theory of change in which this study's model operates. CLP is not a binary condition. Consequently, there are varying levels of severity. Depending on the level of severity, the number of required surgeries varies. The higher the number of required surgeries the more severe is the cleft. The various combinations of possible CLP conditions produce varying levels of severity, as shown in Table 1.

The theory of change indicates that the more severe the cleft, the more pronounced its effects are and thus the more it impacts the social experience of the patient. Consequently, as more surgeries received, and the facial appearance and oral functions are restored to near-normalcy, this then leads to an improved social acceptance in the surrounding environment (school...etc.), as well as improved social interactions, which then leads to better social integration outcomes. Given the theory of change mentioned above, we estimate the following model:

$$Soc\_Integration\_Outcome_{ih} = \alpha + \beta_1 Req\_Surg_{ih} + \beta_2 Rec\_Surg_{ih} + \omega OS\_dummy_{ih} + \delta' X_{ih} + \mu_h + \epsilon_{ih} \quad (1)$$

The above model uses household fixed effects ( $\mu_h$ ), The coefficients of interest in these regressions are  $\beta_1$  and  $\beta_2$ . The former represent the impact of cleft severity, while the latter reflects the impact of receiving corresponding reparative surgeries. The variable reflecting the number of surgeries received is attained through the parental survey, where the medical information is collected for the patient. When possible, we confirm the collected information with Operation Smile. By estimating both variables, we can calculate the extent to which the life outcomes of the patients were restored by the surgery (i.e.  $\frac{\beta_2}{\beta_1}$ ). The other independent variable included in the model is a vector of control ( $\delta' X_{ij}$ ) which includes age, birth order, and gender of

the respondent. The model also encapsulates a dummy variable indicating whether Operation Smile has provided any of the surgeries received by the patient. Given the above model, our null hypotheses are that cleft severity has no impact on social integration, and receiving reparative surgeries has no impact on social integration. Thus, our alternative hypotheses are:

$H_a : \beta_1 < 0$  : Cleft severity negatively impact social integration (social inclusion and prosocial behavior)

$H_a : \beta_2 > 0$  : Reparative surgeries positively impact social integration (social inclusion and prosocial behavior)

#### 4.2 Directed Acyclical Graphs (DAGs)

In addition to our model estimation above, we apply DAGs to demonstrate and test a causal chain of CLP effects. DAGs are a modeling tool to identify causal mechanism with observational data. Initially introduced by Judea Pearls in 1995, it has been widely used in the field of epidemiology (Pearl, 1995, 1999, 2011; Cunningham, 2018). Economists have been hesitant to adopt DAGs in their causal modeling. The usefulness of DAGs in Economics has been a topic of debate in the field over the last few years, as more economists start to incorporate it in their work. DAGs can be helpful in exploring the mechanism of causal relationships by modeling chains of effects. Additionally, DAGs help us in constructing the model by avoiding potential confounder or collider biases (see Figures 2a & 2b). DAGs, however, cannot handle simultaneous causal effects, but rather depend on sequential effects (Heckman & Pinto, 2013). In this paper, we utilize DAGs, as we believe they are useful in demonstrating causal chains of the variables being tested.

In a DAG, lines connecting nodes are considered edges. These edges represent the direct causal effect of one variable on another. Consequently, the absence of connection between two nodes indicates the lack of a direct effect of the ancestor node on the descendant node. For example in the DAG presented in Figure 2, X has a direct causal effect on M and M has a direct causal effect on Y, but X does not have direct causal effect on Y. The node preceding its following predecessor is called an ancestor node while the one succeeding it is called a ‘descendant node’. Succeeding nodes cannot have edges linking to ancestor nodes, hence the name ‘acyclical’.

In this paper, the DAGs are used to identify the causal chain of CLP on social inclusion and subsequently prosocial behavior. This exercise allows us to identify how CLP can affect the behavior of the patient, and how social inclusion is driven by the physical repercussions of CLP. Figure 3 represents the potential relationship between CLP, social inclusion and prosocial behavior. We hypothesize that CLP negatively impacts social inclusion through physical disfigurement and speech impediment resulting from CLP. Social Inclusion, in turn, affects prosocial behavior and is further affected by prosocial behavior.

## 5. Results and Discussion

Our results show that cleft severity negatively impacts social integration. Our estimate of the impact of CLP on the social integration index is mainly driven by its adverse effect on social inclusion. Although cleft severity does not have a direct impact on the prosocial behavior of the patient, it does possess an indirect effect through social inclusion, which will be further explained through a DAG. This result indicates that cleft severity does not directly affect how the patient behaves in society, but rather it affects how the patient is treated in society, which in turn negatively affects the patient's behavior. Furthermore, the impact on social inclusion is led by the role of cleft severity in increasing the incidence of bullying. As can be observed from Figure 9, the distribution of frequency of bullying for untreated and treated patients is seen to the left of non-CLP adolescents, indicating the negative effect of CLP on bullying. To visualize the effect of CLP and correcting it, Figure 6 present kernel densities of the various indices. The effect is more pronounced in the kernel densities of social inclusion index. Our results are robust to different indices construction mechanism (see Table 8). Finally, the negative impacts of cleft severity are also replicated using the adolescents' data collected from the parental perspective. The patterns observed in the parental data correspond to those seen in the observational data (patient data). The results from the parental data show that CLP has a negative impact on social integration. An impact that is driven by the effect of CLP on social inclusion.

This section will proceed as follows. I will start by providing descriptive statistics from the sample, I will then present the results from the models estimating the impacts on social inclusion, prosocial behavior and social integration indices. Following that, I will demonstrate a causal chain using a DAG. Finally, I will present the results from the parental perspective.

### 5.1 *Summary Statistics*

Tables 2 and 3 present descriptive statistics from our sample. The table is divided into three main columns. The three columns represent the general categories of our sample. The first two columns showcase the unweighted sample averages of our control and treated patients and their siblings, while the last column exhibit the sample averages from the non-cleft households and all non-cleft adolescents respectively. Across all categories, the adolescents are equally divided between boys and girls, while their average age hovers around 14.5. Looking at the Anderson indices, there exist noticeable differences in outcomes across the various categories, with untreated patients fairing worse in terms of social inclusion and overall social integration. Non-CLP adolescents score consistently above untreated and treated patients in the main indices. Table 3 provides a more detailed description of summary statistics, breaking down the indices into their composite individual outcomes.

### 5.2 *Identifying Assumption*

The identifying assumption carried in our model asserts that in the absence of an abnormality such as CLP, the difference between siblings, on average, should be constant. To demonstrate the data we have on non-CLP adolescents, Figure 8 shows that the difference between non-CLP siblings in social integration statistically insignificant. In contrast, the difference in social integration outcomes, specifically social inclusion, can be seen to be statistically significant for untreated patients (pure control) and their siblings. That difference exhibits the potential impact of the presence of an anomaly. These results can also be observed in Table 4 where a t-test is employed to showcase the differences between siblings in non-CLP and CLP households.

