INVESTIGATING THE COMPLEX RELATIONSHIP BETWEEN ADVERSE CHILDHOOD EXPERIENCES AND ORAL HEALTH-RELATED QUALITY OF LIFE

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Dental caries is one of the most common chronic disease in children and continues to be a significant global public health concern. Evidence indicates that chronic diseases, and adverse childhood experiences (ACEs), have destructive impacts on overall quality of life, health outcomes, and health care expenditures. The ACE investigation identified cumulative dose-response relationships between ACEs and development of diverse health and social consequences later in life. Research is scarce on investigating causal pathways to facilitate contextualized public health interventions addressing this seismic threat.

Data was utilized from the 2011-2012 National Survey of Children's Health, inclusive of ages 1-17 for dentate status. The dependent variables identified untreated oral health care needs and preventive dental utilization. The key independent variable, ACEs, included exposure to parental death, parental divorce, parental incarceration, mental health illnesses, domestic violence, neighborhood violence, and racial discrimination. Exogenous variables included age, sex, race/ethnicity, number of children in household, socioeconomic status proxies, health insurance status, and presence of special health care needs. Path analysis, a special subcomponent of structural equation modeling was utilized to explore direct, indirect, and

mediating causal pathways. The data, when adjusted for complex survey design, proportionately represents children in the United States.

The results of the adjusted logistic regressions revealed ACEs demonstrating varying magnitudes of significance across diverse racial and ethnic profiles. Exposures to parental divorce and parental death particularly exhibited critical magnitudes of influence. Adjusted path analyses demonstrated alternative family structures contributing a mediating role between ACEs and oral health-related quality of life (OHRQoL).

In keeping with the Pareto Principle, exposure to certain ACEs, namely parental divorce and parental death, potentially introduces more profound social and health-related consequences later in life. Moreover, invocation of Occam's razor, can assist in theorizing that exposure to alternative family structures (i.e. via parental divorce and/or parental death) initiate a concatenated deteriorating domino effect sequela of secondary ACEs. Therefore, contextualized interventions should prioritize psychotherapeutic child, marriage, and family counseling services improving the home, as an enabling environment, to potentially minimize detriments of ACEs on OHRQoL.

CHAPTER I

INTRODUCTION

The Scope of the Problem

Dental caries, or tooth decay, is one of the most common chronic diseases in children and continues to be a global public health issue in the contemporary context (Jain & Pundir, 2010). Literature frequently cites dental caries to be five times more prevalent than asthma and seven times more prevalent than hay fever in children; thus, making dental caries largely prevalent, second only to the common cold, in vulnerable pediatric populations (Jain & Pundir, 2010). Despite the alarming, and frequently cited statistic, dental caries is both preventable and reversible if appropriate preventive measures occur in earlier stages of disease identification and treatment (Martin, Vyavaharkar, Veschusio, & Kirby, 2012).

Bio-Psycho-Social Model of Health

The conceptualization of oral health extends beyond the biomedical model of explaining the etiology of oral diseases. The biomedical modular approach defines oral health as the state of freedom from oral-related diseases, orofacial pain, and craniofacial abnormalities (Brondani & MacEntee, 2014). Under a broader psychosocial outlook, oral health is conceptualized as the extent of oral health that enables or limits people's ability to contribute to communal and societal progression (Brondani & MacEntee, 2014). Chronic oral diseases negatively impact people at the individual and societal platform; in particular, oral diseases contribute to student

academic performance, school absenteeism, and ability to subsequently maintain a job or achieve professional advancement (Seirawan, Faust, & Mulligan, 2012).

Chronic illnesses, such as dental caries, inhibit children's ability to engage in the academic environment fully; in particular, chronic illnesses are attributable to both increases in missed school days and decreases in academic performance (Jackson, Vann, Kotch, Pahel, & Lee, 2011). Specifically, more than 51 million hours of student contact hours at school are lost due to illnesses traceable to dental-related problems (Jackson, Vann, Kotch, Pahel, & Lee, 2011). Evidence suggests that children with both poor oral and systemic health were more than twice as likely to perform poorly in the academic environment compared to their peers (Jackson, Vann, Kotch, Pahel, & Lee, 2011). Lost learning time due to poor oral health-related quality of life (OHRQoL) with vulnerable pediatric populations has substantial negative life-long sequela (Krisdapong, Prasertsom, Rattanarangsima, & Sheiham, 2013). Dental caries in deciduous teeth of preschool children is categorized as early childhood caries; specifically, early childhood caries is a virulent subcategorization of dental caries that propels mass destruction of the primary dentition (Trentesaux, Delfosse, Rousset, Herve, & Hamel, 2014).

The oral cavity is the gateway to the body and is an important consideration for systemic health. Evidence suggests that oral health significantly intertwines with leading health-related causes of death such as cardiovascular disease, diabetes mellitus, and cancer (Vujicic & Nasseh, 2014). Poor oral health has significant expenditures associated with treatment of the disease; for example, treatment of oral diseases includes direct dental health care expenditures, indirect costs for lost productivity, and indirect costs for lost wages (Vujicic & Nasseh, 2014). Pediatric oral health care services account for nearly one-fourth of overall

dental expenditures in the U.S. (Liao, Ganz, Jiang, & Chelmow, 2010). Oral health care expenditures between 1990 and 2010 increased from $756.2 million to over $7.4 billion, an estimated 5 percent increase in dental public health care expenditures (Vujicic & Nasseh, 2014). Despite oral health care coverage under public health insurance programs, low-income children and minority children report having inadequate access to and therefore inferior utilization and expenditure levels compared to their peers (Liao, Ganz, Jiang, & Chelmow, 2010).

Defining Oral Health-Related Quality of Life (OHRQoL)

Multiple conceptual frameworks, objective measurement scales, and subjective measurement scales arguably define quality of life in the oral health context (McGrath & Bedi, 2004). There is no single, universally accepted, parameter quantifying OHRQoL; however, multiple theoretical models often include functional limitations, physiological pain thresholds, psychological discomfort, and multiple dimensions for disability (i.e. physical, psychological, social, and handicap) (John, 2007). However, evidence suggests that though oral diseases and health-related quality of life are interlinked, they are significantly mediated by personal and environmental variables (Locker D. , 2007). The oral health model by Locker continues to be one of the most influential view of oral impairment and disability. Locker's model attempts to conceptualize the consequences of oral diseases as a condition that deteriorates social network and integration platforms for vulnerable populations (Brondani & MacEntee, 2014). Locker's overarching conceptual framework is recognized for stimulating dental public health research, health policy promotion, OHRQoL measurement, and clinical practice (Brondani & MacEntee, 2014). Over calendar time with perpetual research attempting to provide an explanatory framework for OHRQoL, the World Health Organization (WHO) adopted a more comprehensive

multisystem model (ICF conceptual framework) that integrated the complex relationship between biological factors, psychological factors, and sociological factors and their contributions to OHRQoL (Brondani & MacEntee, 2014).

Oral health care is one of the most underutilized health care service among vulnerable pediatric populations, particularly among minority and low-income children (Isong, et al., 2012). Unfortunately, nearly one-fourth of low-income children have not visited the dentist before they begin kindergarten (Culyer, Brown, & Kelly, 2014). Inadequate access to dental health care services significantly contribute to increases in emergency department utilization for preventable oral diseases (Lee, Lewis, Saltzman, & Starks, 2012). Moreover, evidence suggests that decreases in dental public health insurance coverages and reimbursement and significantly associated with decreases in utilization of preventive oral health care services and increases in tertiary, emergency-based, oral health care services frequently requiring utilization of emergency departments and inpatient hospitalizations (Lee, Lewis, Saltzman, & Starks, 2012). In fact, the rate of pediatric dental-related emergency room utilization is significantly more than any other emergency room utilization, including asthma-related visits, between 2001 and 2008 (Lee, Lewis, Saltzman, & Starks, 2012).

Defining Adverse Childhood Experiences (ACEs)

Epidemiological studies focusing on life-course diseases identify OHRQoL factors traceable to a variety of early life experiences (Brennan & Spencer, 2009). Investigating the relationship between Adverse Childhood Experiences (ACEs) and oral health is a critical step towards formulating public health policies protecting vulnerable populations. A macroscopic

lifespan approach towards understanding determinants of health have resulted in significant literature focusing on the long-term impacts of early adverse life experiences on subsequent health (Brennan & Spencer, 2009). ACEs generally represent exposure to exogenous stressors such as parental death, parental divorce, parental incarceration, financial hardship, mental illnesses, domestic violence, neighborhood violence, drugs/alcohol abuse, racial discrimination, and/or unfair treatment (Bright, Alford, Hinojosa, C, & DE, 2015). Evidence suggests that the exposure to adversities early in life might compromise long-term quality of life (McCrory, Dooley, & Layte, 2014). Evidence suggests that risk factors such as ACEs, communicable and non-communicable infections, inadequate dietary consumption, and mental health disadvantages across the lifespan impact the development of disease, either at vulnerable periods of development or collective allostatic load (Brennan & Spencer, 2009). The inadequacy of important social support systems significantly impact physiological and psychological dimensions of human health. Evidence suggests that inadequate social support systems are more likely to lead children to experience premature morbidity and mortality (Brennan & Spencer, 2009). Dental public health studies suggest a dose-response relationship between early adverse life experiences with OHRQoL (Brennan & Spencer, 2009).

Several frameworks assist individuals in understanding ACEs; the Centers for Disease Control and Prevention (CDC) promotes the ACE Pyramid framework that illustrates how ACEs impact the development of health risk factors throughout the lifespan (Centers for Disease Control and Prevention, 2014). The CDC's ACE Pyramid provides a broad understanding of a relationship between ACEs and human health; however, it does not provide a specific modular framework for understanding the relationships between ACEs and oral health (Centers for

Disease Control and Prevention, 2014). Current dental public health interventions utilize an independent and unrelated paradigm to provide preventive dental health services to underserved populations; in particular, the American Dental Association (ADA) and American Dental Hygienists Association (ADHA) utilize community and school-based programs to provide preventive care to captive vulnerable populations (Barber & Wilkins, 2002).

Significance of the Problem

The investigation is of public health significance because I aim to design a conceptual path model that establishes direct, indirect, and mediating pathways between commonly cited ACEs and their impact on OHRQoL. One purpose of the research is to test the reliability for a dose-response relationship between ACE exposures and OHRQoL. Moreover, my research contends that existing models do not sufficiently explain relationships between ACEs and OHRQoL and that it is categorically necessary to develop and refine a superior conceptual path model to better explain the complex relationship. This research intends to address Goal III of the National Institute of Dental and Craniofacial Research (NIDCR)*, "Apply rigorous, multidisciplinary research approaches to overcome disparities in dental, oral, and craniofacial health"* by integrating sciences and targeting health policies that protect the oral health of vulnerable populations (National Institute of Dental and Craniofacial Research, 2014). The proposed research is innovative because of both its conceptual path analysis framework design and the sophisticated analysis of a complex nationally representative survey (Centers for Disease Control and Prevention, 2013).

The central purpose of my research is to explore and refine an effective conceptual path model and correlation approaches to understand the OHRQoL of vulnerable pediatric

populations. The results of my research aim to shift the current paradigm on public health policy and interventions. My research will establish a new conceptual model for policymakers to utilize in formulating public health policies and funding targeted programs that integrate ACEs in preventive oral health care interventions. This study is timely and critical because there is a demand for innovative approaches to assist public health professionals and researchers to effectively and efficiently provide preventive oral health interventions to vulnerable populations.

CHAPTER II

LITERATURE REVIEW

Etiological Overview of Dental Caries

Dental caries, a complex multifactorial disease, trace etiology to a triad of acidogenic bacterium that metabolize carbohydrates and demineralize susceptible tooth surfaces over calendar time; the pathogenic triad consists of *Streptococcus mutans*, *Streptococcus sobrinus*, and lactobacilli (Jain & Pundir, 2010). The typology of dental caries is dependent on the location and extent of hard tissue destruction; thus, dental caries stratifies as either smooth surface based or fit-and-fissure based, respectively. Smooth surface dental caries cultivates on the proximal crown or root surfaces of the susceptible tooth structure, whereas fit-and-fissure dental caries colonize on the deep linear depressions localized on the occlusal surfaces of the susceptible tooth structure (Jain & Pundir, 2010).

The acidogenic theory for dental caries disease process requires the contextualized concurrent presence of (1) a susceptible tooth structure, (2) cariogenic bacterium, (3) fermentable carbohydrates, and (4) an adequate calendar time exposure (Jain & Pundir, 2010). Dental caries is accepted within the strata of communicable diseases, largely modifiable via prudence with modifiable nutritional consumption patterns (Bray, Branson, & Williams, 2003). The dental caries disease initiation process is largely dependent on the frequency, rather than the extent, of exposure to a cariogenic oral environment (Jain & Pundir, 2010). Susceptible tooth surfaces frequently undergo transitional phases of demineralization and remineralization

over time as consumption of meals or snacks occur daily, thereby creating an acidic oral environment from by-products that reduce pH (Jain & Pundir, 2010).

