Associations Between Gender, Comorbidities, and Cerebral Palsy Diagnosis Rate Among Regions of Riverside County, California for Children Provisionally Enrolled Under the Age of Three in the Medical Therapy Program

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Abstract

The Riverside University Health System provides adequate information about adult health disparities within the county; however, very little information is provided regarding health disparities in young children. Literature states that there are gender differences in cerebral palsy (CP) diagnosis and that health disparities can be geographically concentrated. The purpose of this study was to identify any associations between gender, comorbidities, and the rate of CP among regions in Riverside County, California. The 252 participants used in this study were children under the age of three enrolled into the Medical Therapy Program (MTP) at some point during the years 2015 to 2018. The study investigated if there is a difference in CP diagnosis among MTP children across the four regions of Riverside County and if there are gender differences in the rate of comorbidities among MTP children with a primary CP diagnosis. The results indicated that there were no significant differences in the rate of MTP children diagnosed with CP among the four regions of Riverside County ($F(3,37) = .550$, $p = .651$). Additionally, results indicated that there were no significant differences between genders in the diagnosis of comorbidities among children diagnosed with CP in the MTP ($X^2(1) = .997$, $p = .198$). Additional research is needed to understand the disparities in disabilities and illness in children in Riverside County; however, these results may eliminate stereotypes based on gender and assumptions of geographical location as they relate to CP in Riverside County.

Key Words: Cerebral Palsy, comorbidities, diagnosis, gender, Riverside County.

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Review of Literature

Introduction

Recent evidence-based studies have shown that health disparities are often geographically concentrated. For example, areas with poor access to health care, as compared to those with sufficient access, will present lower levels of use of preventative services and a higher burden of chronic diseases (Holmes, Tootoo, Chosy, Bowie & Starr, 2018). The term social epidemiology has been used to describe how the distribution of advantages and disadvantages in a society reflect the distribution of health and disease (Hanjo, 2004; Von Dem Knesebeck, 2015). Visualizing the distribution of health outcomes among small geographic scales by using neighborhoods and ZIP codes is critical in identifying neighborhoods with the greatest need for health and social interventions (Holmes et.al., 2018).

Cerebral Palsy

Cerebral palsy (CP) is the most common developmental motor disability found among children with a prevalence ranging from 1.5 to 4 in every 1,000 children in the United States (Centers for Disease Control and Prevention [CDC], 2018). CP is a group of permanent disorders in the development of movement and posture causing activity limitation that are attributed to nonprogressive disturbances that occurred in the developing fetal or infant brain (Panteliadis, 2018). This non-progressive neuromuscular disability includes movement disorders and impairment to muscle tone or posture often co-occurring with a range of cognitive, behavioral, and sensory impairments (Marret, 2016). Along with muscle tone or posture abnormalities, CP

can also include the presence or loss of selective motor control, alteration in muscular balance, and changes in muscle strength (Miller, 2005).

Prognosis of CP varies depending on associated health conditions and the functioning level of movement which can be classified as spastic, dyskinetic, hypotonic, or ataxic depending on the damage caused from various perinatal or neonatal exposures (Miller, 2005). The first clinical signs of CP can be seen as early as one week to 36 months of age with indicators of hyperreflexia, persistent primitive reflexes, and tonal abnormalities (Miller, 2005). CP can affect different parts of the body resulting in diplegia, hemiplegia, or quadriplegia, and symptoms can present as mild, moderate, or severe (Panteliadis, 2018). Most children with CP are diagnosed within the first two years of their life when symptoms are mild, but a reliable diagnosis is not given until the age of 4 or 5 (Novak et.al., 2017; CDC, 2019). International Classification of Disease, tenth revision (ICD-10) diagnosis codes are currently used to specifically classify and code all diagnoses, symptoms, and procedures recorded in conjunction with medical care in the United States. Since mild and moderate CP symptoms may occur in infants at an early age, ICD-10 codes, such as R29.90 (unspecified signs and symptoms of the nervous system), may be given to a child to help him or her qualify for care he or she may need until a more reliable and permanent diagnosis can be given at a later age.

A California retrospective cohort study of infants from 1991 to 2001 revealed an overall CP prevalence of 1.4 per 1,000 live births within in the 10-year study period (Wu, Xing, Fuentes-Afflick, Danielson, Smith, & Gilbert, 2011). It became apparent that most cases were moderate to severe with quadriplegia being the most

common type of CP diagnosed followed by paraplegia and hemiplegia. African American children had a 29% higher chance of having CP than white children, and this number was the highest of any other ethnicity. Lastly, Wu, Xing, Fuentes-Afflick, Danielson, Smith, and Gilbert (2011) concluded that women younger than 18 or women older than 35 were at a higher risk of giving birth to a child with CP. In conjunction with other previous studies, this research also suggested that low birth weight in infants is a risk factor for CP (Wu et. al., 2011).