## 5.2 Social Inclusion

The first composite element of the social integration index is the social inclusion aspect. Social inclusion, as stated earlier, refers to how the patient is treated in society. As can be seen from table 4, the average level of cleft severity negatively affects social inclusion outcomes.

More specifically, an additional level of cleft severity leads to a 0.1 standard deviation decrease in social inclusion outcomes. This decrease, however, is amended by the positive impact of average cleft surgery. Namely cleft surgeries lead to an increase of 0.15 standard deviation increase in social inclusion index score. Given both estimates, we can infer that cleft surgeries more than fully restores social inclusion lost due to CLP. To infer the exact extent to which cleft surgeries restores social inclusion outcomes, we divide our estimate of the negative impact

by the estimate of the impact of cleft surgery. This will yield the following estimate:  $\frac{0.15}{0.09}$ , or

1.56. This would indicate that cleft surgeries more than fully restore social inclusion outcomes to near-normalcy. It is important to point out that the given estimates above indicate the impact of average surgery. In other words, given the median number of required surgeries by the patient (4 in our sample) to restore life outcomes to near-normalcy, the impact of cleft severity or the restorative surgery is multiplied by the number of surgeries required and the number of surgeries receives, respectively. The estimates above are statistically significant, while the controls do not have a statistically significant effect on the outcomes.

Disentangling the social inclusion index further in Table 6, we start to notice some of the emerging patterns in the individual outcomes composing the index. For example, the main driver of CLP effect on social inclusion index is the outcome indicating the frequency of bullying. Cleft severity carries a statistically significant negative effect on being bullied less (i.e. the more severe the cleft is the more bullied the patient is). All the other individual outcomes are pointing towards the same direction but are not as strong as the estimate of bullying incidence. Those outcomes are feeling of social inclusion, being given equal opportunity to contribute to their communities, and having good relationships.



### 5.3 *Prosocial Behavior*

In terms of prosocial behavior, our results indicate that cleft severity does not have any statistically significant effect on the index score. The lack of significance and strength of those estimates can be seen in Tables (5 and 8). Despite the insignificance of the estimates, the direction of the estimates is pointing at the negative direction when it comes to cleft severity, while the opposite direction for cleft surgeries, indicating both a potentially negative and positive effect respectively. The only individual outcome standing out is a variable for whether an individual would help someone if they are hurt, upset, or feeling ill,. A possible mechanism in which CLP can impact prosocial behavior might be through social inclusion.

### 5.4 *Social Integration*

The two composite indices combined produces the social integration index, where we measure the overall integration of the patient in society, given how they behave in society and how they are treated in it. Generally, we can see that across all models cleft severity has a negative and statistically significant impact on social integration. In contrast, the impact of cleft surgeries, although positive, is statistically insignificant. This result is robust for constructing the outcome using other index-building mechanisms (Kling indices, see table 8).

### 5.5 *Causal Chains of CLP, Social Inclusion, and Prosocial Behavior*

A possible mechanism in which CLP can affect prosocial behavior is through social inclusion. The preliminary results above show that CLP has a negative impact on social inclusion, but not prosocial behavior. Mediation analysis of the impact of CLP on bullying show that the relationship between CLP and bullying is mainly mediated by the speech impediment resulting from CLP(see Table 12). To further explore this relationship and help us demonstrate the effect, we utilize a DAG framework(See Figure 3). We estimate the causal chain presented in Figure 3. The following estimates in Figure 4 showcase the coefficient estimate of each relationship. Additionally, Tables 13-15 present regression results along the causal path being estimated.. The estimations indicate that CLP negatively impacts appearance and speech impediment. Appearance and speech impediment in turn negatively impacts social inclusion. When regressing Social inclusion on appearance and speech impediment, the effect of CLP on social inclusion

disappears, further confirming the mediation effect presented above. The remaining piece to this chain is investigating the link between CLP and prosocial behavior through social inclusion. For that, blocking all the potential paths of effect, we regress prosocial behavior on all the ancestor nodes, in order to obtain the marginal effect of each of those variables. The result of this exercise indicates social inclusion is positively related to prosocial behavior. Although CLP might not possess a direct effect on prosocial behavior, it has a statistically significant impact on social inclusion, which is positively associated with prosocial behavior. The relationship between social inclusion and prosocial behavior is endogenous, but both variables can affect each other. In other words, there is a positive feedback loop between both variables.

### *5.6 Parental Perspective*

In addition to collecting observational data on the patient and the sibling, we also surveyed the parent, in order to collect the demographical information, for example, religion, education, occupation, and housing...etc., as well as gain information on the parental view of their children's outcomes. Of the guardians in our sample, 64% are mothers, while the rest are divided between fathers (30%) and grandparents, uncles and aunts(6%). In the parental survey, we ask the parent to evaluate each of their children's outcomes, relative to other children in their age cohort. Regression results indicate similar patterns to those seen in the observational data, where there is a consistently negative impact of CLP on social integration, but an inconsistent pattern in regards to the positive impacts of CLP surgery (see Tables 9,10, and 11). More specifically, Cleft severity reduces the patient's score in social integration index by 0.07 standard deviations, an effect that is driven by the impact of CLP on social inclusion. The average level of cleft severity reduces social inclusion outcomes by 0.11 standard deviations (see Table 9). This effect is largely pushed by the strong negative impact of CLP severity on being bullied more often. When it comes to social inclusion outcomes, parents of CLP patients report a higher frequency of bullying. The model estimating the impacts on prosocial behavior is reflective of the adolescent's response, where there is no strong indication of the impact of cleft severity or cleft surgeries. Table 11 Disentangles the effect of CLP on prosocial behavior by presenting the effect of CLP on the individual outcomes which comprise the prosocial behavior index. CLP severity leads patients to pursue social interactions less often than non-CLP adolescents while receiving

surgeries increases the likelihood of pursuing social settings. This result can stem from the increased confidence resulting from the restoration of the lip.

## **6. Conclusion**

CLP's adverse impacts on life outcomes are wide-ranging. All the aspects that can be potentially assessed are critical to determining the life outcomes of the patient in the absence or presence of treatment. The social integration outcomes, however, can have a longstanding effect on the life of the patient. The patient can face difficulties in, for example, entering the labor market, or in establishing relationships. Anecdotal data from the field documents a parental concern about CLP patients having potentially difficulty getting into marriage in the future.