Susceptible tooth structures are particularly vulnerable in highly acidic environments; therefore, frequent exposures to highly acidic oral environments over time extensively demineralize susceptible tooth structures and initiate the dental caries hard tissue destruction process (Jain & Pundir, 2010). Initial symptoms in the dental caries destruction process manifests a chalky white appearance of the susceptible tooth structure; specifically, this clinical appearance symbolizes the extent of the demineralization process decomposing the tooth structure (Jain & Pundir, 2010). Incipient dental caries are reversible through proper oral hygiene and topical fluoride exposure; however, advanced lesions decompose through the enamel surface into the dentin or pulpal layer of the tooth structure (Jain & Pundir, 2010). Orofacial pain is commonly reported in areas where the dental caries process irreversibly destroyed tooth structure and exposed nerve tissues (Jain & Pundir, 2010).

Orofacial pain has significant public health considerations at the individual, professional, and population platforms (Lewis & Stout, 2010). At the individual platform, orofacial pain impacts a child's psychosocial and cognitive development; specifically, orofacial pain inhibits a child's ability to engage socially, properly masticate, and focus in academic learning environments (Lewis & Stout, 2010). At the professional-level, orofacial pain prevention need to be an interdisciplinary effort among pediatric health care providers. For example, primary pediatric health care providers such as pediatricians engage with a variety of pediatric populations that (potentially) experience orofacial pain symptoms (Lewis & Stout, 2010). Primary pediatric health care providers can supplement oral health care providers via

anticipatory guidance on oral health, screenings for oral-related diseases, detailed patient interviewing regarding orofacial pain, and referrals to pediatric oral health care providers (Lewis & Stout, 2010). At the population-level, orofacial pain, as an objective measurement, can indicate OHRQoL among vulnerable and underserved populations (Lewis & Stout, 2010). Orofacial pain, as an OHRQoL indicator, can indicate the success or failure of the oral health care system over time (Lewis & Stout, 2010).

The Oral-Systemic Complex

The oral cavity is the gateway to the body and is an important component for systemic health. Evidence suggests that oral health significantly intertwines with leading health-related causes of death such as cardiovascular disease, diabetes mellitus, and cancer (Vujicic & Nasseh, 2014). Poor oral health has significant expenditures associated with treatment of the disease; for example, treatment of oral diseases includes direct dental health care expenditures, indirect costs for lost productivity, and indirect costs for lost wages (Vujicic & Nasseh, 2014). Evidence from trend analysis studies indicate that dental utilization among pediatric populations increased approximately 5 percent over a decade; in particular, the rates of dental utilization among low-income pediatric populations was significantly more pronounced compared to their counterparts (Vujicic & Nasseh, 2014). Despite this noteworthy increase in utilization, dental health care is one of the most underutilized health care service among vulnerable pediatric populations, particularly among minority and low-income children (Isong, et al., 2012). Unfortunately, nearly one-fourth of low-income children have not visited the dentist before the begin kindergarten (Culyer, Brown, & Kelly, 2014).

The American Academy of Pediatric Dentistry recommends that all children establish their first by age one with their first dental visit between their first tooth eruption to no later than first birthday (American Academy of Pediatric Dentistry, 2010). Dental caries disproportionately affect low-income pediatric populations at approximately twice the prevalence rate (Martin, Vyavaharkar, Veschusio, & Kirby, 2012). The establishment of public insurance programs such as Medicaid and CHIP supported the health coverage and reimbursement of pediatric oral health care services.

The Centers for Medicare and Medicaid Services (CMS) reported marked improvements in access to care; in particular, access to dental care services increased approximately 50 percent over a decade of trend observations (Vujicic & Nasseh, 2014). Conversely, children enrolled in dental public health insurance programs, such as Medicaid and CHIP, were nearly twice as likely to have untreated oral health care needs compared to their counterparts (Brickhouse, Rozier, & Slade, 2008). Moreover, evidence suggests that children enrolled in CHIP programs report significantly less untreated dental caries compared to their counterparts (Brickhouse, Rozier, & Slade, 2008).

Health Disparities & Quality of Life

Significant inequities in dental health services are notably significant by variables such as age, race, ethnicity, and special health care needs (Bell, Huebner, & Reed, 2012). Evidence suggests that childhood adversity interlinks with perceived discrimination and mental health illnesses, such as depression, in minority populations (McQuaid, Bombay, McInnis, Matheson, & Anisman, 2015). Discrimination, or at least the perception of discrimination, is associated with

negatively influences psychological well-being among vulnerable populations (McQuaid, Bombay, McInnis, Matheson, & Anisman, 2015). Social networks provide considerable influence on social, physiological, and psychological well-being; specifically, the presence of unsupportive social networks are associated with further negative infiltration into sociological, physiological, and psychological dimensions in quality of life (McQuaid, Bombay, McInnis, Matheson, & Anisman, 2015). Moreover, exposure to abuse or neglect in pediatric populations are associated with mental health illnesses and other psychological traumatic sequela (McQuaid, Bombay, McInnis, Matheson, & Anisman, 2015). Exposure to chronic levels of stressors in life and perceived discrimination mediate the relationship between ACEs and mental health illnesses (McQuaid, Bombay, McInnis, Matheson, & Anisman, 2015). Studies correlate the impact of early life adversity with increased sensitivity to subsequent discrimination, mental health illnesses, and trauma later in adult life (McQuaid, Bombay, McInnis, Matheson, & Anisman, 2015).

The actualized impact of ACEs on vulnerable populations depend on multiple considerations. Two common dependent conditions include the perception of internal locus of control and the ability or inability to cope with life stressors (McQuaid, Bombay, McInnis, Matheson, & Anisman, 2015). A problem-focused, adaptive, copying strategy alleviates stressors by addressing the root causes of concern; for example, a problem-focused copying strategy to early life adversity can involve active resistance against abusive circumstances (McQuaid, Bombay, McInnis, Matheson, & Anisman, 2015). Conversely, an emotion-focused, avoidant, coping strategy delays confrontation to life stressors; for example, an emotion-

focused copying strategy to early life adversity focuses on facilitating an understanding of an emotionally abusive crisis (McQuaid, Bombay, McInnis, Matheson, & Anisman, 2015).

Evidence suggests that vulnerable populations exposed to adversity early in life tend to engage with avoidant, passive, forms of coping and increase their risk potential for experiencing adverse physiological and psychological health outcomes later in life (McQuaid, Bombay, McInnis, Matheson, & Anisman, 2015). Furthermore, studies report ACEs influencing the development of intracranial processors; specifically, exposure to stressors demonstrate an inverse relationship to neurogenesis of the hippocampus; specifically, decreased neurogenesis of the hippocampus negatively impacts observable responses to stressors and subsequent development of mental health illnesses (Agarwal, 2015).

Pediatric oral health care services account for nearly one-fourth of overall dental expenditures in the U.S. (Liao, Ganz, Jiang, & Chelmow, 2010). Oral health care expenditures between 1990 and 2010 increased from $756.2 million to over $7.4 billion, an estimated 5 percent increase in dental public health care expenditures (Vujicic & Nasseh, 2014). Despite oral health care coverage under public health insurance programs, low-income children and minority children report having inadequate access to and therefore inferior utilization and expenditure levels compared to their peers (Liao, Ganz, Jiang, & Chelmow, 2010). Rural children, compared to their counterparts, are less likely to have access to and therefore lower utilization of oral health care services despite their dental coverages under public health care insurance (Martin, Vyavaharkar, Veschusio, & Kirby, 2012).

Studies indicate that families with higher educational levels are associated with significantly higher rates of dental utilization; in particular, this association maintains significant despite controlling for family income relative to the federal poverty level (Griffin, 2009). Inadequate access to dental health care services significantly contribute to increases in emergency department utilization for preventable oral diseases (Lee, Lewis, Saltzman, & Starks, 2012). Moreover, evidence suggests that decreases in dental public health insurance coverages and reimbursement significantly associate with decreases in utilization of preventive oral health care services and increases in tertiary, emergency-based, oral health care services frequently requiring utilization of emergency departments and inpatient hospitalizations (Lee, Lewis, Saltzman, & Starks, 2012). In fact, the rate of dental-related emergency room utilization is significantly more than any other emergency room utilization, including asthma-related visits, between 2001 and 2008 (Lee, Lewis, Saltzman, & Starks, 2012).

Commonly reported barriers to achieving oral health include a lack of awareness, lack of prioritization, insufficient dental insurance, inadequate physical transportation, work schedule conflicts, financial constraints, lack of dental providers accepting dental public health insurances, and low reimbursement rates in dental public health insurances (Culyer, Brown, & Kelly, 2014). Perceived oral health status a significant contribution in the context of oral health care utilization research; specifically, studies report higher dental utilization among populations that perceive themselves with untreated oral health care needs (Griffin, 2009). Despite mixed evidence, the presence of dental health insurance programs play an integral function in reducing the proportion uninsured and/or underinsured vulnerable pediatric populations in the U.S.; this dental health insurance coverage provides a categorically necessary safeguard/safety

net to vulnerable populations in the current uncertain and volatile socioeconomic context (Brickhouse, Rozier, & Slade, 2008).

Consequences of Chronic Disease

Chronic oral diseases negatively impact people at the individual and societal platform; in particular, oral diseases contribute to student academic performance, school absenteeism, and ability to subsequently maintain a job or achieve professional advancement (Seirawan, Faust, & Mulligan, 2012). Chronic illnesses inhibit children's ability to engage in the academic environment fully; in particular, chronic illnesses are attributable to both increases in missed school days and decreases in academic performance (Jackson, Vann, Kotch, Pahel, & Lee, 2011). Specifically, more than 51 million hours of student contact hours at school are lost due to illnesses traceable to dental-related problems (Jackson, Vann, Kotch, Pahel, & Lee, 2011).

Evidence suggests that children with inferior oral and inferior systemic health had double the likelihood of performing poorly in the academic environment compared to their healthier counterparts (Jackson, Vann, Kotch, Pahel, & Lee, 2011). Furthermore, studies identified significant associations between orofacial pain in pediatric populations and a child's failure in the primary-level academic environment; in fact, delayed schooling potentially represents inferior socioeconomic conditions, which are significantly associated with absenteeism from the academic environment (Krisdapong, Prasertsom, Rattanarangsima, & Sheiham, 2013). Moreover, evidence from literature supports a positive relationship between health and cognitive maturation and a positive association between inferior health with reduced productivity (Piovesan, Antunes, Mendes, Guedes, & Ardenghi, 2012). Lost learning

time due to poor OHRQoL with vulnerable pediatric populations has substantial negative life-long sequela (Krisdapong, Prasertsom, Rattanarangsima, & Sheiham, 2013).

Chronic health-related pain, such as orofacial pain secondary to oral diseases, are a significant public health concern with seismic impact on socioeconomic conditions, such as quality of life and economic catastrophe, on a population-level (Anno, et al., 2015). Literature describes chronic pain as a complex condition resulting from a juxtaposition of biological, psychological, and sociological risk factors that negatively impact quality of life (Anno, et al., 2015). Evidence supports ACEs as a probable risk factor in the development and continuance of chronic pain affecting quality of life. In particular, ACE-related physiological and psychological exposures, such as hospitalization, institutional care, and parental death, significantly increased the risk potential for developing chronic pain later, deteriorating quality of life, in adult life (Jones, Power, & Macfarlane, 2009).

The Home as an Enabling Environment

Relationships between parents and children, particularly relationships with secure positive attachments, generally are significant factors attributable to adequate long-term growth and development of vulnerable pediatric populations; conversely, children with adverse parent-child relationships are associated with child insecurity, mental health disorders, and suboptimal development (Anno, et al., 2015). Children that concurrently report a history of suboptimal parent-child relationships and chronic pain also reported significantly elevated propensities of pain tolerance, ailment, and inferior health-related quality of life (Anno, et al., 2015). In addition to governmental mandate to ensure that children receive nurturing in safe

environments, evidence supports lasting socioeconomic and health-related benefits from positive parent-child relationships (Bellis, et al., 2014). In 2008, U.S. Child Protective Services agencies reported over 3.7 million cases involving youth exposed to specific adverse childhood experiences such as abuse, neglect, and domestic violence (Scott, Burke, Weems, Hellman, & Carrion, 2013).

Exposure to violence or maltreatment directly links to adverse health outcomes; specifically, violence can produce physiological harm, psychological harm, or ultimately result in premature mortality (Bellis, et al., 2014). Unfortunately, children who survive adverse childhood experiences related to abuse are at an increased risk to develop harmful behaviors, withdrawal symptoms, non-communicable diseases, mental health illnesses, and classify as disabled later in life (Bellis, et al., 2014). Adverse childhood experiences such as domestic violence, neighborhood violence, abuse, and neglect appear to immediately impact the health and behavior of affected vulnerable populations negatively (Bellis, et al., 2014). Furthermore, the premature death of a parent inherently reduces a significant protective nurturing factor during vulnerable pediatric developmental years (Phillips & Carver, 2015). In particular, parental support systems are critical mechanisms that facilitate healthy physiological, psychological, and sociological development and minimize exposure to ACEs (Phillips & Carver, 2015). Evidence suggests that the premature loss of parental support systems negatively impacts vulnerability among children and are significant predictors for subsequent morbidity and mortality in pediatric populations (Phillips & Carver, 2015).