Comorbidities, such as neuromuscular disorders and cognitive impairments, usually accompany CP. Studies suggest that children with the more severe CP conditions, such as quadriplegia, have a higher chance of having additional comorbidities and a 71% increase in epilepsy risk (Gabis Gabis, Tsubary, Leon, Ashkenasi, & Shefer, 2015; Romeo et. al., 2011). Another study consisting of a sample of 90 cerebral palsy diagnosed children, identified 64% to have quadriplegic CP, and epilepsy was prevalent in 34% of the child of which 23% were from the quadriplegia group (Gabis et al., 2015).

Gender Differences in Cerebral Palsy

It has been difficult to identify gender differences in Gross Motor Function (GMF) and cognitive development among case series (quadriplegia, hemiplegia, and diplegia) with CP children (Romeo, Cioni, Battaglia, Palermo, &Mazzone, 2011). When looking at the differences in dimensions of GMF, specifically laying and rolling, sitting, crawling and kneeling, standing, and walking/running and jumping, only the standing variable showed a significant gender difference in favor of females (Romeo et. al., 2011). Some studies have also tried to link low gestational weight to

gender differences in CP. Males are more likely to present with CP than females, and although the cause is unknown, male babies are more vulnerable to growth deviations either well above or well below optimal birth weight (Jarvis et al., 2005). Evidence also suggests that gender differences in the prevalence of cerebral palsy may be due to hormonal influences. Estrogen may provide protection against hypoxic-ischemic injury that influence the neonatal brain, therefore presenting differences among males and females (Johnson, 2007). While recent studies have identified males to have a greater risk factor for CP than females, studies have been unable to identify gender difference in severity or case series of CP let alone gender differences in comorbidities.

Impact of Cerebral Palsy

Cerebral palsy is a lifelong chronic medical condition that requires long-term supportive care and services that have an estimated cost of about $11.5 billion nationally and $921,000 individually in lifetime expenses (CDC, 2004). As CP co-exists with other cognitive, behavioral, and sensory impairments, this dollar amount includes the indirect and direct medical and non-medical expenses of an individual living with CP. However, these amounts do not include the severity of the condition or out-of-pocket expenditures (CDC, 2004). In a 2012 eight-state cost of illness study, 9,927 children were identified to have CP with about 20% having an additional intellectual disability (ID) (Kancheria, Amendah, Grossee, Yeargin-Allsopp, & Van Naardan Braun, 2012). It was calculated that children with CP with or without ID incurred a mean total of $22,143 in Medicaid expenses in 2005, and those without CP with or without ID only incurred a mean amount of $1,729 (Kancheria et. al., 2012).

This resulted in a $20,414 difference in medical expenses for children diagnosed with CP compared to those without CP regardless of the ID diagnosis. These estimates show a positive relationship between CP diagnosis and cost.

As with any child with special needs, additional support is needed for families with a child diagnosed with a chronic condition such as CP. The earlier the intervention of services, the better the outcome of lifetime setbacks. Under the Individuals with Disabilities Education Act (IDEA), law requires that all children suspected of having a disability be evaluated with no cost to determine if they do in fact have a disability and due to the disability, need special services to maintain or support that disability (National Dissemination Center for Children with Disabilities [NICHCY], 2010). While exploring the advancement of diagnosis and treatment for CP, it was concluded that early diagnosis is advantageous in monitoring a child's CP since motor and cognitive gains are greater from diagnostic and specific interventions (Novack et al., 2017; Panteliadis, 2018).

Research has indicated that brain development and motor refinement continue postnatally and are driven by motor cortex activity. This means that early, and often physical, intervention among children with an early diagnosis of CP is associated with a lower risk of losing cortical connections and dedicated function (Novack et. al., 2017). The aim is to intervene at the earliest age while the child is learning to move against disordered muscle control and weakness, so that maladaptive movements do not result in muscle disuse (Novack et. al., 2017). There is also increasing evidence that an infant's motor behavior, via discovery and interaction

with the environment, generates the growth and development of the muscle and neuromotor system development (Novack et. al., 2017).

Although the exact trigger is not known, factors that may lead to the risk of CP include maternal infections affecting the fetus, genetic disorders, infant infections causing inflammation around the brain, traumatic brain injuries, and asphyxia during labor (Panteliadis, 2018; Miller, 2005). Some other factors that contribute to the risk for CP in children include higher frequencies of births by older women, higher frequencies of preterm births, specific micronutrient deviancies and infections, and toxic exposures (Durkin, 2002). Prenatal and neonatal infections are the most common infectious cause of CP in infants (Miller, 2005).

A common occurrence among children diagnosed with CP is prematurity and low birth weight mostly seen in mothers and children who have contracted an illness or infection during pregnancy. Infants born before the thirty-seventh week of pregnancy and who weigh less than five and a half pounds at birth are more likely to have CP (CDC, 2017). A spatial analysis between low birth weight and socioeconomic and environmental factors produced a positive significance between urban spacing and low birth weights (Tu & Tedders, 2012). Both family income and urban land had significant results for about half of both male and female infants' birth weight. It was determined that urban land will produce poor air quality resulting in air pollution exposure, and low household income is a predictor of educational and residential property attainment (Tu & Tedders, 2012). The positive results between low birth weight and socioeconomic and environmental factors only applied to some of but not all of the urban communities (Tu & Tedders, 2012).

