

## ABSTRACT

- **Objective:** Determine interactions between geospatial and socioeconomic factors influencing cleft lip and/or cleft palate (CL/P) surgery management and outcomes.
- **Design:** Retrospective review and outcomes analysis (n = 740).
- **Setting:** Academic tertiary care center.
- **Patients:** 740 patients undergoing primary (CL/P) surgery from 2009 to 2019.
- **Main Outcomes Measures:** Prenatal evaluation by plastic surgery, nasolabial molding, cleft lip adhesion, and age at CL/P surgery.
- **Results:** Prenatal evaluation by plastic surgery was predicted by the interaction between patient median block group income and patient distance from the care center ( $p = 0.022$ ). Nasolabial molding was also predicted by the interaction between patient median block group income and distance from the care center ( $p = 0.016$ ), whereas cleft lip adhesion was predicted by patient median block group income alone ( $p < 0.001$ ). Lower patient median block group income predicted later age at cleft lip ( $p = 0.011$ ) and cleft palate ( $p = 0.050$ ) repair surgery.
- **Conclusions:** Distance from the care center and lower median income by block group interacted to significantly predict prenatal evaluation by plastic surgery and nasolabial molding for patients with CL/P at a large, urban tertiary care center. Patients living farthest from the care center who received prenatal evaluation by plastic surgery or who underwent nasolabial molding had higher median block group income. Future work will determine mechanisms perpetuating these disparities.

## BACKGROUND

- Cleft lip and/or cleft palate (CL/P) is the most common congenital craniofacial anomaly worldwide, with an estimated incidence of 7.8 in 10,000 in the US and 7.9 in 10,000 globally (Tanaka 2012).
- Sequelae of untreated orofacial clefting are diverse and include aesthetic (Sharma 2012) and functional concerns such as delayed speech and language development (Schönweiler 1999), hindered feeding (Miller 2011), hearing dysfunction (Flynn 2009), and psychosocial distress (Hunt 2005).
- Given the relatively high financial burden of treating orofacial clefting and its aesthetic and functional sequela, it is perhaps unsurprising that lower socioeconomic status is known to have deleterious effects on outcomes (Smillie 2015).
- Additionally, those from racial and ethnic minority backgrounds and non-primary English-speaking families have known delays in surgical repair of orofacial clefts (Abbott 2011, Harb 2021) and increased rates of missed appointments (Lynn 2018).
- Increased patient distance from the care center is one such variable associated with inferior clinical outcomes in a variety of conditions (Borren 2017, Cote 2015, Wasif 2016).
- Previous studies have described high percentages of patients living at least one-hour from American Cleft Palate-Craniofacial Association-certified cleft centers (Peck 2021) – an estimated 25% of patients with CL/P in the United States (US).
- Geospatial access to cleft care may also be regionally dependent, with the highest access in the northeast and lowest access in the southern US (Akiki 2021, Peck 2021). Limited studies have discussed the impact of spatial dependency on CL/P outcomes, with one study suggesting geospatial and socioeconomic factors may interact to predict loss to follow-up (Sharif-Askary 2018).

## OBJECTIVES

- This study aimed to characterize interactions between geospatial and socioeconomic factors influencing CL/P surgery management and outcomes at a large, urban, tertiary care center in the northeastern US.
- Based on previous studies, we hypothesized that distance from the care center alone may not predict management and outcomes in this cohort; rather, interactions between distance and socioeconomic status may be most powerful for revealing disparities surrounding management and outcomes of our patients with CL/P.

## METHODS

- This study retrospectively evaluated patients undergoing primary cleft lip or cleft palate surgery from May 2009 to November 2019 (pre COVID-19 pandemic) through the Division of Plastic & Reconstructive Surgery at a tertiary children's hospital.
- Patients were excluded if they presented with atypical orofacial clefts, submucosal cleft palates, were adopted internationally, or presented after 250 days of age.
- Demographic and clinical variables were extracted from the electronic medical records. Median income by block group was determined from US 2019 census data.
- Distance from the care center was determined by calculating Euclidean distance between patient address coordinates and care center coordinates.
- Analyses involving distance from the care center included patients from Pennsylvania and New Jersey only.
- This study was approved by the Institutional Review Board at the Children's Hospital of Philadelphia.
- The care center is an urban, tertiary center in Philadelphia, Pennsylvania. It is a high-volume cleft and craniofacial center housed in the Division of Plastic, Reconstructive and Oral Surgery in the Department of Surgery.
- The Division performs over 3,000 surgeries each year, and the multidisciplinary cleft clinic team is comprised of plastic surgeons, orthodontists, psychologists, social workers, speech and language pathologists, audiologists, geneticists, nurse practitioners, and a nurse navigator.
- The closest comparable cleft treatment program is over 300 miles away.