The ultimate aspiration of the global dental health care system is to minimize oral diseases and improve oral health status to all susceptible populations, which subsequently

enriches health-related quality of life (Griffin, 2009). Despite public health efforts to reduce the burden of oral diseases in the U.S., certain vulnerable subpopulations are higher risk for acquiring oral diseases; for example, frequently cited vulnerable populations include pediatric populations, special needs populations, lower SES populations, and racial/ethnic minority populations (Trentesaux, Delfosse, Rousset, Herve, & Hamel, 2014).

The cumulative structural disadvantage theory conceptualizes adverse health circumstances to proliferate unequivocally among socioeconomically disadvantaged populations (Pais, 2014). Despite sociobiological etiologies for complex health conditions among minority populations, health disparities also demonstrate significant correlations with distinctive social class and occupational environments (Pais, 2014). Structural disadvantage initializes in vulnerable pediatric developmental years; in particular, endogenous selection places vulnerable populations on a trajectory for inadequate access to health care services, inferior health outcomes, unhealthy lifestyle choices, poor occupational careers, hostile environments, financial constraints, and exposure to daily life stressors (Pais, 2014). Exposure to multiple life stressors during critical developmental years, such as endogenous selections, significantly contribute to long-term health outcomes (Pais, 2014).

Defining Oral Health-Related Quality of Life

There is no single, universally accepted, parameter quantifying OHRQoL; however, popularized theoretical models often include functional limitations, physiological pain thresholds, psychological discomfort, and diverse dimensions for categorical disability (i.e. physical, psychological, social, and handicap) (John, 2007). However, evidence suggests that

though oral diseases and health-related quality of life are interlinked, they are significantly mediated by personal and environmental variables (Locker D. , 2007). The oral health model by Locker continues to be one of the most influential view of oral impairment and disability. Locker's model attempts to conceptualize the consequences of oral diseases as a condition that deteriorates social network and integration platforms for vulnerable populations (Brondani & MacEntee, 2014).

Locker's overarching conceptual framework is recognized for stimulating dental public health research, health policy promotion, OHRQoL measurement, and clinical practice (Brondani & MacEntee, 2014). One major limitation with Locker's oral health model is that the model focused on a static, unidirectional conceptualization, between the complex relationship between oral health and disability (Brondani & MacEntee, 2014). Over calendar time with perpetual research attempting to provide an explanatory framework for OHRQoL, the WHO adopted a more comprehensive multisystem model (ICF conceptual framework) that integrated the complex relationship between biological factors, psychological factors, and sociological factors and their contributions to OHRQoL (Brondani & MacEntee, 2014).

The Oral Health Impact Profile (OHIP) is one of many proxy instruments utilized to measure OHRQoL; the OHIP has been endorsed by the WHO's International Classification of Impairments, Disabilities, and Handicaps for its versatile breadth and depth (John, 2007). The OHIP is an extensive instrument with 49 interlinked items describing multiple dimensions attributable to OHRQoL. Evidence has distinguished patterns between these 49 interlinked indicators resulting in primary and secondary dimensions; specifically, multicollinearity was established between functional limitation and physical disability, psychological discomfort and

psychological disability, social disability and psychological discomfort, handicap and psychosocial impacts (John, 2007).

The refined conceptual model identified physiological/functional, orofacial pain-related, psychological, and sociological aspects as primary dimensions describing OHRQoL (John, 2007). Ultimately, sociodental indicators provide insight on their impact on oral and general-health related quality of life (Brondani & MacEntee, 2014). The refined conceptual models attempt to shift the oral health paradigm from a linear, unidirectional, conceptualization to a more dynamic, multisystem, and complex relationship (Brondani & MacEntee, 2014).

Examining Adverse Childhood Experiences

A macroscopic lifespan approach towards understanding determinants of health have resulted in significant literature focusing on the long-term impacts of early adverse life experiences on subsequent health (Brennan & Spencer, 2009). Adverse experiences in childhood increase the risk for developing health-related morbidities in adulthood (Agarwal, 2015). Evidence suggests that risk factors such as adverse childhood experiences, communicable and non-communicable infections, inadequate dietary consumption, and mental health disadvantages across the lifespan impact the development of disease, either at vulnerable periods of development or collective allostatic load (Brennan & Spencer, 2009).

The notion of allostatic load is a significant concern when discussing exposures to multiple ACEs and their impact later in life; specifically, allostatic load refers to the cumulative impact of a specific set of exposures over calendar time (Tomasdottir, et al., 2015). Conversely, allostatic overload refers to a context of physiological risk where exposures to multiple

stressors exceeds the adaptability threshold thus resulting in premature morbidity (Tomasdottir, et al., 2015). The inadequacy of important social support systems significantly impact physiological and psychological dimensions of human health; in particular, evidence suggest that inadequate social support systems are more likely to experience premature morbidity and mortality (Brennan & Spencer, 2009). Thus, exposure to adversity during vulnerable pediatric years are significant predictors in the proliferation of physiological, psychological, and sociological stressors throughout the lifespan of individual and multiple generations (McQuaid, Bombay, McInnis, Matheson, & Anisman, 2015).

Dental public health studies suggest a dose-response relationship between early adverse life experiences with OHRQoL (Brennan & Spencer, 2009). Epidemiological studies focusing on life-course diseases identify OHRQoL factors traceable to a variety of early life experiences (Brennan & Spencer, 2009). For example, dental caries among adolescent populations are attributable to both early childhood experiences, whereas dental caries in adult and geriatric populations are attributable to life experiences to both life experiences both in developmental pediatric years and to experiences across the lifespan (Brennan & Spencer, 2009).

Moreover, evidence suggests a positive relationship between the cumulative exposure of adverse life experiences and tooth loss among older adults in the U.S.; thus, a theoretical basis for allostatic stress of adverse life experiences and OHRQoL exists (Brennan & Spencer, 2009). Existing research on ACEs supports preventive screenings regularly in routine health examinations (Scott, Burke, Weems, Hellman, & Carrion, 2013). Previous research attempts to

assist clinicians in identifying vulnerable patients exposed to ACEs and implementing targeted interventions to assist at-risk populations.

The Original ACE Investigation

The U.S. Centers for Disease Control and Prevention (CDC) in conjunction with Kaiser Permanente developed a national public health surveillance program for ACEs (Centers for Disease Control and Prevention, 2014). The renowned ACE study attempts to understand how contemporary national social, economic, and leading health-related morbidities and mortalities are traceable to ACEs (Centers for Disease Control and Prevention, 2014). The ACE study was conducted from 1995 to 1997 and involved a two-step process including a (1) detailed physical examination of over 17,000 participants and (2) completion of confidential questionnaire detailing questions about the participant's historical exposure to adverse childhood experiences, life stressors, family dysfunction, health behaviors, and health status (Centers for Disease Control and Prevention, 2014).

Major results of the study are iteratively published in diverse peer-reviewed articles; however, a common finding noted the presence of an existentially graded association between quantity of ACE exposures and the development of health-related problems (Centers for Disease Control and Prevention, 2014). The ACE investigation identified premature exposures to adversities in life with the increased risk for substance abuse, communicable and non-communicable diseases, mental health illnesses, risky sexual activity, and overall decreased health-related quality of life (Centers for Disease Control and Prevention, 2014). Since 2009, the CDC expanded the national research agenda for ACEs into the Behavior Risk Factor Surveillance

System (BRFSS) survey; in particular, the BRFSS ACE module tracked childhood exposures of emotional abuse, physical abuse, sexual abuse, mental health illnesses, substance abuse, domestic violence, parental divorce, and parental incarceration (Ford, et al., 2014).

In 2003, the CDC expanded the research agenda again and included an ACE module into the National Survey of Children's Health (NSCH); in particular, the NSCH ACE module encompasses children's exposure to parental death, parental divorce, parental incarceration, financial hardship, mental health illnesses, domestic violence, neighborhood violence, drug/alcohol abuse, racial/ethnic discrimination, and unfair treatment (Centers for Disease Control and Prevention, 2013). The CDC continues to utilize public health surveillance programs to monitor the prevalence and incidence of ACE nationally and supports research agendas that aims to identify and recommend strategies to reduce the national burden of disease attributable to ACE exposures in vulnerable populations.

International and National Oral Health Directives

The World Health Organization (WHO) reinforced the social consequences of oral diseases resulting in limited school, work, and home-related activities (Seirawan, Faust, & Mulligan, 2012). The 2000 U.S. Surgeon General's report reinforced the seriousness of oral diseases in that affected populations may avoid interpersonal communication due to fear or anxiety regarding the appearance of their teeth; therefore, affected populations compromise their innate ability to construct social relationships and participate in communal activities (US Department of Health and Human Services, 2000). The U.S. Surgeon General's report warned that neglecting oral health compromises overall well-being and diminishes quality of life (US

Department of Health and Human Services, 2000). Specifically, the national report intended spur action by policymakers, professional leadership, media, and the public sector (Texas Department of State Health Services, 2008).

The WHO outlines health as a comprehensive state of overall well-being; in particular, the WHO subcategorizes health into specific physiological, psychological, and sociological well-being parameters (World Health Organization, 1948). Oral health is a result of a health combination of physical, mental, and social well-being. For example, oral diseases impact physical well-being via destruction of susceptible tooth surfaces (Koleoso & Akpata, 2012). Furthermore, oral diseases impact mental well-being via stress, depression, and other negative emotions associated with chronic illnesses (Koleoso & Akpata, 2012). Moreover, oral diseases impact social well-being via halitosis, withdrawal due to orofacial pain, and inadequate appearances due to infected teeth or gingival tissues (Koleoso & Akpata, 2012). Social disparities in oral health are universal with significant higher rates of oral diseases identifiable in deprived vulnerable populations (Piovesan, Antunes, Guedes, & Ardenghi, 2010).

Inferior oral health and adverse socioeconomic conditions negatively interferes with development and quality of life (Piovesan, Antunes, Mendes, Guedes, & Ardenghi, 2012). Studies identify that low levels of education lead to lower family income levels and low levels of employment; subsequently, these adverse socioeconomic conditions influence health behaviors and self-perceived oral health (Piovesan, Antunes, Guedes, & Ardenghi, 2010). Exogenous environmental factors during developmental phases among vulnerable pediatric populations significantly influence health behaviors and self-perception of oral health (Piovesan, Antunes, Guedes, & Ardenghi, 2010). Evidence supports the utilization of self-reported OHRQoL as a

supportive measure to clinical examinations to document pediatric oral health status (Piovesan, Antunes, Mendes, Guedes, & Ardenghi, 2012). Children with oral-related diseases experience a state of unhealthiness and are at risk for adverse social, physiological, and psychological development (Piovesan, Antunes, Mendes, Guedes, & Ardenghi, 2012).

Preventable oral diseases can lead to secondary systemic diseases, emergency room utilization, multiple inpatient hospitalizations, polypharmacy, and premature mortality (Seirawan, Faust, & Mulligan, 2012). Furthermore, oral diseases propel personal, societal, and financial burdens and add fuel to spiraling health care expenditures in the U.S. (Seirawan, Faust, & Mulligan, 2012). In developed nations, oral diseases rank among the top five most expensive diseases to treat; specifically, evidence suggests that the total dental health care expenditures required to provide treatment to all children with dental caries alone would exceed the total healthcare budget allocated for pediatric populations (Trentesaux, Delfosse, Rousset, Herve, & Hamel, 2014).

Mixed evidence exists on the impact of the duration of orofacial pain and its impact on OHRQoL (Koleoso & Akpata, 2012). Some literature supports the claim that acute orofacial pain primarily affects physiological functioning; whereas, chronic orofacial pain extends to affect emotional and sociological factors relevant to health-related quality of life (Koleoso & Akpata, 2012). Chronic oral disadvantage is significantly higher among rural residents compared to their urban counterparts; in particular, the chronic oral disadvantage is likely a result of an access to the dental health care system (Chavers, Gilbert, & Shelton, 2004). Likewise, people that regularly utilize dental health care are reported to be advocates supportive of preventive therapy to reduce the risk for oral diseases compared to their counterparts (Chavers, Gilbert, &

Shelton, 2004). Specifically, people with regular preventive dental utilization report the lowest incidence of tooth loss and highest OHRQoL (Chavers, Gilbert, & Shelton, 2004).

There are multiple public health efforts to reduce the burden of oral diseases in the U.S. Community water fluoridation is among the top ten greatest public health achievements in the 20th century (Griffin, 2009). Water fluoridation is cited as an efficient, economical, and effective public health approach to preventing dental caries over a lifespan (Armfield, Spencer, Roberts-Thomson, & Plastow, 2013). Evidence supports the significant protective effects of water fluoridation to reduce the impact of cariogenic bacteria on both susceptible deciduous and permanent dentitions (Armfield, Spencer, Roberts-Thomson, & Plastow, 2013). Moreover, long-term exposure to community water fluoridation correlates with reducing socioeconomic disparities in dental caries (Armfield, Spencer, Roberts-Thomson, & Plastow, 2013). Community water fluoridation significantly reduces dental caries in all populations and has significantly reduced Medicaid expenditures on the treatment of oral diseases (Griffin, 2009).