Cerebral Palsy in Riverside County

Although Riverside County, California provides adequate health disparity information and statistics on the adult population through, Strategic Health Alliance Pursuing Equity (SHAPE) and the Community Health Assessment, very little information is provided on children's health rates. Disability rates are also combined into a general category, so specific rates of cerebral palsy cannot be determined from data reported by SHAPE and the Community Health Assessment. It was reported that almost 30% of adults living in Riverside County are living with a disability (SHAPE, 2018). This number is higher than the U.S. value (20.6%) but consistent with the California average value (29.7%). With a large percent of adults living with disabilities in Riverside County, it would be advantageous to identify cases of children with disabilities.

Nearly seven of every 100 babies born in Riverside County are considered underweight and one in ten babies are born preterm (SHAPE, 2015). Babies born to women ages 40 and above present a significantly higher percentage of low birth weight. Babies also born to African American and Pacific Islander women presented a higher percentage of low birth weight (SHAPE, 2015). It was reported that 0.5% of children under the age of five and 4.4% of children ages 5-17 years have disabilities in Riverside County (SHAPE, 2019).

California Children's Services (CCS) is a county, state, and federally funded program. Services are provided by the Medical Therapy Program (MTP) that provides therapy services through Medical Therapy Units (MTUs) spread out among each county. Counties perform all case management activities, including managing all

phases of program eligibility, evaluating needs for case specific services, finding appropriate providers, and authorizing necessary care. These services are offered to children whose parents are unable to pay fully or in part and most patients are also Medi-Cal eligible (California Department of Health Care Services [DHCS], 2019).

CCS is a partnership among county health departments and the California DHCS where CCS provides services reimbursed through Medi-Cal. As part of this partnership, CCS provides case management and therapy services related to the condition(s) that made the child eligible. However primary care and prevention services do not fall under CCS; instead, they fall under the partnership health plan. For Riverside County, Inland Empire Health Plan (IEHP) as well as Molina Healthcare covers primary care and preventative services in partnership with CCS.

The 2015 Riverside County Community Health Assessment found that every one in three houses presents a severe housing problem (overcrowding, high housing costs, lack of kitchen or plumbing facilities, mold and mildew growth, pest infestation, lead or other environmental hazards), which is one of the highest percentages of California counties (SHAPE, 2015). These severe housing conditions can lead to physical hazard risks or contribute to health problems such as infectious and chronic diseases, injuries, and poor childhood development. Although more investigation is needed in this area, existing research states between 10% and 25% of CP cases are due to post-natal causes such as blunt force trauma and skull fractures that cause direct injury and secondary injury due to swelling (Miller, 2005).

Poor housing conditions may lead to accidental injury to infants as 13.5 million non-fatal injuries occur in and around the home each year (Krieger &

Higgens, 2002). Further, housing is a strong indicator of socioeconomic status (SES) (Krieger & Higgens, 2002; Bonnefroy, 2007). As stated by Juhn and colleagues (2011), housing attributes are a reflection of SES through its association with the distribution of health and wellbeing, control over life circumstances, and access to human, materialistic, and social resources. The effects of housing conditions have been compared to adverse birth affects resulting in low birth weight and preterm infants. Women who were more likely to report mold or dampness in their home were more likely to give birth to a low birth weight baby (Harville & Rabito, 2018). Symptoms from mold/dampness growing in a home include gastrointestinal diseases, aches and pains, and respiratory conditions. These conditions can also reduce the oxygen and nutrients available to a developing fetus and worsen perinatal outcomes, which can lead to adverse effects on fetal and infant development (Harville & Rabito, 2018).

Neuromuscular disabilities found among children have been linked to several risk factors that stem from environmental influences. Risk factors for CP are not primarily driven by differences in health care access or quality, but rather by socioeconomic and environmental conditions in which children are raised. Spatial statistics are valuable tools for a public health approach aimed at identifying areas of risk where it appears relevant to strengthen, adapt, and prioritize needs (Lachkhen, Minvielle, & Rican, 2018; Holmes et. al., 2018). Although the cause for such disabilities like CP is still uncertain, these environmental risk factors have been found to be influential in the development of CP and other neuromuscular disorders.

Moreover, these disorders have a higher chance of being preventable when correct measures are taken.

Spatial analysis using ZIP codes and ZIP Code Tabulation Areas (ZCTA) are an emerging type of analysis. ZIP codes were created for the United States Postal Service (USPS) and often change for route improvements, whereas ZCTAs are combined ZIP codes the United States Census Tract uses to reach more people, but contain topological features (i.e. lakes and rivers) that can hinder spatial analysis (Grubesic & Matisziw, 2006). ZIP code level data have been used to investigate health disparities to identify many predictors of health risks that are associated with human habituation among communities (Grubesic & Matisziw, 2006; Yueyan, Ponce, Pan, Opsomer, & Hongjian, 2015; Lachkhem, Minvielle, & Rican, 2018). However, using ZIP code level data runs the risk of reducing the ability for analysis to compare data across spatial units and can cause spatiotemporal mismatch as ZIP codes may change.