Overall, the negative impact of cleft severity on social integration outcomes is persistent across all models. This impact is also consistently driven by the negative effect of CLP on social inclusion. Cleft severity seems to be specifically increasing the frequency of bullying. Although we do not know exactly the sources of bullying, anecdotal evidence suggests that the school is a big part of it. Other sources might be older siblings or community kids. The significance of this result lies in the psychological and economic long term impact of childhood bullying (Wolke and Lereya, 2015; Brimblecombe et al., 2018). In addition to estimating the impact of cleft severity and cleft surgery on social integration, we were able to pinpoint in the mechanism of this relationship. Speech impediment resulting from CLP fully mediates the path between CLP and social inclusion, while social inclusion affects prosocial behavior. Additionally, parents of CLP patients rate the social inclusion outcomes of their CLP children lower than their siblings. The negative impact of CLP is an indicator of the importance of intervention to correct this anomaly.

Luckily, our model estimates the impact of receiving reparative surgeries. Although the estimates of the impact of receiving an average surgery on the social integration of patients are generally weaker, they are persistently positive, indicating potential benefits of CLP restorative surgeries.

### *6.1 Policy Implications*

The findings of this paper yield potential policy implications. Firstly, the consistent negative impact of CLP on social integration, and the corresponding positive effect of receiving surgeries indicates the importance of further investment in the treatment. Secondly, the positive feedback loop between social inclusion and prosocial behavior in the path between CLP and prosocial behavior illustrates the importance of intervening at the school or community level to raise awareness and campaign for better treatment of CLP patients. Finally, the strong mediation effect of speech impediment in the relationship between CLP and bullying points towards the potential benefits of including speech therapists in the treatment protocols of NGOs; This can potentially curb the persistent patterns of bullying.

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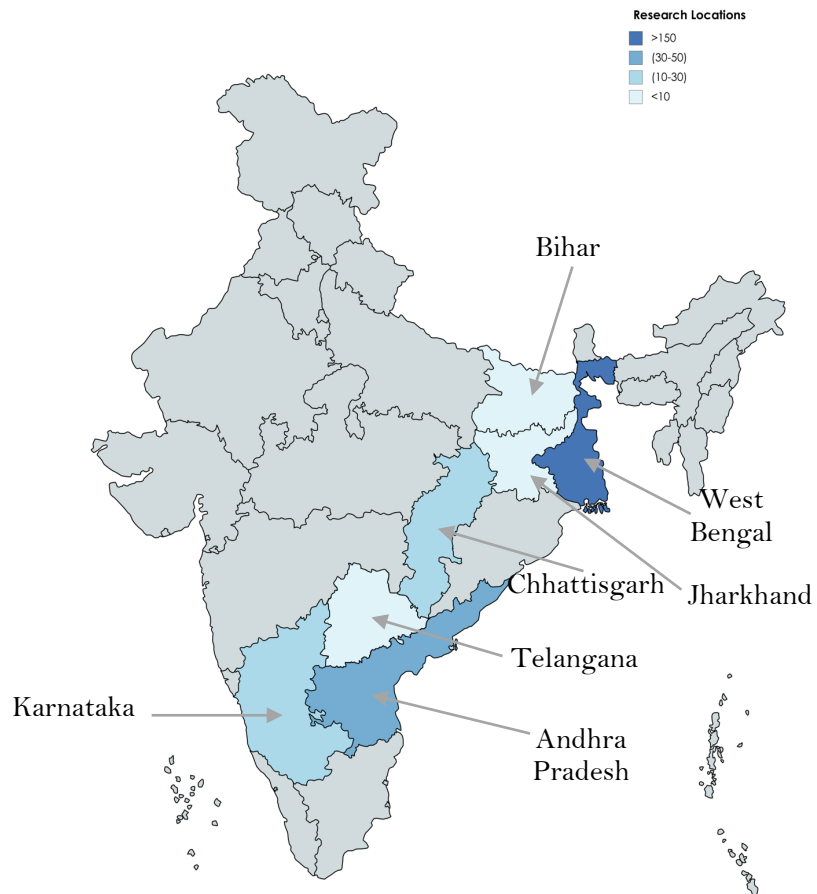


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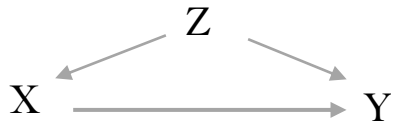
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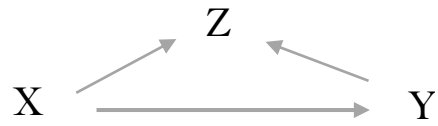
**Figure 1 : The States from Which the Data was Collected, Color-coded by Number of Patients**



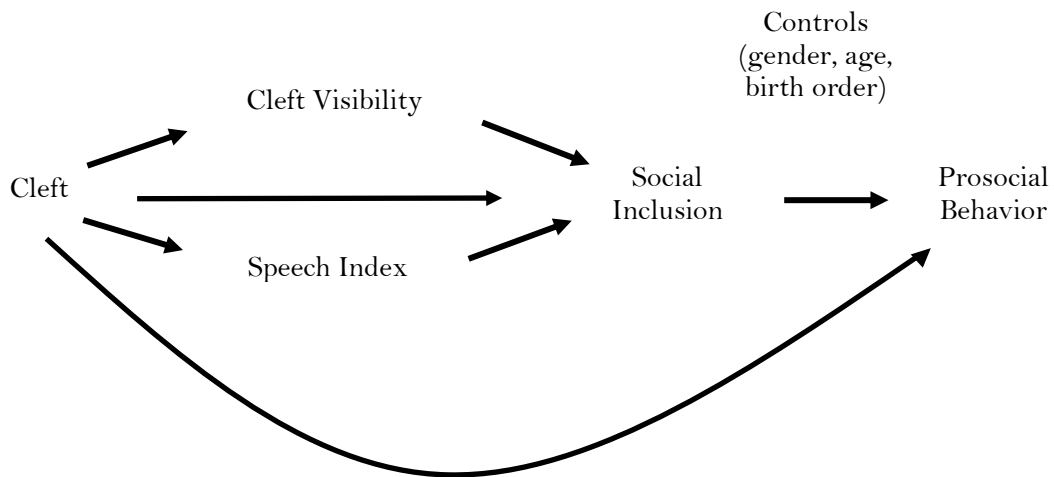
**Figure 2 : An example of a simple DAG**