Healthy People, a federal health promotion and disease prevention initiative outlines specific oral health objectives aimed to improve quality of life (Office of Disease Prevention and Health Promotion, 2015). Poverty is a known sociological determinant for health and continues to increase its prioritization in federal public health initiatives, for the fourth decade, as part of a national strategic agenda to address health disparities (Dye & Thornton-Evans, 2010). The oral health objectives for Healthy People 2020, specific to children, include (1) reducing the proportion of the population with oral disease, (2) increasing oral health care utilization, (3) increasing the proportion of low-income populations utilizing the oral health care system, (4) increasing the proportion of school and government-based health centers, and (5) increasing

oral and craniofacial health surveillance systems in the U.S. (Culyer, Brown, & Kelly, 2014). Public health efforts to improve the oral health of vulnerable pediatric populations include efforts to increase access to dental health care services, governmental funding for dental public health care research, community-level dental public health interventions, and professional-level education on the burden of oral diseases in vulnerable pediatric populations (Huebner, Bell, & Reed, 2013).

Historically public health professionals have attempted to reduce the incidence and prevalence of oral diseases by focusing on health behavioral changes (Willems, Vanobbergen, Martens, & Maeseneer, 2005). Health behaviors, reportedly, directly impact perceived and clinical oral health outcomes; for example, proper tooth brushing with fluoridated dentifrices regularly directly improve oral health via cleaning the oral cavity from pathogenic bacterium (Griffin, 2009). Unfortunately, current health policies and community health interventions are partially ineffective in reducing the oral disease burden in the U.S.

Some studies identify a Pareto Principle approach; for example, evidence suggests that 24 percent of the highly vulnerable subpopulation experiences 80 percent of pediatric dental caries (Trentesaux, Delfosse, Rousset, Herve, & Hamel, 2014). However, despite marked improvements in pediatric oral health, children in deprived families report experiencing a higher, disproportionate, amount of oral diseases (Willems, Vanobbergen, Martens, & Maeseneer, 2005). Evidence suggests that race, ethnicity, and socioeconomic status of the family are significant sociodemographic variables influencing the risk potential for the development of dental caries in vulnerable pediatric populations (Willems, Vanobbergen, Martens, & Maeseneer, 2005). One study reported neighborhood deprivation and ethnicity to

be significantly associated with pediatric dental caries; furthermore, the combined impact of neighborhood deprivation and ethnicity appears to undervalue the effect size of other socioeconomic variables such as family income, highest educational attainment, and occupational status (Willems, Vanobbergen, Martens, & Maeseneer, 2005).

The Indefensible Status Quo

There are multiple prevention strategies recommended to combat the impact of ACEs on OHRQoL. Public health prevention efforts focusing at both the policy-level and the community-level can target interventions to reduce the impact of ACEs on OHRQoL. One recommended policy-level intervention is targeting health policies that fund and/or support valuable resources to vulnerable populations heavily influenced by ACEs. For example, underserved populations with higher rates of poverty, violence, and reported abuse/neglect are critical areas needing public health resources to improve quality of life conditions. Another recommended cost-effective, community intervention-based, approach to improve the oral health of vulnerable and underserved pediatric populations include the implementation of school-based, preventive, dental screening programs (Locker, Frosina, Murray, Wiebe, & Wiebe, 2004). Studies indicate that targeted dental screening programs are highly effective in identifying, referring, and following up with highly vulnerable and underserved children (Locker, Frosina, Murray, Wiebe, & Wiebe, 2004). Furthermore, effective dental screening programs are linked with increase dental attendance rates among highly vulnerable pediatric populations (Locker, Frosina, Murray, Wiebe, & Wiebe, 2004). ACEs are a significant global public health concern and require immediate focus in both research, practice, and policy.

CHAPTER III

RESEARCH METHODOLOGY

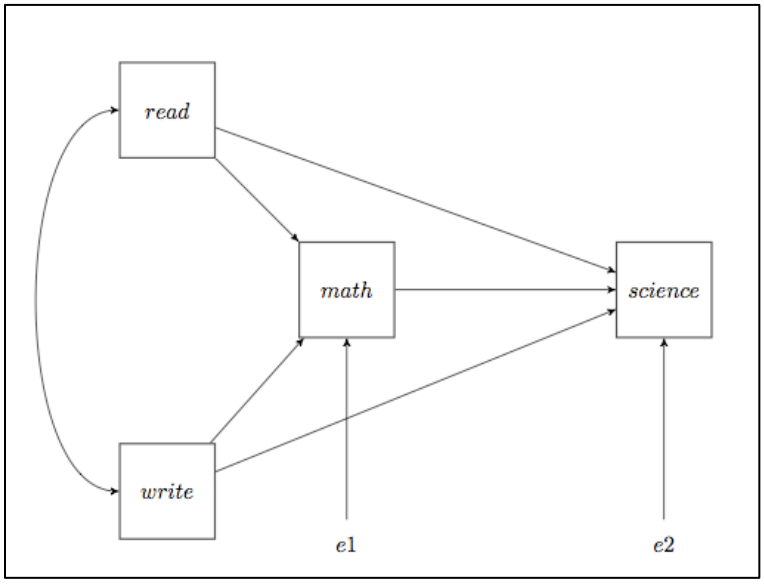
Overview of Structural Equation Modeling & Path Analysis

Structural equation modeling (SEM) was employed to statistically measure the complex relationship between ACEs and OHRQoL. SEM, an extension of generalized linear modeling, is typically utilized to test a multivariable conceptual or theoretical model (Lei & Wu, 2007). SEM's methodology attempts to statistically measure significant relationships among observed and latent variables (StataCorp, 2015). SEM has significant advantages over other methodological approaches primarily because of SEM's ability to measure statistically significant multivariable relationships in a mega analysis. Additionally, SEM offers the ability to measure a comparison of universality among complex models and assists in the identification of a model that best fits the multiple complex relationships (Tomarken & Waller, 2005). Moreover, SEM enables me to specify and measure latent variables and their estimated relationship with observable indicators (Tomarken & Waller, 2005).

Path analysis, an extension of multiple regression is one special modular subcomponent within SEM and is utilized to model complex structural multivariable relationships (Lei & Wu, 2007). SEM, more specifically path analysis, can be utilized to understand complex health and health behaviors in a structured approach; specifically, results of path analysis are potentially significant to public health researchers, health policymakers, clinicians, and community-level activists. Path analysis is a refined mechanism that can model direct, indirect, and mediating

effects among multiple variables simultaneously (Lei & Wu, 2007). Figure 1 provides an example to assist in understanding the methodological approach utilized by path analysis. Variables in the path analysis can be exclusively endogenous, exclusively exogenous, or serve as both and be a mediating variable. For example, the variables 'read' and 'write' are exogenous, or independent variables, and have a direct path to influencing math and science; additionally, 'read' and 'write' have a reciprocal direct path. The variable 'math' serves as a mediating variable because it is both exogenous in that it has a direct path to impacting 'science'; however, 'math' also is an endogenous variable because it indirectly facilitates a specific relationship between 'read' and 'write' on 'science'. The variable 'science' is an endogenous, dependent variable, because the result of 'science' is dependent on the influence of (1) 'read', (2) 'write', (3) 'math', and (4) 'read' and 'write' on 'science' through mediating 'math'. 'Science', in this example, does not influence other variables and therefore is exclusively endogenous.

Figure 1. Conceptual Model of Path Analysis



Source: StataFAQ: Path Analysis

Sources of Data

Data was obtained from the 2011-2012 National Survey of Children's Health (NSCH). The NSCH is sponsored by both the Maternal and Child Health Bureau of the Health Resources and Services Administration and the Department of Health and Human Services (Centers for Disease Control and Prevention, 2013). The Centers for Disease Control and Prevention's (CDC) National Center for Health Statistics, State and Local Area Integrated Telephone Survey program conducted the most recent survey that will be utilized for data analysis (Centers for Disease Control and Prevention, 2013). The goal of the NSCH is to document multidimensional pediatric health including risk and protective factors that relate to overall pediatric well-being; specifically, the NSCH documents medical homes, parental health, health insurance, school-related experiences, extracurricular activities, and neighborhood characteristics (Centers for Disease Control and Prevention, 2013).

The cross-sectional data for the 2011-2012 NSCH was collected between February 2011 through June 2012 via telephone survey across all 50 states and the District of Columbia (Centers for Disease Control and Prevention, 2013). The 2011-2012 NSCH also extended telephone surveys to the U.S. Virgin Islands between July 2011 through January 2012 in a different file source that was not utilized in the analysis (Centers for Disease Control and Prevention, 2013). Inclusion criterion for the 2011-2012 NSCH included households with at least one resident child under the age of 18 years at the time of the interview (Centers for Disease Control and Prevention, 2013). For the purposes of the study, only children ages 1 through 17 were included because of dentate status; therefore, eligibility criterion resulted in a sample of 90,555 children in the analysis.

The 2011-2012 NSCH data utilized a complex stratified clustered sample design; in particular, the final sample (*n*=95,677) was stratified by state and source of telephone interview (landline or cellular device) and clustering occurred at the household level where a sample child (S.C.) was randomly selected to represent the household where multiple children resided (Centers for Disease Control and Prevention, 2013). The respondents to the interviews were either parents or guardians with the requisite knowledge of the health and health care of the selected S.C. in the household (Centers for Disease Control and Prevention, 2013). The 2011-2012 NSCH was linguistically available in English, Spanish, Mandarin, Cantonese, Vietnamese, and Korean languages (Centers for Disease Control and Prevention, 2013). Survey weights are required to extrapolate data for valid and reliable representation of all non-institutionalized children in the U.S. (Centers for Disease Control and Prevention, 2013).

Dependent Variables

The preliminary dependent variables in this research investigation address OHRQoL, a latent variable in the analysis. The observant dependent variables in the 2011-2012 NSCH include pediatric oral health care utilization and pediatric untreated oral health care needs. Pediatric oral health care utilization was ascertained using the NSCH survey question, "Did the S.C. see a dentist for any kind of dental care, including check-ups, dental cleanings, x-rays, or filling cavities?" (Centers for Disease Control and Prevention, 2013). Valid responses for this item were dichotomized as yes or no; negative responses were utilized to indicate poor oral health.

Pediatric preventive oral health care utilization was ascertained with the NSCH survey question, "How many times did the S.C. see a dentist for preventive dental care, such as check-

ups and dental cleanings?" (Centers for Disease Control and Prevention, 2013). Valid responses for this survey question were dichotomized; affirmative responses stated at least one dental visit indicated a preventive dental visit. Pediatric untreated oral health care needs were ascertained with the NSCH survey question, "Did the S.C. have a toothache, decayed teeth, or unfilled cavities?" (Centers for Disease Control and Prevention, 2013). Valid responses for this survey question were dichotomized as yes or no; affirmative responses were utilized to indicate poor oral health.

Key Independent Variables – ACEs

The primary, key, independent variable was the S.C.'s exposure to ACEs. The survey collectively addressed multiple ACEs including the S.C.'s exposure to a parental divorce, parental death, domestic violence, drugs/alcohol exposure, mental illnesses, parental incarceration, neighborhood violence, household financial hardship, racial/ethnic discrimination, and unfair treatment (Centers for Disease Control and Prevention, 2013). Pediatric exposure to household financial hardship was ascertained with the NSCH survey question, "Since S.C. was born, how often has it been very hard to get by on your family's income, for example, it was hard to cover the basics like food or housing?" (Centers for Disease Control and Prevention, 2013).

Pediatric exposure to parental divorce was ascertained with the NSCH survey question, "Did S.C. ever live with a parent or guardian who got divorced or separated after S.C. was born?" (Centers for Disease Control and Prevention, 2013). Pediatric exposure to parental death was ascertained with the NSCH survey question, "Did S.C. every live with a parent or guardian who died?" (Centers for Disease Control and Prevention, 2013). Pediatric exposure to

parental incarceration was ascertained with the NSCH survey question, “Did S.C. ever live with a parent or guardian who served time in jail or prison after S.C. was born?” (Centers for Disease Control and Prevention, 2013). Pediatric exposure to domestic violence was ascertained with the NSCH survey question, “Did S.C. ever see or hear any parents, guardians, or any other adults in his/her home slap, hit, kick, punch, or beat each other up?” (Centers for Disease Control and Prevention, 2013). Pediatric exposure to neighborhood violence was ascertained with the NSCH survey question, “Was S.C. ever the victim of violence or witnessed any violence in his/her neighborhood?” (Centers for Disease Control and Prevention, 2013).