Purpose of the Study

The purpose of this study is to identify if a child's CP diagnosis is related to the region in which he or she resides. Other studies have identified poor housing conditions to be linked to low birth weight, which is also a strong risk factor for CP (Harville & Rabito, 2018). Additionally, it has been identified that one in three houses in Riverside County possess a severe housing condition (SHAPE,2015). Cerebral palsy has also been found to be more prevalent among boys than girls and comorbidities are common with a CP diagnosis. However, little research is provided about gender and comorbidities among CP children, so this study also aims to

investigate gender differences between comorbidities of children diagnosed with CP as well as environmental factors related to CP.

Research Questions

In this study, there were two research questions.

Research Question 1: Is there a difference in the rate of CP (per 1,000 children) across cities in the four regions of Riverside County for children under the age of 3 provisionally enrolled in the Riverside County MTP?

Research Question 2: Is there a difference in the rate of comorbidities among male and female children under the age of 3 diagnosed with CP in the Riverside County MTP?

Hypotheses

Hypothesis 1: It is hypothesized that certain regions in Riverside County will present the highest prevalence of CP diagnosis based on ICD-10 codes for children under the age of three enrolled in the Riverside County MTP.

Hypothesis 2: It is hypothesized that male children under the age of three enrolled in the MTP are more likely to have a comorbidity than females under the age of three enrolled in the program.

Method

Design

Data from the Riverside County Medical Therapy Program was used to answer the two research questions. This study specifically looks at (1) the MTP rate of cerebral palsy diagnosis among the four regions in Riverside County and (2) gender differences in the prevalence of comorbidities of MTP children with a CP diagnosis. Due to the restricted number of dataset participants, the city of residence variable was converted to a region variable where cities were grouped together to make up four regions based on location within the County. These regions were then used in an Analysis of Variance (ANOVA) to test the hypothesis that certain cities in Riverside County will present a higher prevalence of CP disorders among children enrolled in Riverside's MTP from 2015-2018. This study uses a cross-sectional study design. IRB approval was granted by the IRB Committee at California Baptist University (Appendix C).

Procedures

Data from the Riverside County's Office of California Children's Services, Medical Therapy Program was used for this study. The dataset was collected from MTU Online version 7 and CMSWeb databases from years 2015-2018. The dataset included 252 participants, 134 boys and 118 girls. The sample size for Hypothesis 1, for which an ANOVA test was performed, was drawn using G*Power Software Version 3.1.92, with a medium effect size of .3, an alpha level of .05, and a power of 80%, which provided a minimum required sample size of 128 participants. The sample size for Hypothesis 2, for which a Chi-Square Test of Independence was

performed, was drawn using G*Power Software, Version 3.1.92, with a medium effect size of .3, an alpha level of .05, and a power of 80%, which provided a sample size of 190 participants. This sample size exceeds the minimum required to answer each research question.

Permission to obtain and analyze the data was given by the Chief Therapist at the Riverside County CCS offices in Riverside, CA. This dataset is county level data originally collected for quality improvement of the Medical Therapy Program. The Excel file was only accessed at the Riverside County CCS office until deidentified. Since the data was originally used internally, for the purpose of this study the process of deidentification was carried out by the Primary Investigator. Participants' were deidentified and given an identification number, and ZIP codes were generalized to the city to which that ZIP code applied. This method allowed an analysis of the variable to depict any trends of CP children living within the same areas of Riverside County.

Participants

The participants included in this study were children under the age of three provisionally enrolled in the Riverside County MTP from January 2015 to December 2018. Required criteria for program participants included children who were enrolled into the program with a cerebral palsy or related diagnosis of one or more of the following ICD-10 codes: G12.0, G54.0, G80.0, G80.1, G80.2, G80.4, G80.5, G80.8, G80.9, G81.10, G81.14, G81.90, G82.50, G83.10, G96.9, R27.0, and R29.90. Some children also may have a comorbidity of various conditions that come secondary to their CP diagnosis. Comorbidities included in this study were other substantial

cognitive, behavioral, and sensory impairments that co-exist with CP for a child. All open and closed MTP cases from this time period were included in this study. Any children brought into the program over the age of three were not included in this dataset as different criteria for MTP enrollment applies after the age of three. Consent for use of participants' medical information was obtained by the parents with a release of information form as well as HIPPA notice packet signed in the orientation phase of each child's MTP enrollment.

Independent Variable and Dependent Variable

Once deidentified, the dataset was converted from an Excel file and programmed into SPSS to prepare for data analysis. Variables reported for this study were: gender, ethnicity, city, region, CP ICD-10 code, and other ICD-10 codes (if applicable).