**Figure 2a: An example of Confounder Bias**



**Figure 2b: An example of Collider Bias**



**Figure 3 : Hypothesized Causal Mechanism**

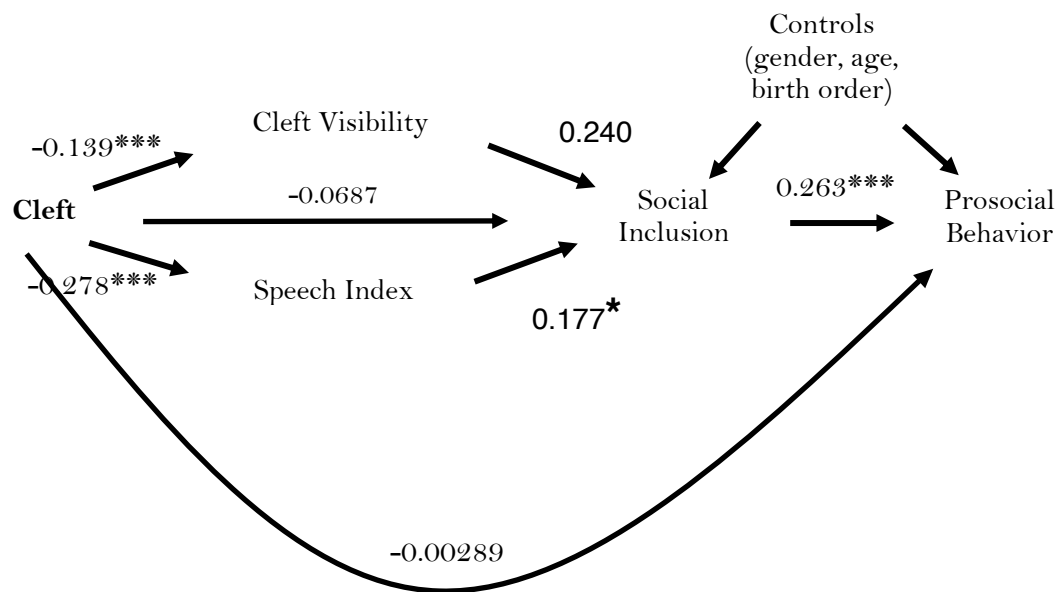


Figure 4 : Estimated Causal Chain

Marginal Effect of Cleft Severity on Social Integration Indices

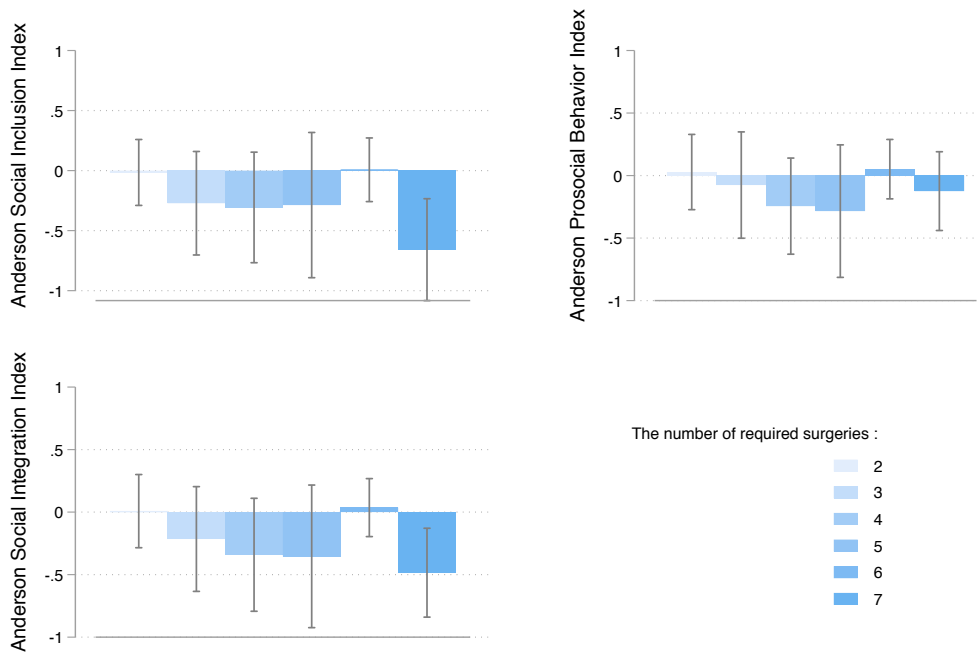


Figure 5 : Marginal Effect of Cleft Severity on Social Integration Indices

Kernel Densities of Social Integration Indices