Pediatric exposure to mental health illnesses was ascertained with the NSCH survey question, “Did S.C. ever live with anyone who was mentally ill or suicidal, or severely depressed for more than a couple of weeks?” (Centers for Disease Control and Prevention, 2013). Pediatric exposure drugs/alcohol was ascertained with the NSCH survey question, “Did S.C. ever live with anyone who had a problem with alcohol or drugs?” (Centers for Disease Control and Prevention, 2013). Pediatric exposure to racial/ethnic discrimination was ascertained with the NSCH survey question, “Was S.C. ever treated or judged unfairly because of his/her race or ethnic group?” (Centers for Disease Control and Prevention, 2013). Pediatric exposure to unfair treatment was ascertained with the NSCH survey question, “During the past year, how often was S.C. treated or judged unfairly?” (Centers for Disease Control and Prevention, 2013). Affirmative responses relative to exposure to any one of the ACEs was indicative of an exposure in the investigation.

The ACE Investigation

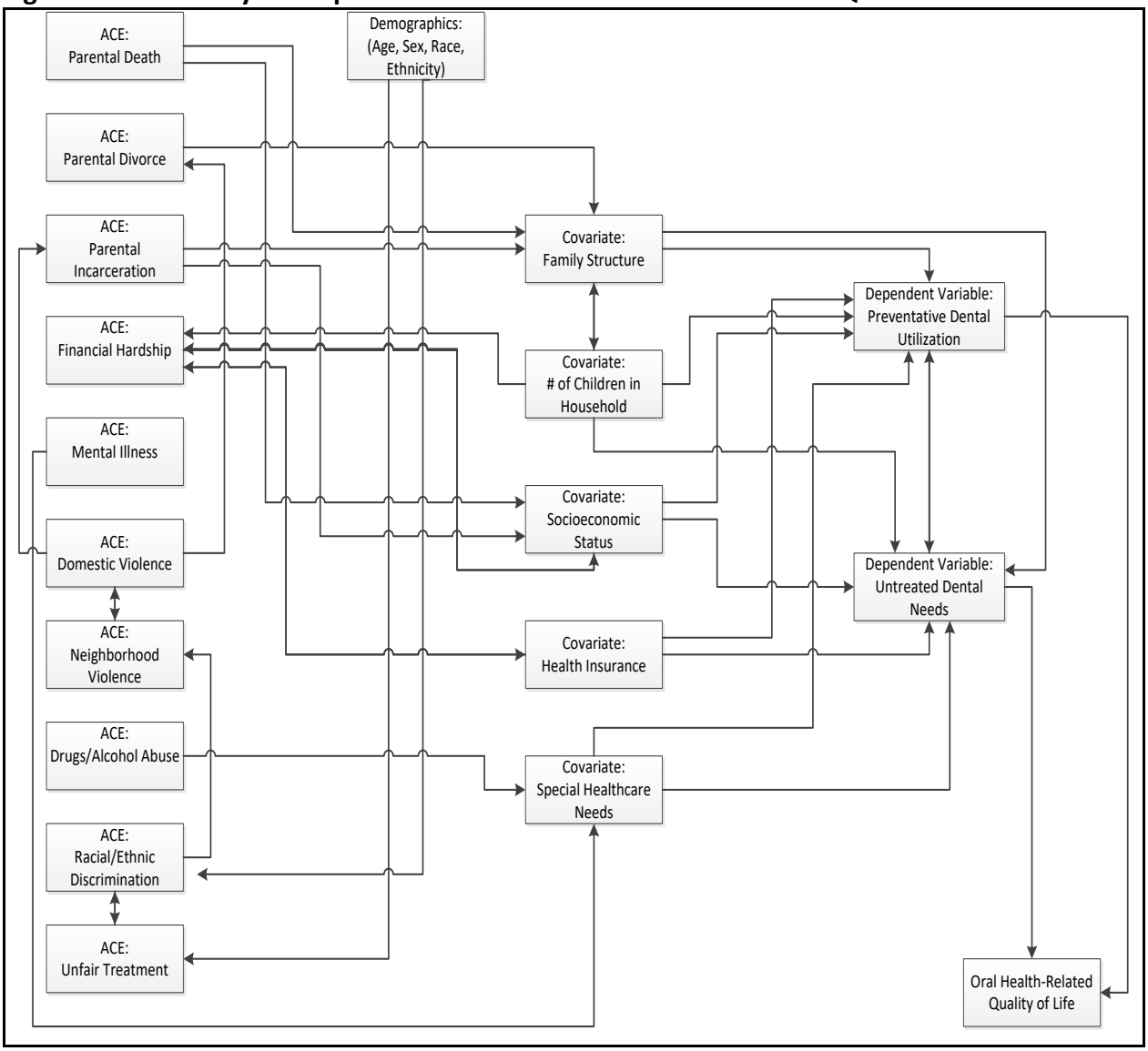
The original phase of the ACE study was a collaboration between Kaiser Permanente and the CDC between 1995 and 1997 with over 17,000 enrolled participants (Centers for Disease Control and Prevention, 2014). The ACE study required enrolled participants to undergo a standardized physical examination and a confidential survey that assessed exposure to childhood maltreatment, family dysfunction, current health status, and behaviors (Centers for Disease Control and Prevention, 2014). The goal of the ACE investigation was to assess associations between premature exposures to adversity early in life and overall health and well-being later in adult life (Centers for Disease Control and Prevention, 2014). The ACE pyramid depicts a conceptual framework across the lifespan that identifies scientific gaps between understanding how ACEs affect psycho-social-cognitive impairments, adoption of risky health behaviors, morbidity, sociocultural development, and ultimately premature mortality (Centers for Disease Control and Prevention, 2014). Specifically, the objective of the ACE study was to answer, "If risk factors for disease, disability, and early mortality are not randomly distributed, what influences precede the adoption or development of them?" (Centers for Disease Control and Prevention, 2014). Ultimately, the ACE study intends to uncover the lifelong impact of childhood adversity and the development of risk factors on the overall quality of life (Centers for Disease Control and Prevention, 2014).

Exogenous Variables

Additional covariates were included and analyzed in a multivariable model. The preliminary mediating variables in the conceptual path model included family structure (i.e. two-parent household, single-parent household, biological or adopted guardians, etc.), number

of children in the household, socioeconomic status, health insurance status, and the presence of special health care needs. Preliminary exogenous variables included basic sociodemographic variables such as chronological age, biological sex, and racial/ethnic affiliation status.

Figure 2. Preliminary Conceptual Path Model between ACEs and OHRQoL.



Preliminary Conceptual Path Model

A preliminary conceptual path model (Figure 2) was postulated by me identifying potentially explainable direct, indirect, and mediating pathways. The preliminary conceptual

path model hypothesized the potential directionality of influence between diverse endogenous and exogenous variables. The exogenous variables in this preliminary conceptual path model included all ACEs identified in the 2011-2012 NSCH; the exogenous variables included parental death, parental divorce, parental incarceration, financial hardship, mental illness, domestic violence, neighborhood violence, drugs/alcohol abuse, racial/ethnic discrimination, and unfair treatment. The mediating variables in the preliminary conceptual path model included family structure, number of children in household, socioeconomic status, health insurance, and special health care needs. Controlling variables in the preliminary conceptual path model included critical demographic information including chronological age, sex, race, and ethnicity. The endogenous variables in the preliminary conceptual path model were preventive dental utilization and untreated dental needs. The endogenous variables were observable identifiers that attempted to measure the latent variable, OHRQoL, collectively in the overall preliminary conceptual model.

The preliminary conceptual path analysis model can be explained through examples of the direct, indirect, and mediating pathways. For example, parental divorce, parental death, and parental incarceration could have a direct impact and impact on family structure; an alternative family structure could have a direct impact on preventive dental utilization and/or untreated dental needs because of potentially limited economic and social resources available to receive oral health care services. Additionally, family structure could serve as a mediating variable that facilitates an indirect path relationship between parental divorce, parental death, and parental incarceration (ACEs) and OHRQoL. Furthermore, increasing financial hardship

(ACE) could have a direct impact on the ability to acquire and sustain health insurance because of a lack of economic resources.

The presence or absence of health insurance could have a direct impact on preventive dental utilization and untreated dental needs because of subsidized cost of health care services. In this example, health insurance could serve as a mediating variable that facilitates an indirect path relationship between financial hardship (ACE) and OHRQoL. Additionally, mental health illnesses could have a direct impact on a child being classified with special health care needs. A child with special health care needs could have a direct negative impact on preventive dental utilization and untreated dental needs because of an increased risk for the development of oral diseases and lack of oral health care providers (OHCPs) trained to care for children with special health care needs. In this example, special health care needs could serve as a mediating variable that facilitates an indirect path relationship between mental health illnesses (ACE) and OHRQoL.

Moreover, parental death, parental incarceration, and financial hardship could have a direct impact on socioeconomic status because of limited family income to provide daily necessities (i.e. food, water, shelter). People with lower SES could have a direct negative impact on their preventive dental utilization and untreated dental needs. In this example, SES could serve as a mediating variable that facilitates an indirect path relationship between parental death, parental incarceration, and financial hardship (ACEs) and OHRQoL. These examples provided a demonstration of direct, indirect, and mediating roles of potentially significant relationships between ACEs and OHRQoL.

Preliminary stages included critical appraisal of reported data including exploring for patterns in missing observations and intervariable multicollinearity. The identification of patterns in missing data observations (Tables 1 and 2) revealed a successful response rate of 92 percent for all key independent variables, ACEs, except for *unfair treatment*, which had a response rate of 3 percent. Moreover, there is a conceptual proximity between ACE survey questions that inquire about presence of racial discrimination and presence of unfair treatment; some forms of unfair treatment present in the context of racial discrimination scenarios. Consequently, due to extraordinarily high patterns in missing observations and conceptually presumable proximity of survey questions, the ACE variable *unfair treatment* was dropped and excluded from subsequent descriptive and inferential statistics.

Furthermore, a pairwise correlational analysis was conducted on all ACEs to detect presence of multicollinearity within the key independent variables. The pairwise correlational matrix (Table 3) revealed that the ACE variable drug abuse exhibited a moderate magnitude of multicollinearity with violence-related ACEs including domestic violence and neighborhood violence. Consequently, due to extraordinary presence of multicollinearity, the ACE variable *drug abuse* was dropped and excluded from all descriptive and inferential statistics. The preliminary deployment of multiple dataset appraisal techniques enabled me to optimize the dataset for further statistical analyses.

Similarly, the ACE variable financial hardship has conceptual proximity to the exogenous variable of annual family income and thus warranted further evaluation; in this context, as mentioned earlier, ACE survey questions were dichotomized and dependent upon subjective factors such as respondent's perception of financial hardship compared to annual family

income which was objectively quantified against national federal poverty levels. Consequently, in keeping with presumable proximity of survey questions and attempts to maintain objectivity on SES, the ACE variable *financial hardship* was included in regression analyses but dropped and excluded in complex path analyses. Furthermore, after multiple iterations of complex unadjusted path analyses, I re-appropriated insignificant preliminary mediating variables such as highest parental education, number of children in household, children with special health care needs, and health insurance, as exogenous variables in the refined, complex, adjusted path analysis model.

All descriptive and inferential statistical analytics were conducted in Stata SE version 14 (StataCorp, 2014). The alpha level, α, for all inferential statistics was estimated at ≤ 0.05 for interpretation of statistical significance. The NSCH data was appropriately weighted and adjusted to accommodate for the inherent complex survey design found in the 2011-2012 NSCH dataset (Centers for Disease Control and Prevention, 2013). Microsoft Visio Professional 2010® was utilized for all pictographic representations of estimated path analyses.

CHAPTER IV

RESULTS

Descriptive Statistics

Table 4 describes the proportionate distribution of the S.C. (*n*=61, 530). Overall, 18.3 percent of the population experienced untreated oral health care needs morbidity and 99.6 percent utilized preventive oral health care services. The population's exposure to our refined eight key independent variables, ACEs, ranged from 3 percent to 50 percent; nearly half of the population reported their family experiencing financial hardship. Roughly 20 percent of the population reported exposure to parental divorce during their pediatric developmental years. Approximately 46 percent of the children were reported to be between the ages of 6 and 12; thus, nearly half of the population was experiencing a biological, transitional, segment in their dentition exfoliation and eruption lifecycle. Younger children, between the ages of 1 to 5, accounted for nearly 20 percent while teenagers, ages 13 to 17, comprised the remaining 34.5 percent of the population included in the investigation.

A slight, 52 percent, majority of the S.C. were males. Non-Hispanic Whites (NHWs) served as the referent category and accounted for over two-thirds, 68.9 percent, of the population. Hispanics accounted for approximately 12.1 percent of the total population. Non-Hispanic Blacks (NHB) and all other racial/ethnic groups represented 8.7 percent and 10.3 percent respectively. Approximately 86.4 percent of the children lived in homes with at least one parent/guardian that achieved at least a high school diploma; however, only approximately

one-third of the households, 34.6 percent, reported that the highest parental education did not extend beyond a high school diploma. Unfortunately, approximately 13.4 percent of the children lived in households with parent(s)/guardian(s) that did not complete minimum high school diploma standards. Likewise, over three-fourths, 80 percent, of S.C. resided in households that earned >150 percent of the federal poverty level (FPL). Conversely, an estimated 11.7 percent of S.C. resided in households that earned <100 percent of the FPL and were potentially eligible for Medicaid services.