For the first research question, the independent variable used was the region in which the child resided. According to the United States Census Bureau (2018), Riverside County has a population size of about 2,450,758 people. Cities in Riverside County and their population size of children under the age of five, based on the United States Census Bureau data include: La Quinta (1,896), Indio (6,083), Palm Desert (1,994), Palm Springs (1,616), Coachella (3,317), Desert Hot Springs (2,238), Bermuda Dunes (291), Blythe (1,210), Cathedral City (3,565), Rancho Mirage (218), Thermal (205), Thousand Palms (453), Indian Wells (15), Mecca (889), Banning (1,991), Beaumont (3,148), Hemet (5,202), San Jacinto (3,741), Cabazon (466), Winchester (159), Aguanga (12), Anza (285), Calimesa (192), Homeland (641), Idyllwild (99), Lake Elsinore (5,422), Menifee (5,804), Murrieta (7,893), Temecula

(1,775), Wildomar (2,301), Canyon Lake (618), Corona (10,747), Eastvale (4,863), Moreno Valley (15.436), Norco (1,161), Perris (6,037), Jurupa Valley (7420), Riverside (21,326), Mira Loma (1708), and Sun City/Romoland (185). Riverside County CCS, Medical Therapy Program has ten Medical Therapy Units spread out among the county and placed in the more densely populated cities. These MTUs are placed in Banning, Corona, Hemet, Indio, Murrieta, and Palm Springs and there are two in both Riverside and Moreno Valley. Data was retrieved from the Riverside University Health system CCS office in Riverside, CA.

Riverside County is broken down into four main regions including West, South, Mid, and East. The western region includes Corona, Eastvale, Jurupa, Mira Loma, Moreno Valley, Norco, Nuevo, Perris, Riverside, Sun City/Romoland (Zip code 92585). The southern region includes Canyon Lake, Lake Elsinore, Menifee (Zip codes 92584 and 925856), Murrieta, Temecula, and Wildomar. The Mid region includes Aguanga, Anza, Banning Beaumont, Calimesa, Hemet, Homeland, Idyllwild, San Jacinto, and Winchester. Lastly, the eastern region includes Blythe, Cathedral City, Coachella, Desert Hot Springs, Indian Wells, Indio, La Quinta, Mecca, Palm Desert, Palm Springs, Rancho Mirage, Thermal, and Thousand Palms. The independent variable region was recorded as a nominal measure coded into SPSS with values (1 = West, 2 = South, 3 = Mid, 4 = East).

The dependent variable used for the first research question was “rate of CP diagnosis by region," (per 1000 children). To calculate this, the number of children from the MTP given a CP diagnosis in each region was divided by the total American

Community Survey (ACS) five-year estimate (2013-2017) number of children under the age of five for cities in each region to produce a rate of diagnosis by region.

For the second research question, the independent variable was "gender" recorded at the nominal level (1 = male and 2 = female). As some children had comorbidities and others did not, the dependent variable "other ICD codes" value was labeled as comorbidities and also given nominal values (1 = yes and 2 = no).

Data Analysis

Descriptive statistics were produced to examine demographics of each separate region, gender, and comorbidity group. A one-way ANOVA was computed to test the hypothesis that certain regions in Riverside County will present a higher rate of children under three from the MTU with a CP ICD diagnosis. A one-way ANOVA was appropriate to use for this analysis because the dataset provided a large group of children with a CP diagnosis that could be turned into a rate of CP (per 1000 children) by region to create an independent variable. A significant difference will be determined if the rate of CP diagnosis was higher among the certain regions of Riverside County, CA. In this case, an additional Bonferroni Post Hoc test will be run if the one-way ANOVA suggests a significant difference to identify which of the four regions present an increase in the rate of CP diagnosis.

A Chi-Square Test of Independence was also computed to test the hypothesis that males are more likely to have a comorbidity than females in the MTP. The Test of Independence was appropriate because it allowed analysis of frequency distribution and associations for the two nominal variables, gender (1 = males and 2 = females) and comorbidities (1 = yes and 2 = no).

Results

Data from Riverside County Children's Medical Services, MTP 2015-2018 included 252 participants, which were used to answer the research questions in this study. Of the participants, 134 (53.2%) were male and 118 (46.8%) were female. All participants used in this study were under the age of three when they were enrolled into the program. Descriptive statistics showed that 116 (46%) of the children were Hispanic, 41 (16.3%) were White, 27 (10.7 %) were African American, 3 (1.2%) were Filipino, 3 (1.2%) were Asian, 1 (.4%) was Native American, and 2 (.8%) were considered Other. Additionally, 59 (23.4%) children had an unknown race/ethnicity. When considering the region variable, 115 (45.6%) of participants were in the West region, 52 (20.6%) were in the South region, 42 (16.7%) were in the Mid region, and 43 (17.1%) were in the East region. See Tables 1 and 2 for complete demographic information.

Rate of MTP CP Disability Across Regions

In order to answer the first research question, "*Is there a difference in the rate of disability (per 1,000 children) across cities in the four regions of Riverside County for children under the age of three provisionally enrolled in the Riverside County MTP*?", a one-way ANOVA was computed, comparing MTP children under the age of three with CP diagnosis rates (per 1,000) in cities within the four regions of Riverside County. No significant differences were found ($F(3,37) = .550$, $p = .651$). The CP diagnosis rate (per 1,000) of MTP children who resided in the West, South, Mid, and East regions of Riverside County do not differ significantly. The West region MTP had a mean CP diagnosis rate of 2.05 (sd = 1.49). The South region MTP

had a mean CP diagnosis rate of 2.77 (sd = 5.47). The Mid region MTP had a mean CP diagnosis rate of 1.65 (sd =0.54). The East region MTP had a mean CP diagnosis rate of 1.11 (sd = 1.08). See Table 3 for One-way Analysis of Variance results.