## RESULTS

**Table 1. Demographic and Clinical Information**

<b>Sex</b>	
Male	419 (56.6)
Female	281 (43.4)
<b>Race</b>	
White	504 (68.1)
Black	91 (12.3)
Asian	43 (5.8)
Other/unknown	102 (13.8)
<b>Ethnicity</b>	
Hispanic	66 (8.9)
Non-Hispanic	674 (91.1)
<b>Insurance</b>	
Public	278 (37.6)
Private	462 (62.4)
<b>Cleft Phenotype</b>	
CL	216 (29.2)
CP	266 (35.9)
CLP	258 (34.9)
<b>Syndromic</b>	
Age at CLR (mo)	4.81 ± 2.09
Age at CPR (mo)	11.3 ± 2.60
Prenatal visit with PRS	160 (21.6)
<b>Age at first outpatient appointment (mo)</b>	
Feeding issues at first appointment	328 (44.3)
Failure to thrive	70 (9.5)
<b>NICU</b>	
NICU stay	268 (36.2)
NICU LOS (d)	25.9 ± 33.1
Median block group income (USD)	\$87,040 ± 43,349
Distance from care center (mi)	31.4 ± 30.1

## RESULTS

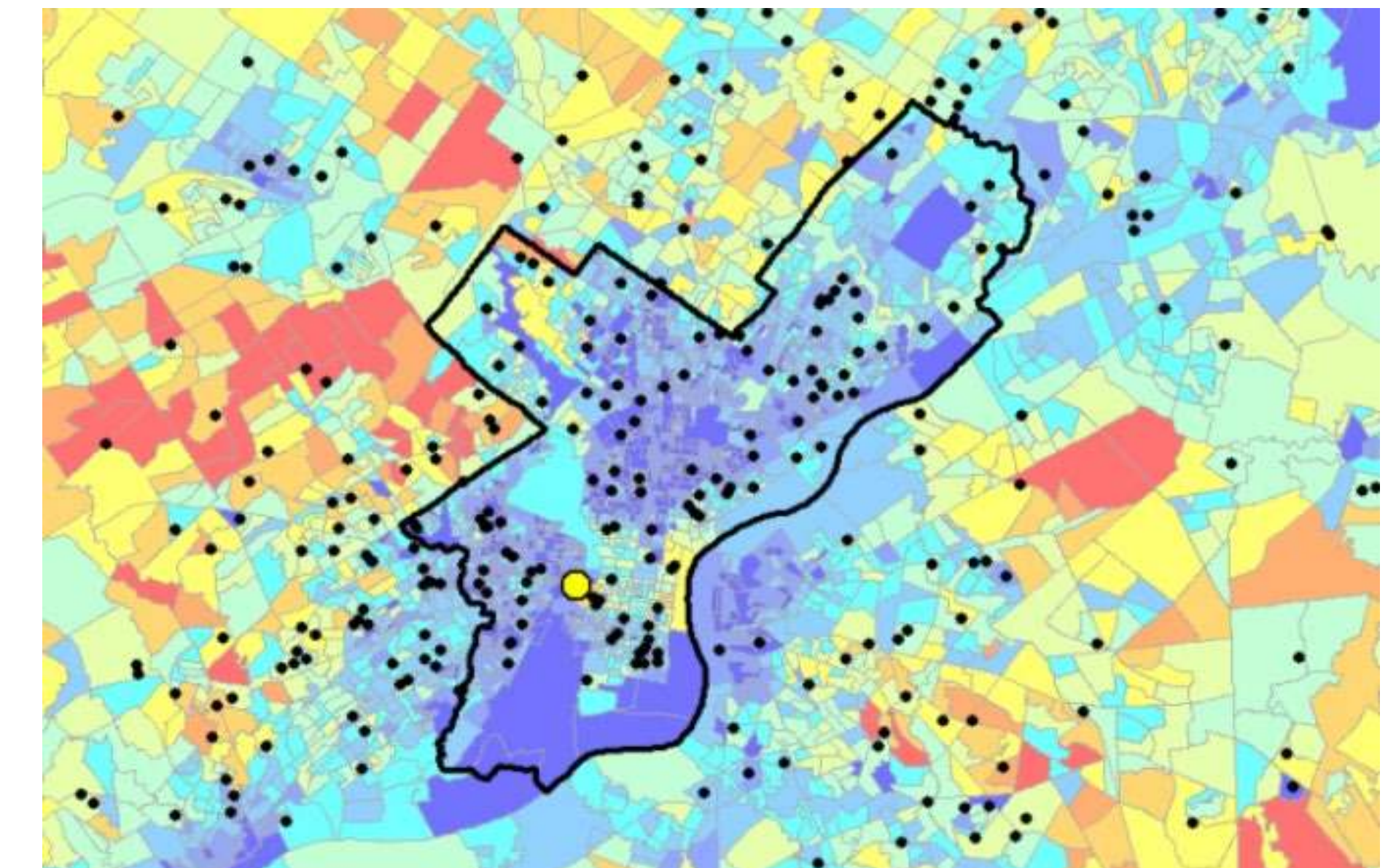


Figure 1. Cases of cleft lip and cleft palate (black) mapped around the tertiary care center (yellow) overlaying block groups coded by income level.