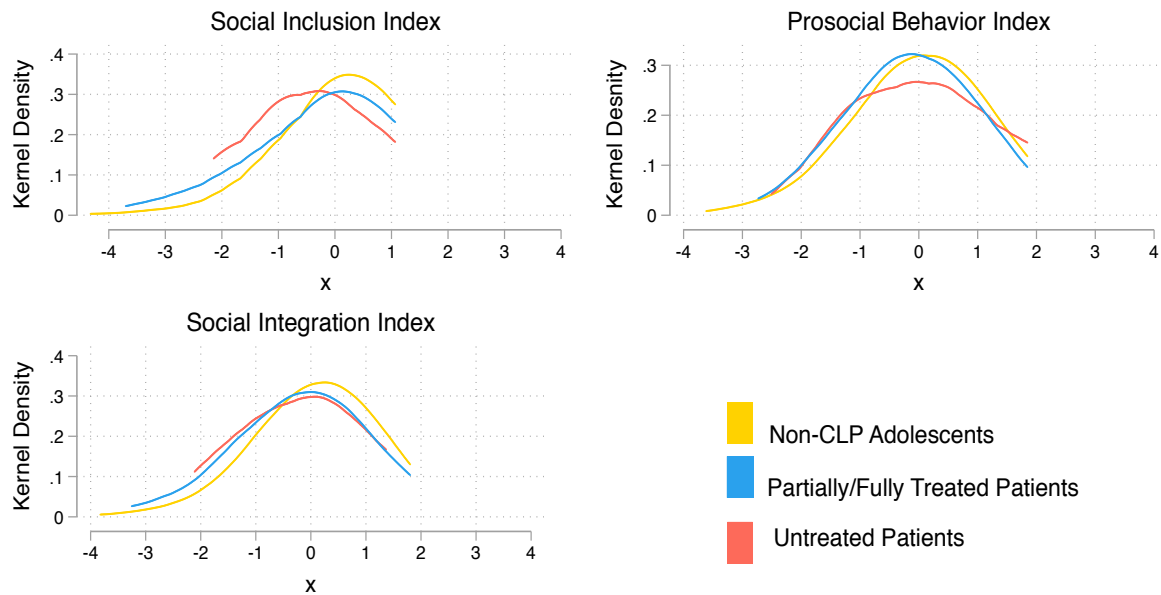
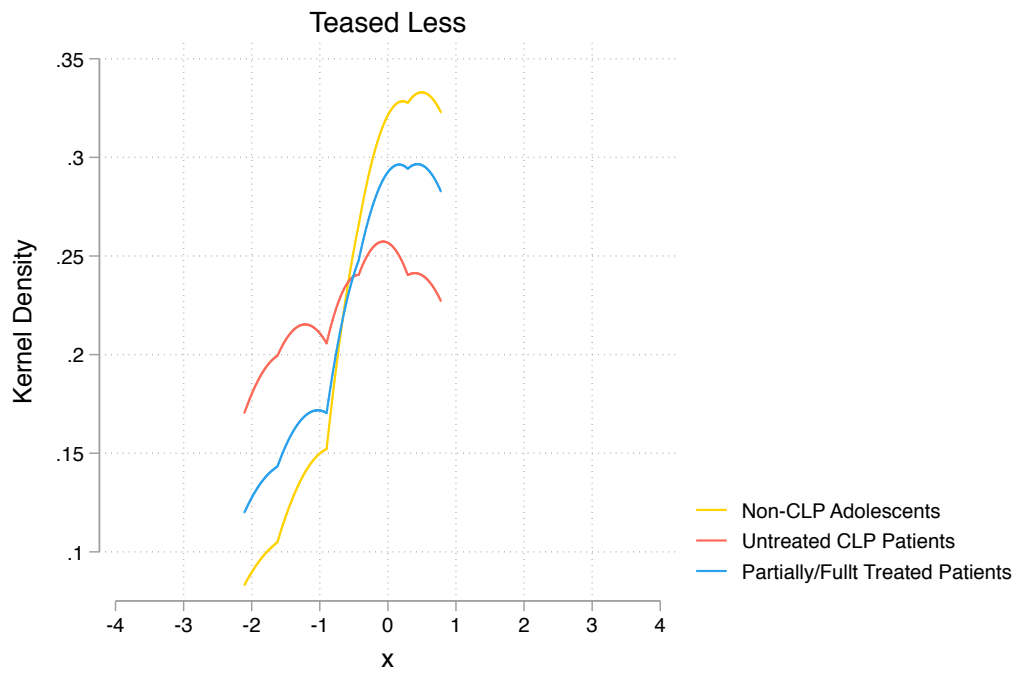
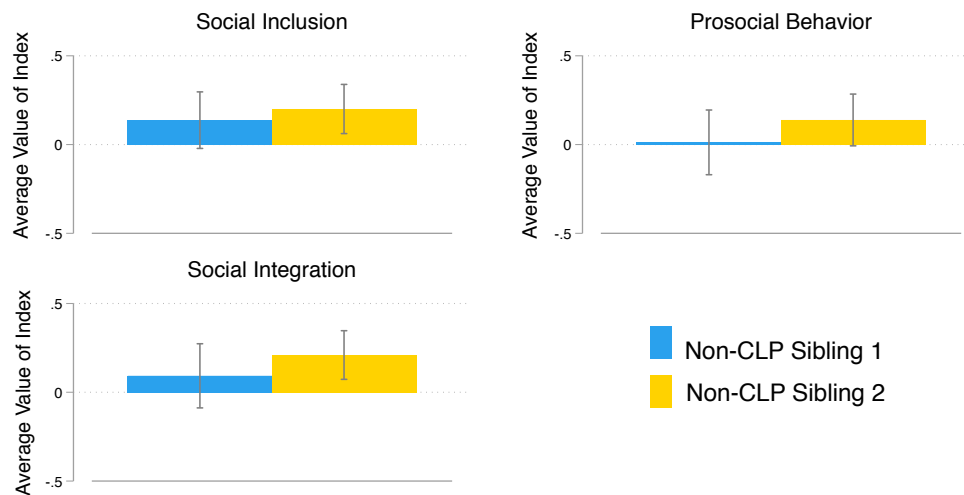


Figure 6 : Kernel Densities of Social Integration Indices



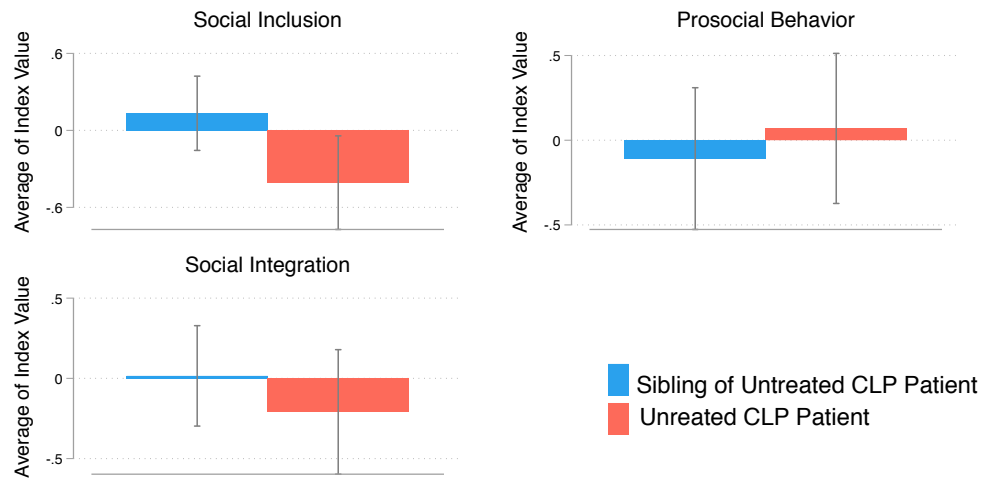
**Figure 7 : Kernel Density of Bullying Incidence**

### The Difference in Outcomes Between Non-CLP Siblings



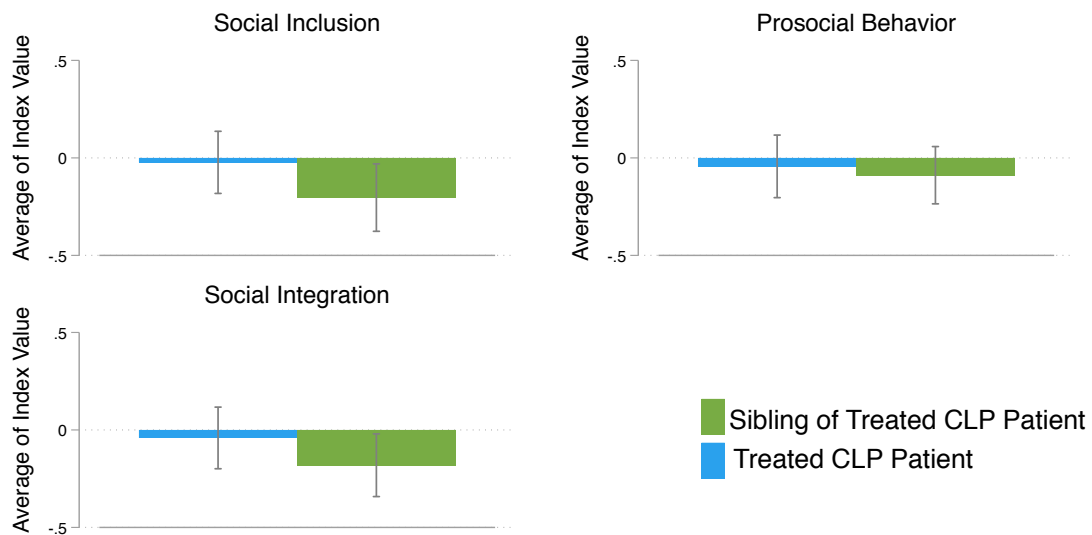
**Figure 8 : Bar graph of social integration indices Averages**