Approximately three-fourths, 78.9 percent, of respondents comprised of family structures that included two parental figures; the majority, 71.2 percent, of the two parent households comprised of biological and/or adopted parents as opposed to stepparents. An estimated 15 percent of the respondents dwelled in households with single parents, specifically single mothers. Most households surveyed indicated multiple children living in the same household, 61.9 percent, compared to single child households, 38.1 percent. There was also a seismic proportion of children with special health care needs in this population; nearly one-fourth, 23 percent, of respondents were derived as special needs from survey questions that inquired about medical conditions. Over 97 percent of survey respondents affirmed that they had general health insurance; however, no survey questions specifically inquired about the presence of dental insurance.

Unadjusted Regressions

Table 5 overviews the unadjusted regression matrix specific to the population segment that experienced untreated oral health care needs morbidity. The distribution was stratified by

race/ethnicity to evaluate risk and protective factors amongst diverse segments of the population. Unadjusted chi-square analyses were performed between untreated oral health care needs and all categorical key independent variables, preliminary mediating variables, and exogenous variables ($p \leq 0.05$). Interestingly, NHWs had an estimated 15.8 percent (n=6,691) response rate for experiencing untreated oral health care needs and demonstrated statistical significance with all key independent variables, preliminary mediating variables, and exogenous variables. Moreover, almost all ACEs demonstrated statistically significant relationships with exposure to untreated oral health care needs across all racial/ethnic profiles. Among Hispanics (n=7,414), a 26 percent response rate, did not exhibit statistical significance for parental death or racial discrimination with exposure to untreated oral health care needs.

Minority populations, such as NHB and Hispanics, demonstrated unique patterns in statistical significance with exposure to untreated oral health care needs. NHB respondents had nearly one-fourth, 23.4 percent (n=1,248) response rate for experiencing untreated oral health care needs. NHBs exhibited statistical significance for all key independent variables, almost all preliminary mediating variables and exogenous variables. Among NHBs, family structure, special health care needs, health insurance, and biological sex did not achieve statistical significance with exposure to untreated oral health care needs. On the other hand, Hispanics demonstrated significance with highest parental education, number of children in household, health insurance status, chronological age, and annual family income. The residual, 'All Other', respondents had an approximately 22 percent (n=1,391) response rate for experiencing untreated oral health care needs. All key independent ACE variables demonstrated statistically significant relationship with 'All Other' respondents experiencing untreated oral health care

needs. Most variables excluding females, those with health insurance, and the number of children in the household were statistically significant relationships for 'All Other' respondents to experience untreated oral health care needs.

Table 6 overviews the unadjusted correlational matrix specific to the population segment that reported preventive dental utilization. The distribution was stratified by race/ethnicity to evaluate risk and protective factors amongst diverse segments of the population. Unadjusted chi-square analyses were performed between reported preventive dental utilization and all categorical key independent variables, preliminary mediating variables, and exogenous variables ($p \leq 0.05$). A gross evaluation of Table 6 indicates minimal significant relationships between preventive dental utilization and ACEs, preliminary mediating variables, and exogenous variables.

Interestingly, NHWs had an approximate 99.6 percent (*n*=42,305) response rate for utilizing preventive dental services and appeared to be the only racial/ethnic group with substantial statistically significant relationships. NHW respondents with financial hardship, parental divorce, domestic violence, neighborhood violence, and mental illness demonstrated statistically significant relationships with preventive dental utilization. Most sociodemographic variables and covariates for NHW respondents excluding females, highest parental education, and children with special health care needs demonstrated statistically significant relationships with preventive dental utilization. NHB respondents had an approximate 99.7 percent (*n*=5,315) response rate for utilizing preventive dental services. There were no statistically significant relationships identified with NHB respondent's preventive dental utilization and any key independent ACE variables, sociodemographic variables, and covariates. Hispanic respondents

had an approximate 99.3 percent (*n*=7,363) response rate for utilizing preventive dental services. Only Hispanic respondents with financial hardship and presence of health insurance demonstrated statistically significant relationships with preventive dental utilization. The residual, 'All Other', respondents had an approximate 98.4 percent (*n*=6,228) response rate for utilizing preventive dental services. Only 'All Other' respondents with parental incarceration as a ACE demonstrated statistical significance with preventive dental utilization. Moreover, only age and presence of health insurance in 'All Other' respondents demonstrated statistical significance with preventive dental utilization.

Preliminary Adjusted Logistic Regressions

Table 7 overviews the adjusted logistic regression specific to the population segment that experienced untreated oral health care needs morbidity. The distribution was stratified by race/ethnicity to evaluate risk and protective factors amongst diverse segments of the population. In keeping with ceteris paribus, adjusted logistic regression was performed between untreated oral health care needs and all categorical key independent variables, preliminary mediating variables, and exogenous variables ($p \leq 0.05$).

In this context, all racial/ethnic groups had an overall increased risk for experiencing untreated oral health care needs with the presence of a statistically significant ACE exposure. NHWs with exposure to parental divorce had a (1.51 OR) increased odds, exposure to parental death had a (1.29 OR) increased odds, exposure to domestic violence had a (1.19 OR) increased odds, exposure to neighborhood violence had a (1.43 OR) increased odds, and exposure to mental health illnesses had a (1.22 OR) increased odds for experiencing untreated oral health

care needs, respectively. NHBs with exposure to financial hardship had a (1.48 OR) increased odds, exposure to parental incarceration had a (1.47 OR) increased odds, and exposure to racial discrimination had a (1.29 OR) increased odds for experiencing untreated oral health care needs, respectively. Hispanics with exposure to financial hardship had a (1.44 OR) increased odds, exposure to domestic violence had a (1.28 OR) increased odds, exposure to mental health illnesses had a (1.39 OR) increased odds for experiencing untreated oral health care needs, respectively. All other racial/ethnic groups with exposure to financial hardship had a (1.41 OR) increased odds and exposure to neighborhood violence had a (1.59 OR) increased odds for experiencing untreated oral health care needs, respectively.

Furthermore, in this context, all major racial/ethnic groups had a significant inverse relationship between experiencing untreated oral health care needs and SES indicators; thus, SES indicators such as highest parental education and annual family income may have an inverse protective factor function. Less than high school diploma served as referent value in the highest parental education category. NHWs with a high school diploma had a (0.84 OR) decreased odds for experiencing untreated oral health care needs compared to NHWs with less than a high school diploma. Likewise, NHWs with more than a high school diploma had a (0.78 OR) decreased odds for experiencing untreated oral health care needs compared to NHWs with less than a high school diploma. NHBs with a high school diploma had a (0.80 OR) decreased odds for experiencing untreated oral health care needs compared to NHBs with less than a high school diploma. Likewise, NHBs with more than a high school diploma had a (0.77 OR) decreased odds for experiencing untreated oral health care needs compared to NHBs with less than a high school diploma. Hispanics with a high school diploma had a (0.73 OR) decreased

odds for experiencing untreated oral health care needs compared to Hispanics with less than a high school diploma. Likewise, Hispanics with more than a high school diploma had a (0.69 OR) decreased odds for experiencing untreated oral health care needs compared to Hispanics with less than a high school diploma. All other racial/ethnic groups with a high school diploma had a (0.73 OR) decreased odds for experiencing untreated oral health care needs compared to all other racial/ethnic groups with less than a high school diploma. Likewise, all other racial/ethnic groups with more than a high school diploma had a (0.74 OR) decreased odds for experiencing untreated oral health care needs compared to all other racial/ethnic groups with less than a high school diploma.

Similarly, all major racial/ethnic groups had a significant inverse relationship between experiencing untreated oral health care needs and annual family income relative to FPL. Less than 100 percent of FPL served as the referent value in the annual family income category. NHWs with annual household income at 100-150 percent of the FPL had a (0.88 OR) decreased odds for experiencing untreated oral health care needs compared to NHWs with annual household income less than 100 percent of the FPL. NHWs with annual household income at greater than 150 percent of the FPL had a (0.59 OR) decreased odds for experiencing untreated oral health care needs compared to NHWs with annual household income less than 100 percent of the FPL. NHBs with annual household income at 100-150 percent of the FPL had a (0.70 OR) decreased odds for experiencing untreated oral health care needs compared to NHBs with annual household income less than 100 percent of the FPL. NHBs with annual household income at greater than 150 percent of the FPL had a (0.63 OR) decreased odds for experiencing untreated oral health care needs compared to NHBs with annual household income less than

100 percent of the FPL. Hispanics with annual household income at greater than 150 percent of the FPL had a (0.64 OR) decreased odds for experiencing untreated oral health care needs compared to Hispanics with annual household income less than 100 percent of the FPL. All other racial/ethnic groups with annual household income at greater than 150 percent of the FPL had a (0.63 OR) decreased odds for experiencing untreated oral health care needs compared to all other racial/ethnic groups with annual household income less than 100 percent of the FPL.

Alternative family structures and chronological age of child demonstrated increased odds for experiencing untreated oral health care needs in certain racial/ethnic groups suggesting as potential risk factor for morbidity. Two biological and/or adoptive parents served as the referent value in the family structure category. NHWs with two stepparent family structure had a (1.20 OR) increased odds for experiencing untreated oral health care needs compared to NHWs with two biological and/or adoptive parents. NHWs with a single mother family structure had a (1.15 OR) increased odds for exposure to untreated oral health care needs compared to NHWs with two biological and/or adoptive parents. NHWs with other family structures had a (1.17 OR) increased odds for experiencing untreated oral health care needs compared to NHWs with two biological and/or adoptive parents. NHBs with other family structures had a (1.35 OR) increased odds for experiencing untreated oral health care needs compared to NHBs with two biological and/or adoptive parents. All other racial/ethnic groups with two stepparent family structure had a (1.34 OR) increased odds for experiencing untreated oral health care needs compared to all other racial/ethnic groups with two biological and/or adoptive parents.

NHWs with transitional dentition had a (1.5 OR) increased odds for experiencing untreated oral health care needs compared to NHWs with deciduous dentition. NHWs with permanent dentition had a (1.08 OR) increased odds for experiencing untreated oral health care needs compared to NHWs with deciduous dentition. NHBs with transitional dentition had a (1.30 OR) increased odds for experiencing untreated oral health care needs compared to NHBs with deciduous dentition. NHBs with permanent dentition had a (1.32 OR) increased odds for experiencing untreated oral health care needs compared to NHBs with deciduous dentition. Hispanics with transitional dentition had a (1.78 OR) increased odds for experiencing untreated oral health care needs compared to Hispanics with deciduous dentition. Hispanics with permanent dentition had a (1.27 OR) increased odds for experiencing untreated oral health care needs compared to Hispanics with deciduous dentition. Likewise, all other racial/ethnic groups with transitional dentition had a (1.30 OR) increased odds for experiencing untreated oral health care needs compared to all other racial/ethnic groups with deciduous dentition.

Interestingly, the number of children in a household demonstrated contrasting odds among various racial/ethnic groups and their risk for experiencing untreated oral health care needs; thus, cultural tendencies may play a significant role in shifting the function of the quantity of children in each household between a risk and protective factor. One child in a household served as the referent value in the number of children in a household category. NHWs with multiple children had a (0.94 OR) decreased odds for experiencing untreated oral health care needs compared to NHWs with a single child in their household. Conversely, NHBs with multiple children in a household had a (1.18 OR) increased odds for experiencing untreated oral health care needs compared to NHBs with a single child in their household.

Table 8 overviews the adjusted logistic regression specific to the population segment that reported preventive dental utilization. The distribution was stratified by race/ethnicity to evaluate risk and protective factors amongst diverse segments of the population. In keeping with ceteris paribus, adjusted logistic regression was performed between preventive dental utilization and all categorical key independent variables, preliminary mediating variables, and exogenous variables ($p \leq 0.05$). A gross evaluation of Table 8 reveals minimal significant relationships between preventive dental utilization and ACEs, preliminary mediating variables, and exogenous variables. Consequently, due to minimal statistical significance, I dropped and excluded the dependent variable *preventative dental utilization* from all subsequent, except for the final, iteration of path analyses.

Exposure to statistically significant ACEs consistently demonstrated decreased odds, suggesting an inhibitory effect, for utilizing preventative oral health care services. NHWs with exposure to parental divorce had a (0.45 OR) decreased odds and exposure to domestic violence had a (0.50 OR) decreased odds for utilizing preventative oral health care services, respectively. Hispanics with exposure to financial hardship had a (0.50 OR) decreased odds and exposure to parental incarceration had a (0.40 OR) decreased odds for utilizing preventative oral health care services, respectively. All other racial/ethnic groups with exposure to parental incarceration had a (0.32 OR) decreased odds for utilizing preventative oral health care services.

Conversely, the presence of health insurance consistently yielded increased odds, suggesting a stimulatory effect, for utilizing preventative oral health care services. NHWs with exposure health insurance had a (4.95 OR) increased odds, Hispanics with exposure to health insurance had a (6.42 OR) increased odds, and all other racial/ethnic groups with exposure to

health insurance had a (3.21 OR) increased odds for utilizing preventative oral health care services, respectively.