Gender Differences in Comorbidities

For the second research question, "*Is there a difference in the rate of comorbidities among male and female children under the age of three diagnosed with CP in the Riverside County MTP?*", a Chi-Square Test of independence was calculated comparing gender and comorbidities among children in the MTP with a primary CP diagnosis. Of the 252 participants, 195 children (107 males and 88 females), have a secondary comorbidity to their CP diagnosis. Based on the literature, it was hypothesized that male MTP children will be more likely to have a significant coexisting secondary condition to their CP diagnosis. No significant relationship was found between gender and comorbidity (X^2 (1) = .997, p = .198). Comorbidities among CP diagnosis for the MTP in Riverside County are independent of gender. See Table 4 for Chi-square Test of Independence results.

Discussion

Summary of Major Findings

Data from the Medical Therapy Program of California Children's Services, Riverside County, California was analyzed to explore associations between gender, region, and the rate of cerebral palsy diagnosis among children under age three provisionally enrolled in Riverside County's MTP. The first research question examined potential differences in the rate of CP diagnosis (per 1,000 children) across cities in the four regions of Riverside County, California. A one-way ANOVA was calculated; however, it revealed no statistically significant differences. This required rejecting the research hypothesis and accepting the null hypothesis that CP diagnosis rate (per 1,000) of MTP children under the age of three who reside in West, South, Mid, and East regions of Riverside County do not differ. Cerebral palsy is a condition that impacts children throughout Riverside County, and the rates are not higher in certain areas but consistent throughout all regions. These results are consistent with current literature as CP rates are consistent in areas that also experience higher rates of infant low birth weight and poor housing conditions like Riverside County.

The second research question addressed differences in rate of comorbidities among male and female children under the age of three diagnosed with CP in the Riverside County MTP. A Chi-Square Test of Independence was conducted comparing gender and comorbidities among children in the MTP with a primary CP diagnosis. No significant relationship was found between gender and comorbidity, thereby rejecting the research hypothesis and accepting the null hypothesis that cerebral palsy diagnosis for the Riverside County MTP is independent of gender.

This study aligns with previous research as the literature presents inconsistent results when looking at gender and comorbidities.

Public Health Implications

This research illustrated that there is no relationship between gender and CP comorbidities among children enrolled in the Riverside County MTP. The dataset used for this study only contained children with a CP diagnosis. The demographics of this dataset showed that there were more MTP male participants than female participants in Riverside County, which aligned with previous studies implicating that males are more likely to have a CP diagnosis than females (Jarvis et.al., 2005). However, when looking at the relationship between comorbidities among gender there was no significant difference. Other studies have tried to link gender with specific comorbidities, such as epilepsy and learning disabilities, but results have been inconsistent. There have been gender differences in learning disabilities, but these differences were not found in epilepsy research (Prasad, Burneo, & Corbett, 2014). Understanding that gender does not influence having a comorbidity with CP, gives credence to the theory that comorbidities may be caused and better understood by studying other factors. Further studies investigating the relationship between CP and comorbidities should look at other factors aside from gender. Since this study found MTP children's comorbidities to be unrelated to their gender, further studies should also investigate early screening and its relationship with comorbidities.

The study results also showed that MTP CP diagnosis rates do not differ significantly among the four regions of Riverside County. Previous research has implicated that people with poor access to health care services will result in lower

levels of use of preventative services and a higher burden of chronic diseases (Holmes et al., 2018). Riverside County has a sufficient amount of health care programs and services for low income families with a CP diagnosed child. Several of these programs cater to both U.S. and non-U.S. citizens. These programs include United Cerebral Palsy of the Inland Empire, Inland Regional Center, Loma Linda University Health PossAbilities, Riverside University Health System (RUHS) Child Health and Disability Prevention Program (CHDP), and CCS Medical Therapy Program.

The Medical Therapy Program offers treatment services, medical case management, and physical and occupational services for low-income families with disabled children (Riverside University Health System, 2019). Riverside County's MTUs are where MTP children go to seek their physical and occupational therapy services (Riverside University Health System, 2019). These units have been strategically placed around Riverside County as the dataset showed; the cities with the most CP diagnosed participants were the cities in which the MTUs are placed. Additionally, the two cities that contain two MTUs are Riverside and Moreno Valley, which also appear to be the cities with the highest ACS children under the age of five as well as the most CP diagnosed MTP children. However, the CCS can only authorize care to CCS paneled and approved doctors and facilities. Although these providers are approved by CCS, this limits families' options to get care near their home. Access to transportation to get to and from services and appointments may be an issue for MTP children in more rural-like areas of Riverside County, especially the desert cities. Families in cities without an MTU and approved facilities have to travel

to get their child to appointments. Some children with CP are wheelchair bound and traveling may be an issue for some families when it comes to transportation. Medical transportation is included in Medi-Cal benefits however, limitations may apply. Many families cannot use this provided service because they cannot work around the pick-up and drop-off timeframe. It should be considered by Medi-Cal to adjust the requirements and create flexibility for families who are not able to work their schedule around Medi-Cal provided medical transportation.