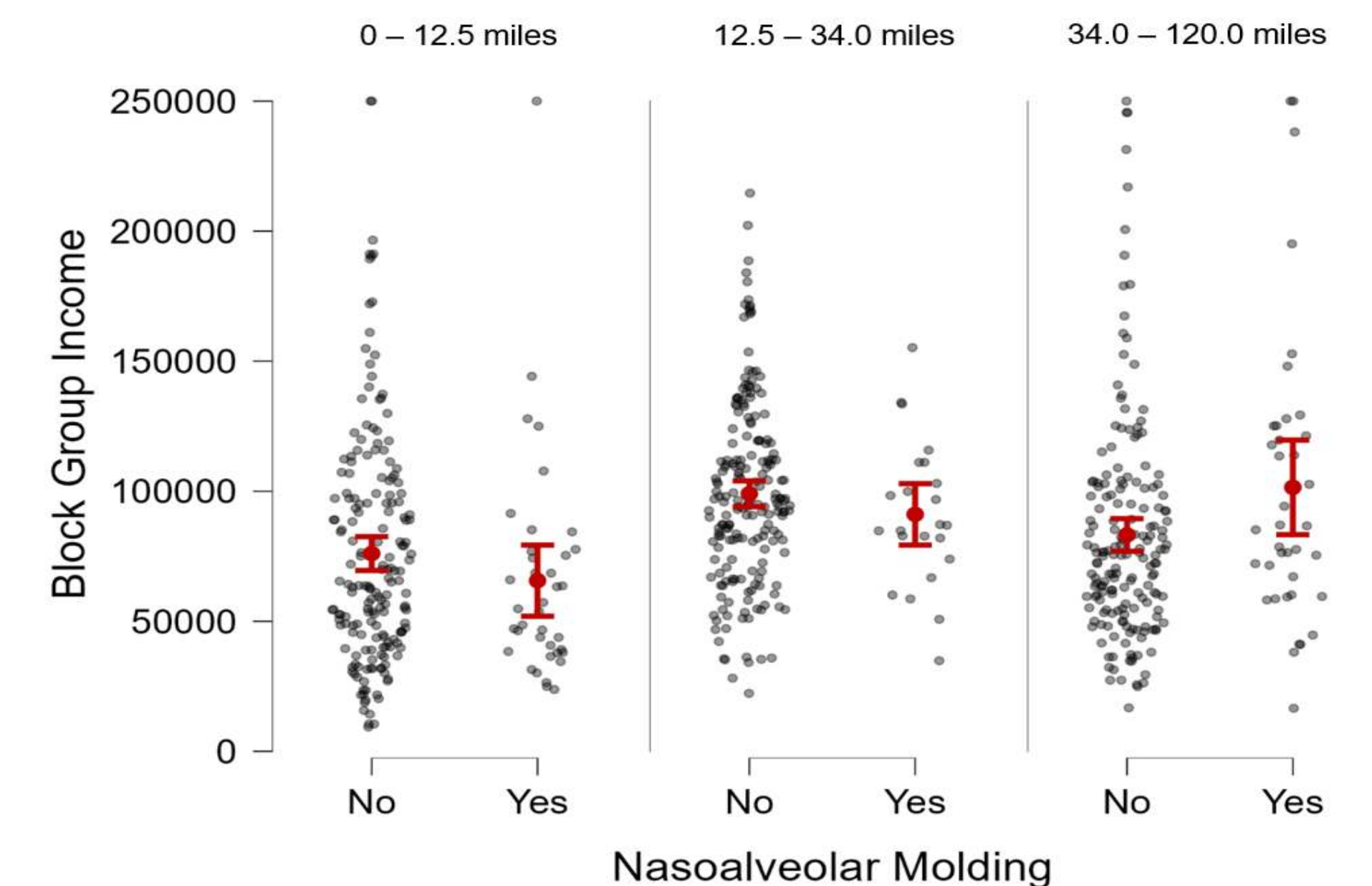


Figure 2. Nasoalveolar molding by patient block group income and distance from the care center.

## CONCLUSIONS

- This study augments current literature on disparities in cleft lip and palate surgery by describing relationships between distance from care center, socioeconomic status, cleft-associated services, and clinical outcomes.
- Geospatial and socioeconomic factors may interact with one another to influence prenatal evaluation by plastic surgery and management with nonalveolar molding or cleft lip adhesion.
- Future work will aim to characterize factors implicated in these disparities and to determine appropriate interventions to mitigate these differences.