The children's chronological age demonstrated increased odds, suggesting a positive effect, for utilizing preventative oral health care services. NHWs with transitional and permanent dentition had a (2.58 OR) increased odds for utilizing preventative oral health care services compared to NHWs with deciduous dentition. Likewise, all other racial/ethnic groups with transitional dentition had a (2.90 OR) increased odds and all other racial/ethnic groups with permanent dentition had a (2.72 OR) increased odds for utilizing preventative oral health care services compared to all other racial/ethnic groups with deciduous dentition, respectively.

Iterations of Unadjusted Path Analyses and Models

Tables 9-13.1. overview multiple iterations of unadjusted path analysis models, inclusive of logistic and multinomial regressions, that quantify valid mediating variables with statistically significant direct and indirect pathways. Each individual unadjusted path analysis models significance, directionality, and magnitude of influence attempting to identify mediating variable(s) and detail exogenous variables that statistically measure the complex relationship between adverse childhood experiences and OHRQoL ($p \leq 0.05$). Figures 3-7 assist in conceptualizing the iterative refinements of the complex framework.

In Tables 9 and 9.1, the unadjusted presumed mediating variable, *family structure*, was analyzed for statistically significant pathways, directionality, and magnitude of influence. Figure 3 conceptualizes the unadjusted path model for family structure. Two biological and/or adoptive parents served as the referent value in the family structure category. Interestingly,

almost all key independent ACE variables exhibited statistical significance with the exceptions of mental health illnesses for two-stepparent households and racial discrimination for all alternative family structures. Understandably, populations that reported exposure to the ACE variable *parental divorce* demonstrated extraordinary increased relative risk for experiencing alternative family structures such as two stepparent households (80.39 RRR), single mother households (52 RRR), and other (64.97 RRR) compared to two biological and/or adoptive parent households. Interestingly, exposure to only two stepparent households demonstrated statistical significance as an alternative family structure that has a (1.28 OR) increased odds for experiencing untreated oral health care needs, compared to two biological and/or adoptive parent households. Additionally, populations that reported exposure to the ACE variable *parental death* also demonstrated extraordinary increased relative risk for experiencing alternative family structures; specifically, two stepparent households (14.47 RRR), single mother households (17.57 RRR), and other (33.66 RRR) compared to two biological and/or adoptive parent households. Annual family income demonstrated an inverse relative risk across all alternative family structures for exposure to ACEs. NHBs, compared to NHWs, demonstrated a consistently increased relative risk for exposure to ACEs; specifically, two stepparent households (3.50 RRR), single mother households (8.17 RRR), and other (5.40 RRR) compared to two biological and/or adoptive parent households. Additionally, racial/ethnic minorities demonstrated (1.48) NHBs, (1.62) Hispanics, and (1.3) Other increased odds for experiencing untreated oral health care needs.

In Tables 10 and 10.1. the unadjusted presumed mediating variable, *highest parental education*, was analyzed for statistically significant pathways, directionality, and magnitude of

influence. Figure 4 conceptualizes the unadjusted path model for highest parental education. Less than high school graduate served as the referent value in the highest parental education category. Interestingly, the ACE variable *parental divorce* was the only consistent exposure that demonstrated increased relative risk for experiencing higher levels of parental education such as high school graduate (1.19 RRR) and greater than high school graduate (1.19 RRR) compared to households with the highest parental education as less than high school graduates. Exposure to the ACE variable racial discrimination demonstrated an isolated increased relative risk among households with parental education higher than high school graduate (1.55 RRR) compared to households with the highest parental education as less than high school graduates. Moreover, increasing levels of parental education exhibited an inverse, protective mediating effect, against experiencing children experiencing poorer oral health; specifically, households with highest parental education as high school diplomas had a (0.73 OR) and more than high school diploma had a (0.70 OR) less odds for experiencing untreated oral health care needs compared to households with highest parental education as less than high school diploma. NHBs and Hispanics, compared to NHWs, experienced a decreased relative risk for residing in households with increased levels of parental education. Additionally, racial/ethnic minorities demonstrated (1.50 OR) NHBs, (1.42 OR) Hispanics, and (1.29 OR) other racial/ethnicities increased odds for experiencing untreated oral health care needs.

In Tables 10.2. and 10.3. the unadjusted presumed mediating variable, *highest parental education*, was transformed from an ordinal to dichotomous variable and reanalyzed for potential amalgamation paradox. Figure 4.1. conceptualizes the unadjusted path model for the dichotomized highest parental education. A sensitivity analysis was configured to determine if

significant variation arises when comparing households with highest parental education as high school versus post-high school. Less than and/or equal to high school graduate served as the referent value in the highest parental education category. Interestingly, exposure to the ACE variable *parental divorce* was no longer significant to interpret and exposure to the ACE variable *racial discrimination* slightly decreased (1.29 RRR) in relative risk for experiencing households with highest parental education as post-high school. Moreover, exposure to households with highest parental education as post-high school graduate continued to demonstrate a protective effect with (0.90 OR) decreased odds for experiencing untreated oral health care needs morbidity. Compared to NHWs, racial/ethnic minorities such as NHBs (1.48 OR), Hispanics (1.58 OR), and Other (1.33 OR) continued to have increased odds for experiencing untreated oral health care needs morbidity.

In Tables 11 and 11.1. the unadjusted presumed mediating variable, *health insurance*, was analyzed for statistically significant pathways, directionality, and magnitude of influence. Figure 5 conceptualizes the unadjusted path model for health insurance. The absence of health insurance served as the referent value in the health insurance category. Interestingly, all key independent ACE variables were statistically insignificant and thus not interpreted. Households with annual family income more than 150 percent of the FPL, compared households with annual family income less than 100 percent of the FPL, demonstrated a (1.52 OR) increased odds for having health insurance. Hispanics exhibited a (0.42 OR) decreased odds for having health insurance. Moreover, the presence of health insurance exhibited as a protective factor against untreated oral health care needs morbidity; thus, populations with health insurance, compared to those without, had a (0.75 OR) decreased odds for experiencing untreated oral

health care needs. All minorities with health insurance, compared to NHWs with health insurance, demonstrated increased odds for experiencing untreated oral health care needs.

In Tables 12 and 12.1. the unadjusted presumed mediating variable, *special health care needs*, was analyzed for statistically significant pathways, directionality, and magnitude of influence. Figure 6 conceptualizes the unadjusted path model for special health care needs. The absence of special health care needs served as the referent value in the special health care needs category. All key independent ACE variables, except for parental death, demonstrated significant increased odds for experiencing special health care needs. Exposure to parental divorce exhibited (1.17 OR), parental incarceration exhibited (1.29 OR), domestic violence exhibited (1.26 OR), neighborhood violence exhibited (1.39 OR), mental health illnesses exhibited (1.87 OR), and racial discrimination exhibited (1.31 OR) increased odds for experiencing special health care needs. Females with exposure to ACEs, compared to their male counterparts, exhibited decreased odds (0.71 OR) for experiencing special health care needs. All minorities with special health care needs, compared to NHWs with special health care needs, demonstrated increased odds for experiencing untreated oral health care needs.

In Tables 13 and 13.1. the unadjusted presumed mediating variable, *number of children in household*, was analyzed for statistically significant pathways, directionality, and magnitude of influence. Figure 7 conceptualizes the unadjusted path model for number of children in household. Households with only one child served as the referent value in the number of children in household category. Exposures to multiple ACEs including parental divorce (0.77 OR), parental death (0.61 OR), and neighborhood violence (0.80 OR) decreased odds for affected households to have multiple children compared to a single child. Interestingly, the

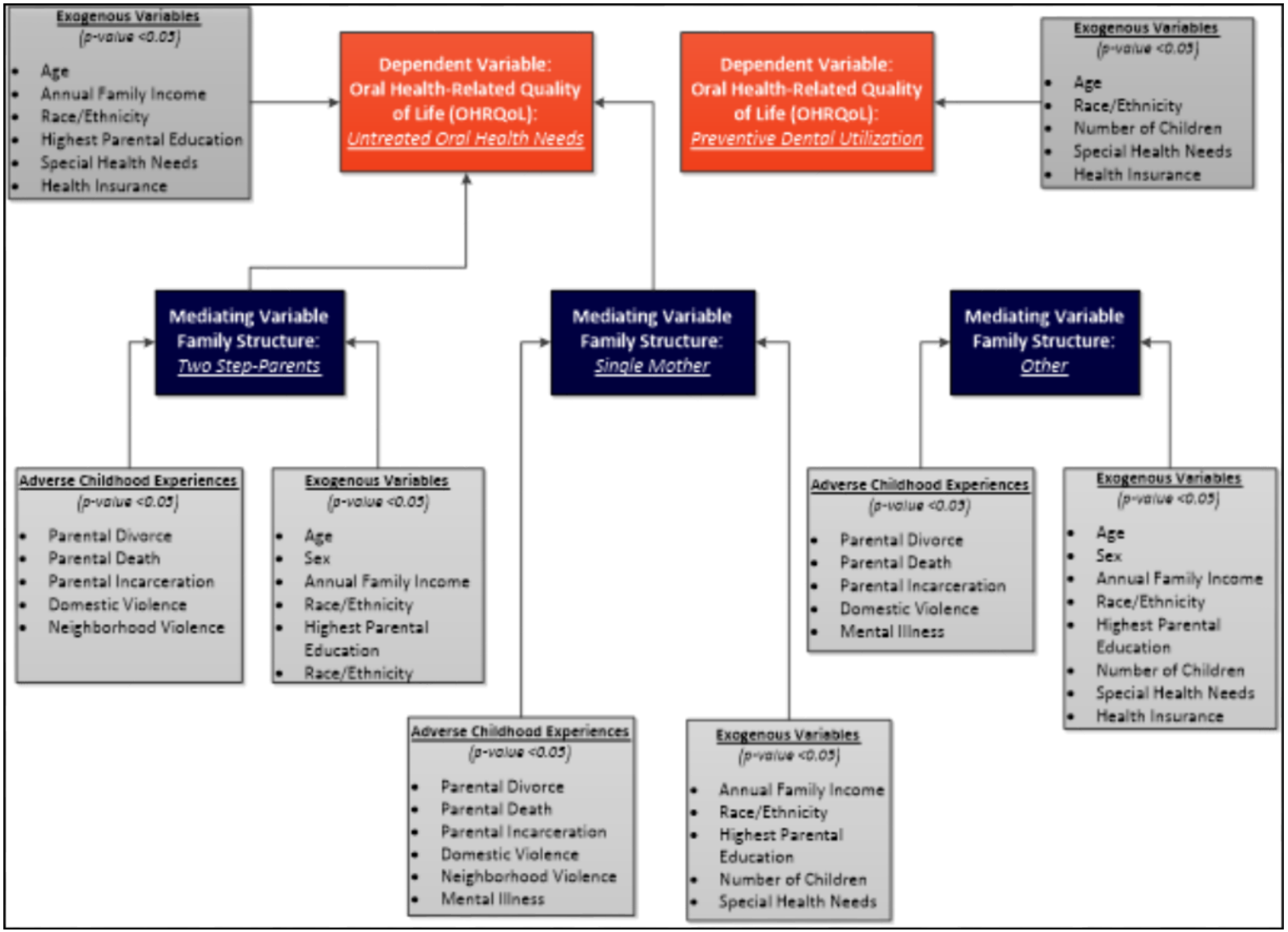
number of children in a household did not have a statistically significant impact on experiencing untreated oral health care needs morbidity and thus the coefficient was not interpreted. All minorities with multiple children in a household, compared to their NHW counterparts, demonstrated increased odds for experiencing untreated oral health care needs.