### Difference in Outcomes Between Untreated Patients and their Siblings



**Figure 9 : Bar graphs of social integration indices averages**

### Difference in Outcomes Between Treated Patients and their Siblings



**Figure 10 : Bar Graphs of Social Integration Indices Averages**



**Table 1 : The Combination of CLP Conditions and the Corresponding Number of Surgeries Required**

<b>Condition</b>	<b>Number of Required Surgeries</b>
Incomplete unilateral cleft lip, but no cleft palate	2
Incomplete bilateral cleft lip, but no cleft palate:	2
Incomplete bilateral cleft lip, but no cleft palate:	3
Incomplete bilateral cleft palate, but no cleft lip:	3
Complete unilateral cleft lip	4
Complete bilateral cleft lip	4
Complete unilateral cleft lip and palate	6
Complete bilateral cleft lip and palate	7
Complete bilateral cleft lip and palate with deviated premaxilla	8

Table 2: Descriptive Statistics - CLP and non-CLP Adolescents

	Untreated CLP		Partially or Fully Treated CLP		Non-CLP Adolescents	
	Patient	Sibling	Patient	Sibling	All Non-CLP Adolescents	Non-CLP Household Adolescents
Age	14.464 (0.407)	14.036 (0.699)	14.887 (0.195)	14.661 (0.350)	14.055 (0.187)	13.694 (0.225)
Male	0.536 (0.096)	0.429 (0.095)	0.512 (0.039)	0.524 (0.039)	0.488 (0.024)	0.470 (0.032)
Birth order	2.429 (0.215)	2.464 (0.174)	1.762 (0.074)	1.976 (0.064)	1.927 (0.040)	1.833 (0.054)
Anderson Social Inclusion Index	-0.407 (0.182)	0.133 (0.144)	-0.204 (0.088)	-0.023 (0.081)	0.104 (0.043)	0.169 (0.053)
Anderson Prosocial Behavior Index	0.070 (0.221)	-0.109 (0.209)	-0.089 (0.075)	-0.043 (0.082)	0.031 (0.047)	0.075 (0.059)
Anderson Social Integration index	-0.209 (0.194)	0.015 (0.156)	-0.181 (0.082)	-0.041 (0.080)	0.084 (0.045)	0.151 (0.058)
N	28	28	168	168	454	248

Table 3: Descriptive Statistics - CLP and non-CLP Adolescents

	Untreated CLP		Partially or Fully Treated CLP		Non-CLP Adolescents	
	Patient	Sibling	Patient	Sibling	All Non-CLP Adolescents	Non-CLP Household Adolescents
Bullied Less	-0.433 (0.219)	0.005 (0.161)	-0.137 (0.084)	0.142 (0.075)	0.094 (0.044)	0.056 (0.059)
Included in Society	-0.102 (0.224)	0.091 (0.130)	-0.138 (0.088)	-0.028 (0.081)	0.061 (0.044)	0.102 (0.055)
Given Equal Opportunity	-0.219 (0.235)	0.121 (0.182)	-0.110 (0.081)	-0.138 (0.080)	0.042 (0.045)	0.139 (0.058)
Has Good Relationship w/Friends	-0.192 (0.197)	0.131 (0.119)	-0.116 (0.088)	-0.078 (0.085)	0.052 (0.044)	0.133 (0.052)
Nervous when Meeting for 1st Time	0.381 (0.193)	0.204 (0.186)	-0.054 (0.076)	-0.003 (0.076)	-0.007 (0.047)	-0.029 (0.064)
Prefers to be w/Others their Age than Alone	-0.492 (0.199)	-0.122 (0.187)	-0.127 (0.080)	-0.046 (0.077)	0.070 (0.046)	0.154 (0.061)
Share w/Others	0.201 (0.138)	0.130 (0.120)	0.031 (0.072)	0.019 (0.084)	-0.025 (0.049)	-0.088 (0.068)
Help when Someone is Ill or	0.186 (0.161)	-0.391 (0.238)	0.035 (0.073)	-0.023 (0.080)	-0.002 (0.047)	0.034 (0.059)

Take Chances to Meet New People	-0.126	-0.126	-0.104	-0.062	0.043	0.126
	(0.240)	(0.197)	(0.083)	(0.082)	(0.045)	(0.055)
N	28	28	168	168	454	248

Table 4 : T-test of Social Integration Indices

<b>Non-CLP Hhs</b>					
	Sibling 1	Sibling 2	Diff	t	N
Social Integration	0.093	0.210	-0.117	-1.017	124
Social Inclusion	0.137	0.200	-0.063	-0.587	124
Prosocial Behavior	0.012	0.139	-0.126	-1.065	124
<b>Untreated CLP Hhs</b>					
	Patient	Sibling	Diff	t	N
Social Integration	-0.209	0.015	0.224	0.903	28
Social Inclusion	-0.407	0.133	-0.137**	2.328	28
Prosocial Behavior	0.070	-0.109	0.178	0.903	28
<b>Treated CLP Hhs</b>					
	Patient	Sibling	Diff	t	N
Social Integration	-0.181	-0.041	-0.111	1.221	168
Social Inclusion	-0.204	-0.023	0.181	1.512	168
Prosocial Behavior	-0.089	-0.043	0.045	0.410	168

Table 5: The Impact of Cleft Severity and Cleft Surgery on Social Integration - Household fixed effects

	Anderson Social Inclusion Index	Anderson Prosocial Behavior Index	Anderson Social Integration Index
Cleft Severity	-0.0953** (0.0435)	-0.0351 (0.0437)	-0.0807* (0.0410)
Cleft Surgery	0.155* (0.0798)	0.0241 (0.0809)	0.111 (0.0742)
OS dummy	-0.238 (0.241)	0.0823 (0.189)	-0.0961 (0.208)
Age	0.0394 (0.0292)	0.0280 (0.0238)	0.0417 (0.0257)
Male	-0.0939 (0.149)	-0.0211 (0.150)	-0.0712 (0.150)
Birth order	0.0291 (0.103)	-0.0313 (0.0822)	-0.00132 (0.0879)
Intercept	-0.563 (0.583)	-0.350 (0.463)	-0.565 (0.503)
N	400	400	400

OLS with fixed effects at the household level. Standard errors clustered at the household level are in parentheses. Dependent variables are all standardized Anderson indices. OS dummy is a dummy variable where 1=Received at least one Operation Smile surgery and 0=Has not received any OS surgeries. Male is a dummy variable for gender where male=1 and female=0.