Most children enrolled in the MTP are Medi-Cal eligible, according to CCS. This means that children can receive care from any of the approved providers through CCS. Although this may limit a families' options, CCS ensures providers within their network provide quality care as they are carefully paneled and approved. Children who are not Medi-Cal eligible are case managed through their own HMO or PPO private insurance and primary care providers. Although these children could have the option of seeking care locally, there is a risk that they may not get the best physician or facility to treat their child's condition as these physicians may not have been CCS approved. Another policy recommendation is that all children in the State of California should be able to seek care through CCS paneled and approved physicians, whether they are in the CCS network or not, therefore expanding care choices for clients with HMOs and PPOs.

Understanding that MTP CP diagnosis rates across the four Riverside County regions do not differ can help future programs promote early CP screening of children. Although Riverside County provides adequate services, obtaining these services for children under the age of three can be difficult since most program

guidelines require an actual CP diagnosis for access to program services (DHCS, 2019). The MTP uses the code R29.90 "unspecified symptoms and signs involving the nervous system" to help grant children at-risk for CP or other neuromuscular disorders access to therapy services and case management to help provide early intervention services before a reliable diagnosis can be made. Early screening can help monitor any symptoms and can help children get the services they need in order to maintain their cortical connections and dedicated functions while they are still developing (Novack, 2017; Panteliadis, 2018). Additionally, these study results can help public health professionals avoid any assumptions for risk of CP, including stereotypes regarding gender and geographical location within the Riverside County.

There has been little research concerning cerebral palsy among Riverside County; however, these study results could provide basis for further research. Results from this study may help many public health professionals understand the impact the Medical Therapy Program has on low-income families with children with a CP diagnosis in Riverside County so they can develop further strategies for CP-based programs throughout other counties. Due to the limited number of dataset participants from the MTP, further research should investigate rates of CP diagnosis for all children within Riverside County.

Study Limitations

This study had several limitations. Data from the Riverside County Medical Therapy Program (2015-2018) was used in this study. Only children with cerebral palsy who were enrolled in the MTP during this timeframe were included. This excluded any child in Riverside County who had a CP diagnosis but did not seek

treatment through California Children's Services, MTP. Data from July 2014-April 2019 is available; however only data for years 2015-2018 were complete enough to be used in this study. Only children enrolled under the age of three into the MTP were used in this study, creating another limitation. Children over the age of three who were enrolled into the MTP were not included because different CP diagnostic criteria apply to children above the age of three. This could have affected the actual impact of CP displayed by the MTP.

After deidentification of the data, the dataset only included eight elements, leaving little room for additional analysis regarding CP in the Riverside County MTP. This dataset also contained missing data elements for several participants, including ICD code, city, and ethnicity. Children with missing ethnicity were coded as "unknown." However, children with missing information regarding their ICD diagnosis and city of residence were excluded from the analyses.

In order to run an analysis regarding CP diagnosis among MTP children in Riverside County, a rate of CP by both city and region had to be made. Study factors, including creating study-specific CP rates and not having additional data on each child, limited the types of comparisons that could be made regarding MTP children with CP under the age of three in Riverside County. The few data elements made an organized dataset, which is fitting for a relatively small sample size.

Conclusion

This study found that there are no significant differences between gender, region, and cerebral palsy diagnosis rate among children under the age of three provisionally enrolled in the Riverside County Medical Therapy Program. There is

little research presented for Riverside County concerning CP and its effect on society. The results of this study could help eliminate stereotypes based on gender and assumptions regarding risk for CP based on geographical location of children diagnosed with cerebral palsy in the Riverside County, California MTP. These findings emphasize the importance of the MTP for California Children's Services as MTP CP diagnosis rates are consistent throughout the county.

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Appendix A: Tables

Table 1

Demographic Details for Rate by Region (n = 252)

Region	City	ACS 5-year estimate	*N*	% (Per 1,000 children)
East		23990	43	1.8
	Bermuda Dunes city, California	291	1	3.4
	Blythe city, California	1210	3	2.47
	Catherdral City, California	3565	3	0.84
	Coachella city, California	3317	5	1.8
	Desert Hot Springs city, California	2238	5	2.2
	Indian Wells city, California	15	0	0
	Indio city, California	6083	16	2.6
	La Quinta city, California	1896	2	1
	Mecca city, California	889	0	0
	Palm Desert city, California	1994	3	1.5
	Palm Springs city, California	1616	2	1.2
	Rancho Mirage city, California	218	1	4.58
	Thermal city, California	205	1	4.87
	Thousand palms city, California	453	1	2.2
Mid		15936	42	2.51
	Aguanga city, California	12	0	0
	Anza city, California	285	0	0
	Banning city, California	1991	5	2
	Beaumont city, California	3148	8	2.5
	Cabazon city, California	466	1	2.1
	Calimesa city, California	195	0	0
	Hemet city, California	5202	20	3.8
	Homeland city, California	641	0	0
	Idyllwild city, California	99	0	0
	San Jacinto city, California	3741	5	1.3
	Winchester city, California	159	3	18.8
South		29213	52	1.78
	Canyon Lake city, California	618	1	1.61
	Lake Elsinore city, California	5422	13	2.3
	Menifee city, California	5804	13	2.2
	Murrieta city, California	7893	13	1.6
	Temecula city, California	7175	10	1.3
	Wildomar city, California	2301	2	0.86
West		69418	115	1.67
	Corona city, California	10747	12	1.2
	Eastvale city, California	4863	1	0.2
	Jurupa Valley city, California	7420	1	0.13
	Mira Loma city, California	1708	1	0.58
	Moreno Valley city, California	15436	39	2.5
	Norco city, California	1161	2	1.7
	Nuevo city, California	535	0	0
	Perris city, California	6037	16	2.8
	Riverside city, California	21326	43	2
	Sun City, California	185	0	0