\* p<0.10 \*\* p<0.05 \*\*\* p<0.01

Table 6: The Impact of Cleft severity and Cleft surgery on Social Inclusion - Individual Outcomes

	Bullied Less	Included In Society	Given Equal Opportunity	Has Good Relationships w/Friends
Cleft severity	-0.101** (0.0428)	-0.0522 (0.0460)	-0.0411 (0.0441)	-0.0308 (0.0484)
Cleft surgery	0.0794 (0.0715)	0.108 (0.124)	0.0955 (0.0836)	0.104 (0.0896)
OS dummy	-0.00699 (0.206)	-0.228 (0.261)	-0.0573 (0.236)	-0.318 (0.266)
Age	0.0273 (0.0361)	0.0293 (0.0271)	0.0338 (0.0271)	0.00901 (0.0288)
Male	0.00964 (0.133)	-0.0784 (0.166)	-0.0797 (0.151)	-0.101 (0.142)
Birth order	-0.00914 (0.115)	0.0309 (0.0947)	0.101 (0.0996)	-0.0313 (0.114)
Intercept	-0.256 (0.725)	-0.442 (0.514)	-0.735 (0.536)	-0.0511 (0.586)
N	400	400	400	400

OLS with fixed effects at the household level. Standard errors clustered at the household level are in parentheses. Dependent variables are all standardized. OS dummy is a dummy variable where 1=Received at least one Operation Smile surgery and 0=Has not received any OS surgeries. Male is a dummy variable for gender where male=1 and female=0.

\* p<0.10 \*\* p<0.05 \*\*\* p<0.01

Table 7: The Impact of Cleft Severity and Cleft Surgery on Prosocial Behavior - Individual Outcomes

	Nervous when Meeting for 1st Time	Prefers to be w/Others than Alone	Share Often	Help When Someone ill	Take Chances to Meet New People
Cleft severity	-0.0384 (0.0429)	-0.0464 (0.0379)	-0.0313 (0.0372)	0.0441 (0.0407)	-0.00514 (0.0450)
Cleft surgery	0.0463 (0.0813)	0.102 (0.0734)	0.0484 (0.0736)	-0.110 (0.0715)	-0.0592 (0.102)
OS dummy	0.0247 (0.184)	-0.161 (0.197)	0.0153 (0.195)	0.165 (0.193)	0.230 (0.206)
Age	-0.0196 (0.0237)	0.0202 (0.0245)	0.0279 (0.0258)	0.0431 (0.0276)	-0.00212 (0.0244)
Male	-0.0622 (0.133)	0.201 (0.142)	-0.0635 (0.135)	-0.159 (0.152)	0.0201 (0.157)
Birth order	-0.0172 (0.0922)	0.0302 (0.0920)	0.0118 (0.0908)	-0.0649 (0.110)	-0.0489 (0.0907)
Intercept	0.402 (0.481)	-0.521 (0.474)	-0.326 (0.508)	-0.453 (0.598)	0.0458 (0.478)
N	400	400	400	400	400

OLS with fixed effects at the household level. Standard errors clustered at the household level are in parentheses. Dependent variables are all standardized. OS dummy is a dummy variable where 1=Received at least one Operation Smile surgery and 0=Has not received any OS surgeries. Male is a dummy variable for gender where male=1 and female=0.

\* p<0.10 \*\* p<0.05 \*\*\* p<0.01



Table 8: The Impact of Cleft Severity and Cleft Surgery on Social Integration - Household fixed effects

	Kling Social Inclusion Index	Kling Prosocial Behavior Index	Kling Social Integration Index
Cleft severity	-0.0905** (0.0433)	-0.0312 (0.0441)	-0.0754* (0.0416)
Cleft surgery	0.156* (0.0821)	0.0111 (0.0844)	0.103 (0.0757)
OS dummy	-0.245 (0.243)	0.111 (0.193)	-0.0837 (0.211)
Age	0.0400 (0.0290)	0.0281 (0.0244)	0.0421 (0.0257)
Male	-0.100 (0.151)	-0.0260 (0.152)	-0.0782 (0.153)
Birth order	0.0368 (0.100)	-0.0360 (0.0833)	0.000611 (0.0876)
Intercept	-0.597 (0.574)	-0.345 (0.477)	-0.583 (0.505)
N	400	400	400

OLS with fixed effects at the household level. Standard errors clustered at the household level are in parentheses. Dependent variables are all standardized Kling indices. OS dummy is a dummy variable where 1=Received at least one Operation Smile surgery and 0=Has not received any OS surgeries. Male is a dummy variable for gender where male=1 and female=0.

\* p<0.10 \*\* p<0.05 \*\*\* p<0.01

Table 9: The Impact of Cleft Severity and Cleft Surgery on Social Integration - Parental Data - Household fixed effects

	Anderson Social Inclusion Index	Anderson Prosocial Behavior index	Anderson Social Integration Index
Cleft severity	-0.110*** (0.0347)	-0.0206 (0.0277)	-0.0749** (0.0298)
Cleft surgery	0.0236 (0.0817)	0.0604 (0.0490)	0.0592 (0.0611)
OS dummy	0.143 (0.140)	-0.273* (0.144)	-0.114 (0.130)
Age	0.0230 (0.0196)	-0.0221 (0.0187)	-0.0156 (0.0157)
Male	0.0836 (0.104)	0.198** (0.0853)	0.181** (0.0854)
Birth order	0.0712 (0.0708)	0.0245 (0.0710)	0.0391 (0.0635)
Intercept	-0.433 (0.390)	0.159 (0.375)	0.0908 (0.319)
N	400	400	400

OLS with fixed effects at the household level. Standard errors clustered at the household level are in parentheses. Dependent variables are a standardized Anderson index and they are listed across the top row. OS dummy is a dummy variable where 1=Received at least one Operation Smile surgery and 0=Has not received any OS surgeries. Male is a dummy variable for gender where male=1 and female=0.

\* p<0.10 \*\* p<0.05 \*\*\* p<0.01

Table 10: The Impact of Cleft Severity and Cleft Surgery on Social Inclusion Composite Outcomes - Parental Data - Household fixed effects

	Bullied Less	Included In Society
Cleft severity	-0.147*** (0.0368)	-0.0230 (0.0303)
Cleft surgery	0.117 (0.0755)	-0.0800 (0.0759)
OS dummy	-0.0420 (0.158)	0.264* (0.155)
Age	0.0310 (0.0238)	0.00464 (0.0148)
Male	0.0946 (0.120)	0.0348 (0.0854)
Birth order	0.190** (0.0875)	-0.0796 (0.0639)
Intercept	-0.731 (0.488)	0.0614 (0.299)
N	400	400

OLS with fixed effects at the household level. Standard errors clustered at the household level are in parentheses. Dependent variables are a standardized and they are listed across the top row. OS dummy is a dummy variable where 1=Received at least one Operation Smile surgery and 0=Has not received any OS surgeries. Male is a dummy variable for gender where male=1 and female=0.