Note. N = Program Participants, %= Rate (per 1,000) of MTP children in each city/region. Source: American Community Survey 5-year population estimates. (2013-2017)

Table 2
Demographic Details for MTP Participants (n = 252)

		N	*%*
Gender			
	Male	134	53.2
	Female	118	46.8
Ethnicity			
	African American	27	10.7
	Hispanic	116	46
	White	41	16.3
	Filipino	3	1.2
	Asian	3	1.2
	Native American	1	0.4
	Other Race	2	0.8
	Unknown	59	23.4
Region			
	West	115	45.6
	South	52	20.6
	Mid	42	16.7
	East	43	17.1

Note. N= sample size, %= percentage. Source: California Children's Services, MTP.

Table 3

One-way Analysis of Variance Comparison of Rate of MTP Cerebral Palsy and Riverside County Region

	N	Mean	SD	F	P
Rate of CP by Region				0.55	0.651
1	10	1.11	1.08		
2	6	1.65	0.54		
3	11	2.77	5.47		
4	14	2.05	1.49		
Total	41	1.95	2.98		
					*p >.05

Note. The ANOVA did not reveal a significant difference between Rate of CP diagnosis among MTP children and region within Riverside County. Source: California Children's Services, MTP.

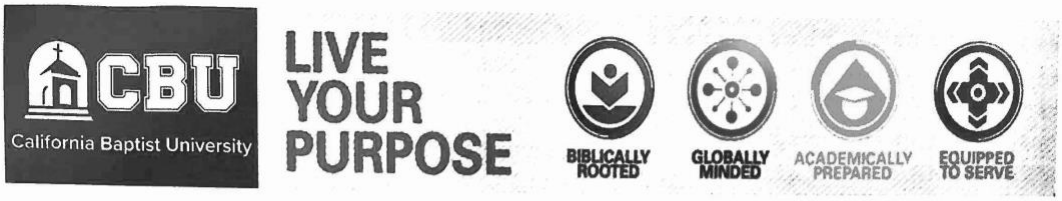
Table 4

Bivariate Association between Gender and Comorbidity

Gender	Yes Comorbidity n (%)	No Comorbidity n (%)	Adjusted OR 95% CI
Male	107 (79.9%)	27 (20.1%)	1.351
Female	88 (74.6%)	30 (25.4%)	(.74, 2.4)

Note. OR= Odds Ratio; CI= Confidence Interval. The Chi-square Test of Independence did not reveal a significant relationship between Gender and Comorbidity. *p =.198. Source: California Children's Services, MTP.

Appendix B: Research Agreement



California Baptist University, Chaylin Couzens and

California Children's Services Riverside, CA

Data Use Agreement

To Whom It May Concern:

I, ROBERT IBRAHIM, agree to allow **Chaylin Couzens** to access the **Therapy Cases** data file at **RUHS California Children's Services, (10769 Hole Ave., Suite 220, Riverside CA 92505)** for the study entitled "**Associations Between ZIP Code and ICD Code Among Children Enrolled in Riverside County's Medical Therapy Program**." I understand the benefits, risks, and time involved in this study. I am fully aware of the procedures for data de-identification and allow data analysis procedures to be used on this data set as approved by CBU's IRB. Please contact me if you have any further questions.

Phone: 951-358-5231

Email: RIBRAHIM@RUHealth.org

Sincerely,

4/16/19

[1]

Appendix C: IRB Approval

RE: IRB Review
IRB No.: 106-1819-EXP

Project: Associations Between Gender, City and ICD Code Among Children Enrolled Under the age of Three in Riverside County's Medical Therapy Program 2014 – 2018

Date Complete Application Received: 5/24

Principle Investigator: Chaylin Couzens
Faculty Advisor: Ashley Parks

College/Department: CHS

IRB Determination: Expedited Application Approved – Student research looking at secondary data to examine the geographical and gender trends of children with Cerebral Palsy; no minor participants due to secondary data being used; no more than minimal risk/risk appropriately mitigated; no deception utilized; consent procedures and documentation are n/a; acceptable data protection procedures. Data examination may begin, in accordance with the final submitted documents and approved protocol.

Date: June 5, 2019