\* p<0.10 \*\* p<0.05 \*\*\* p<0.01

Table 11: The Impact of Cleft Severity and Cleft Surgery on Prosocial Behavior Composite Outcomes - Parental Data - Household fixed effects

	Gets Along w/Friends	Comfortable Meeting Strangers	Has Many Friends	Makes New Friends Easily	Pursue Social Situations
Cleft severity	0.0258 (0.0264)	-0.00249 (0.0284)	-0.0205 (0.0254)	0.0102 (0.0337)	-0.0507* (0.0268)
Cleft surgery	-0.00228 (0.0424)	-0.00442 (0.0575)	0.0298 (0.0468)	-0.0195 (0.0635)	0.120** (0.0477)
OS dummy	-0.178 (0.132)	-0.0918 (0.149)	-0.0448 (0.133)	-0.161 (0.163)	-0.267* (0.147)
Age	-0.00174 (0.0142)	-0.0240 (0.0305)	-0.0311 (0.0203)	-0.0338 (0.0308)	0.00604 (0.0236)
Male	0.166** (0.0771)	0.160 (0.102)	0.257*** (0.0799)	0.167* (0.0867)	-0.0420 (0.106)
Birth order	0.0417 (0.0580)	-0.0337 (0.0875)	-0.00230 (0.0684)	-0.113 (0.0898)	0.0975 (0.0752)
Intercept	-0.205 (0.271)	0.415 (0.583)	0.299 (0.389)	0.604 (0.588)	-0.283 (0.458)
N	400	400	400	400	400

OLS with fixed effects at the household level. Standard errors clustered at the household level are in parentheses. Dependent variables are all standardized. OS dummy is a dummy variable where 1=Received at least one Operation Smile surgery and 0=Has not received any OS surgeries. Male is a dummy variable for gender where male=1 and female=0.

\* p<0.10 \*\* p<0.05 \*\*\* p<0.01

Table 12: The Mediation Effect of Speech Impediment in the Relationship between CLP and Bullying

	1st stage regression	2nd stage regression	3rd stage regression
	Anderson Speech Index	Bullied Often	
Cleft Severity	-0.309*** (0.0231)		-0.0306 (0.0469)
Anderson Speech Index		0.309*** (0.0818)	0.246** (0.122)
Male	0.0745 (0.156)	-0.0926 (0.200)	-0.0971 (0.202)
Age	-0.000760 (0.0206)	-0.00865 (0.0343)	-0.00855 (0.0346)
Birth order	-0.0473 (0.0821)	-0.103 (0.125)	-0.117 (0.124)
Intercept	0.705* (0.398)	0.388 (0.689)	0.481 (0.706)
N	186	186	186

OLS with fixed effects at the household level. Standard errors clustered at the household level are in parentheses. Dependent variables are all standardized. OS dummy is a dummy variable where 1=Received at least one Operation Smile surgery and 0=Has not received any OS surgeries. Male is a dummy variable for gender where male=1 and female=0.

\* p<0.10 \*\* p<0.05 \*\*\* p<0.01

Table 13 : The Impact of Cleft Severity on Cleft Visibility and Speech Impediment

	Cleft Visibility	Speech Index
Cleft Severity	-0.139*** (0.00636)	-0.278*** (0.0208)
Age	-0.0130 (0.0127)	-0.000685 (0.0186)
Male	0.0532 (0.0538)	0.0671 (0.141)
Birth order	-0.0147 (0.0368)	-0.0427 (0.0740)
Intercept	1.136*** (0.243)	0.635* (0.358)
<b>N</b>	400	186

OLS with fixed effects at the household level. Standard errors clustered at the household level are in parentheses. The cleft variables is an indicator variable =1 if the adolescent does not have a visible cleft or a scar from a surgery

\* p<0.10 \*\* p<0.05 \*\*\* p<0.01

Table 14 : The Impact of Cleft Severity, Speech impediment, and Cleft Visibility on Social Inclusion

	Anderson Social Inclusion Index			
Cleft Severity	-0.0953** (0.0435)			-0.0687 (0.0583)
Speech Index		0.213*** (0.0660)		0.177* (0.105)
Cleft Visibility			0.261* (0.138)	0.240 (0.239)
Age	0.0394 (0.0292)	-0.00320 (0.0173)	0.0440 (0.0296)	-0.00338 (0.0180)
Male	-0.0939 (0.149)	-0.163 (0.124)	-0.0944 (0.150)	-0.136 (0.136)
Birth order	0.0291 (0.103)	-0.0898 (0.0755)	0.0430 (0.105)	-0.110 (0.0748)
Intercept	-0.563 (0.583)	0.281 (0.327)	-0.951* (0.561)	0.333 (0.360)
<b>N</b>	400	186	400	186

Clustered standard errors in parentheses. OLS with fixed effects at the household level. Standard errors clustered at the household level are in parentheses. The 'Visible Cleft' variable is an indicator variable = 1 if the adolescent does not have a visible cleft or a scar from a surgery, Speech Index is an Anderson Index.

\* p<0.10 \*\* p<0.05 \*\*\* p<0.01

Table 15 : The Impact of Cleft Severity on Prosocial Behavior

	Anderson Prosocial Behavior Index	
Cleft Severity	-0.0174 (0.0204)	-0.00289 (0.0205)
Social Inclusion Index		0.263*** (0.0731)
Male	-0.0224 (0.149)	-0.000148 (0.142)
Age	0.0277 (0.0239)	0.0175 (0.0239)
Birth order	-0.0283 (0.0837)	-0.0344 (0.0844)
Intercept	-0.350 (0.466)	-0.204 (0.468)
N	400	400

OLS with fixed effects at the household level. Standard errors clustered at the household level and are in parentheses. The Anderson Speech index is an Anderson index composed of multiple individual outcomes related to speech assessed by a speech therapist

\* p<0.10 \*\* p<0.05 \*\*\* p<0.01



## PART D / PART D Agreement Scale Questions

**\*\*SCRIPT:** *“I will now say several statements with which you may agree or disagree. Using the 1–5 scale on this card, indicate your agreement with each statement as it relates to your own life.”*

- 5 - / Strongly agree
- 4 - / Somewhat agree
- 3 - / Neither agree nor disagree
- 2 - / Somewhat disagree
- 1 - / Strongly disagree

### Social Inclusion

\_\_\_\_D20. / You feel included in society

\_\_\_\_D21. / Overall, you feel that you have good relationships with friends

\_\_\_\_D22. / Overall, you feel that you are given equal opportunity as others to contribute to your community

\_\_\_\_D23. / You get bullied a lot

### Prosocial Behavior

\_\_\_\_D24. / When you have had the chance to meet new people, you have taken it

\_\_\_\_D25. / You have often chosen to be alone rather than spend time with people of your age

\_\_\_\_D26. / You have often been helpful when someone is hurt, upset, or feeling ill

\_\_\_\_D27. / You have often shared with others, for example food, games, toys

\_\_\_\_D28. You have felt nervous when meeting someone for the first time