Tables 14, 14.1., and 14.2. describe the refined and adjusted path analysis model. Family structure served as the sole, significant, mediating variable with two biological and/or adoptive parents as the referent value in the category. Figure 8 conceptualizes the adjusted path model for family structure and is also known as our contextualized framework. The refined model was examined for statistical significance with both preliminary dependent variables – preventative dental utilization and untreated oral health care needs. Exposure to the ACE variables parental divorce, parental death, parental incarceration, and domestic violence consistently demonstrated as a significant risk factor across all alternative family structures, thereby increasing the relative risk for children to experience certain ACEs in alternative family structures compared to two biological and/or adoptive parent households. Exposure to neighborhood violence exhibited as a significant risk factor for children to live in alternative family structures with (1.36 RRR) two stepparent households and (1.37 RRR) single mother households having increased relative risk compared to two biological and/or adoptive parent households, respectively. Exposure to mental health illnesses exhibited as a significant risk factor (1.57 RRR) for children to live in households with single mothers having increased relative risk compared to two biological and/or adoptive parent households. Consistent with the unadjusted model, the adjusted model exhibited that populations that reported exposure to the ACE variable *parental divorce* demonstrated extraordinary increased relative risk for

experiencing alternative family structures such as two stepparent households (81.04 RRR), single mother households (54 RRR), and other (69.38 RRR) compared to two biological and/or adoptive parent households. Furthermore, exposure to alternative family structures demonstrated statistically significant, (1.29 OR) two stepparent households and (1.15 OR) single mother households, increased odds for experiencing untreated oral health care needs morbidity. Interestingly, family structure did not demonstrate as a statistically significant mediating variable for children to experience preventative dental utilization; thus, the coefficients were not interpreted. Additionally, populations that reported exposure to the ACE variable *parental death* also demonstrated extraordinary increased relative risk for experiencing alternative family structures; specifically, two stepparent households (14.62 RRR), single mother households (17.24 RRR), and other (32.70 RRR) compared to two biological and/or adoptive parent households. Minorities, across all alternative family structures, consistently demonstrated increased relative risk for exposure to ACEs, compared to their NHW counterparts. NHBs exhibited as the highest relative risk for experiencing ACEs with (3.45 RRR) in two stepparent households, (8.09 RRR) in single mother households, and (5.19 RRR) in other alternative family structures compared to two biological and/or adoptive parent households. Females, compared to males, demonstrated less relative risk for exposure to ACEs in both (0.85 RRR) two stepparent households and (0.81 RRR) other alternative households, compared to two biological and/or adoptive parent households. Annual family income demonstrated as a statistically significant inverse relative risk across all alternative family structures for exposure to ACEs. Surprisingly, increased levels of parental education in both two stepparent and single mother households, compared to two biological and/or adoptive parent households,

demonstrated an increased relative risk for children to have ACEs. Single mother households (0.33 RRR) and other alternative family structures (0.31 RRR) with multiple children, compared to a single child, had decreased relative risk for children to have ACEs. Children with special health care needs in single mother households, compared to two biological and/or adoptive parent households, had a (1.23 RRR) increased relative risk for children to have ACEs. Moreover, children in transitional dentition demonstrated the highest odds of experiencing untreated oral health care needs morbidity. Minorities consistently exhibited higher odds, compared to their NHW counterparts, to experience untreated oral health care needs morbidity. Highest parental education demonstrated a statistically significant inverse relationship, suggesting as a protective factor in experiencing untreated oral health care needs. Annual family income that exceed 150 percent of the FPL, compared to annual family income that was below 100 percent of the FPL, demonstrated a (0.58 OR) decreased odds for experiencing untreated oral health care needs. Children with special health care needs demonstrated as a (1.13 OR) increased odds for experiencing untreated oral health care needs. The presence of health insurance demonstrated as a (0.76 OR) decreased odds, suggesting a protective effect, for experiencing untreated oral health care needs.

Figure 8. Adjusted Path Model (Family Structure) – Contextualized Framework



CHAPTER IV

DISCUSSION AND CONCLUSION

Contextualized Path Model & Framework

The findings from my adjusted logistic regressions largely converge with evidence from existing scientific literature on the longer-term detrimental impacts of ACEs on diverse dimensions in quality of life. As per my suspicion, health disparities manifested among diverse racial/ethnic groups with minorities suffering from disproportionately higher risk profiles for experiencing ACEs.

The process through which ACEs impact OHRQoL continues to be a complex phenomenon and thus is only partially explainable. The path analysis model underwent several iterative analytical cycles through which I revised and refined the preliminary conceptual model to the contextualized framework. The preliminary dependent variable, preventative dental utilization, surprisingly demonstrated gross insignificance across several critical variables in both the preceding unadjusted and adjusted regression analyses; thus, I elected to exclude statistically measuring preventative dental utilization from unadjusted path analysis iterations until the final adjusted model was developed. Preventative dental utilization continued to demonstrate insignificance in the refined, contextualized framework and thus I elected to drop and exclude the variable altogether.

Family Structure as Mediating Variable

The preliminary mediating variables underwent a series of statistical measurements that extrapolated potential significance, magnitude, and directionality of influence. Interestingly,

only *family structure* manifested as the potentially explainable mediating variable in the investigation. Other preliminary mediating variables, such as children with special health care needs and quantity of children in household, demonstrated an extent of significance; however, these preliminary mediating variables are consistently reported as characteristic of exogenous variables in other scientific studies relative to ACEs.

Invocation of the Pareto Principle

Exposure to almost all ACEs demonstrated a significantly increased relative risk factor for experiencing alternative family structures. One of the initial goals in my research investigation was to employ the Pareto principle and explicitly identify the most critical ACEs that exhibited the highest detrimental magnitude of influence and risk to OHRQoL. Fortunately, I uncovered an extraordinarily high relative risk factor with exposure to the ACE variable *parental divorce*, with exposure to *parental death* being the second most profound relative risk factor, over any other key independent variable for experiencing alternative family structures. Thus, in keeping with the Pareto principle, an estimated 80 percent of the detrimental effects on OHRQoL are presumably attributable to 20 percent of the ACE exposures; in this context, the ACE variables *parental divorce* and *parental death* are of the highest magnitude of risk for children experiencing households with alternative family structures.

Households with two biological and/or adoptive parents, are more likely equipped with adequate resources to provide children with favorable environments to experience their growth and development; adequate resources can, for example, include a diverse array of favorable social, economic, cultural, and educational conditions. As demonstrated in the analysis, children in households with alternative family structures, irrespective of racial/ethnic

affiliations, exhibited an increased risk for exposure to a variety of ACEs, namely *parental divorce* and *parental death*. Consequently, households with alternative family structures are experiencing added psychosocial stressors such as emotional instability and enduring loss in addition to existing stressors to provide a favorable household environment for positive child growth and development.

Invocation of *Occam's Razor*

The diverse and disproportionate negative impacts of ACEs on OHRQoL alludes to the inherent plurality of scientific explanations that could potentially describe the complex relationship. In this complex context, I elected to invoke the heuristic philosophical principle of *Occam's razor*, which logically rationalizes that if a universal explanation is presumable for a diverse array of complications, then it is likely that the valid explanation dwells in the simplest of justifications (Anda, et al., 2006). In this context, one presumable justification conceptualizes the amalgamated complexity of ACEs as a concatenated *domino effect* with *parental divorce* and *parental death* as the initial domino piece; if/when the exposure to *parental divorce* and *parental death* occurs, the systemic impact endures a systematic progression of increasing risk factors for exposures to additional ACEs. For example, when a household with two biological parents experiences the unfortunate death of one biological parent (i.e. father), the surviving parent (i.e. mother) likely endures through significant physiological and psychological stressors. The surviving, widowed, mother becomes solely responsible to provide a favorable environment for the growth and development of their child or children in addition to enduring through loss. Presumably, the surviving mother has limited socioeconomic resources, compared to when the household had two biological parents, and necessarily adjusts the household

environment to a more suitable context. In this permanent transition, the child or children increase their risk for enduring through additional ACEs such as a potentially a new neighborhood with increased violence and/or discrimination, lack of a biological father in their critical developmental years, and the increased likelihood that their surviving mother experiences a degree of mental health illness, such as depression, from loss of a spouse. Children in proximate household contexts also become at an increased risk for experiencing loss in annual family income, loss of health insurance, and loss of various other protective resources. Moreover, children in proximate household contexts experience a higher likelihood for mental health illnesses such as psychosocial depression, anxiety, and withdrawal and/or engagement in illicit drug/substance abuse (Anda, et al., 2006).

Applying Learnings from Battered Child Syndrome and WorldSAFE Investigation

The collective long-term consequences of ACEs have the potential to impact both the affected individual and their households throughout their lifespan. Essentially, exposure to the diverse ACE risk factors increases the likelihood of people who were exposed to ACEs to iterate proximate circumstances in their households as adults/parents themselves. Thus, as Dr. Henry Kempe's conceptualization of the *Battered Child Syndrome* suggests an individual who was exposed to the ACE variable *domestic violence* was at a significantly higher risk and conditioned likelihood to either be abusive or be abused in their adulthood relationships (Leventhal & Krugman, 2012). Consequently, an initial exposure to ACEs commences a deteriorating sequela of ACE exposures that iteratively permeates through subsequent generations (Leventhal & Krugman, 2012). In our context, the exposure to the ACE variable with the highest magnitude of influence, *parental divorce*, is of significant concern, particularly with increasing trends of

divorce rates in the US. More importantly, evidence from the World Studies of Abuse in the Family Environment (WorldSAFE), a WHO endorsed cross-national investigation, revealed that alternative family structures, family size, and household composition were among the leading characteristics that were more likely to expose children to diverse ACEs including child abuse and neglect (Krug, Dahlberg, Mercy, Zwi, & Lozano, 2002). If the conceptualized *domino effect* paradigm with ACEs and OHRQoL holds true, then increasing national trends of divorce rates projects a potentially abysmal trajectory, with each subsequent generation increasing their risk and likelihood for deteriorating health-related quality of life (HRQoL).

Research Limitations

Inevitably, there are multiple limitations in this investigation. Unfortunately, there is no universally accepted parameter quantifying OHRQoL. Previous studies have utilized a juxtaposition of functional limitation, physiological pain thresholds, psychological discomfort, and multiple dimensions for disability to define OHRQoL (John, 2007). I elected to utilize *untreated oral health care needs*, inclusive of orofacial pain and presence of untreated oral health care needs, as the primary observable variable to proxy measurement of OHRQoL. In the investigation, I was unable to control for geocentric influences of community water fluoridation as a potentially significant confounder in the incidence and prevalence of oral diseases.

Moreover, my investigation fundamentally aimed to statistically measure ACEs, a subject of immense sensitivity and likelihood of underreporting in the data collection process. The 2011-2012 NSCH data collection process utilizes parental, or proximate guardian, reporting as exclusive means to document survey data on S.C., including oral health status and exposure to ACEs. Consequently, parental/guardian perceptions of their child's health status are utilized

as a proxy to objective results of professional and clinical examinations; however, several studies have indicated positive correlations between parental perceptions of their child's health status and results of professional/clinical examinations (Barbosa & Gaviao, 2008).

The WorldSAFE investigation also found that cultural contexts vary significantly on acceptable parenting practices, particularly regarding views on child abuse or maltreatment (Krug, Dahlberg, Mercy, Zwi, & Lozano, 2002). For example, the WorldSAFE study found that *moderate* forms of child discipline (i.e. spanking child's buttocks with hand or object, slapping child's face or head, pulling child's hair, hitting child with knuckles, twisting child's ear, and putting hot peppers in child's mouth, etc.) *were not universally agreed upon to be abusive*, though some professionals and parents regarded such forms of discipline as unacceptable (Krug, Dahlberg, Mercy, Zwi, & Lozano, 2002). Therefore, in keeping with globalization patterns and varying degrees of acculturation amongst populations, investigators seeking to obtain valid and reliable measures of exposures to child maltreatment should integrate the principles of cosmopolitanism and anthropologic, ethnocultural, sensitivity within their research designs. Additional qualitative research studies are indicated to further investigate the contextual role of culture and acculturation in the contextualized framework.

Lastly, I utilized cross-sectional survey data; therefore, the extrapolated results of the investigation are limited to theoretical associations and presumable pathways that statistically measure the complex relationship between ACEs and OHRQoL. Additionally, the utilization of cross-sectional survey data does not explicitly identify the length of calendar time the affected child was exposed to ACEs; thus, results are limited to if an exposure to ACEs was present or absent. Further research, such as longitudinal and time-series data, is indicated to help

establish a more explicit understanding regarding both multiyear trends and length of exposure in the contextualized framework.

Implications for Health Policy & Professional Practice

The contextualized framework conceptualizes the complex relationship between ACEs and OHRQoL through causal pathways that statistically measure significance, directionality, and magnitude of influence. Prior research studies investigated the cumulative risk, or allostatic load, of ACEs on HRQoL and found a dose-response relationship; thus, a deteriorating effect of ACEs on OHRQoL was presumable. My research adds to the emerging body of literature by identifying *alternative family structures* as the primary mediating mechanism through which ACEs impact OHRQoL, with identifying specific ACEs such as *parental divorce* and *parental death* having the largest magnitude of influence.

In keeping with the Pareto principle, targeted public health efforts should be directed towards populations affected by the aforementioned ACEs. Public health interventions such as expanding resources in psychological and therapeutic marriage and family counseling services, notably in at-risk communities can help facilitate a positive transition in struggling households. Youth psychological and therapeutic counseling services, inclusive of screening for abuse and/or neglect, should also be integrated into at-risk school districts. Health policies should also empower school health care professionals to conduct annual ACE-related screenings on all children thereby assisting with early detection, reporting to authorities, and referring for professional intervention. Psychological and therapeutic counseling can be a transformative resource for all members of diverse households and can potentially mitigate a deteriorating sequalae through professional intervention. Engaging community leadership and stakeholders

can also help tailor public health interventions that are exceedingly sensitive to the *cultural context* of at-risk populations.

Evidence-based clinical interventions, from the fields of pediatric psychology and psychiatry, also supports developing *resilience* in children experiencing ACEs as a legitimate counter rehabilitation methodology; resilience, broadly defined as adaptive and responsive caregiving, is aimed to facilitate child development into a more effective, productive, and healthy adulthood (Ungar, 2015). The resilience endeavor essentially aims to group an affected child with a responsible adult that establishes a positive, trusting, environment, role models constructive behavior, and facilitates the affect child's posttraumatic growth. Psychosocial therapies, such as the CDC endorsed *Positive Parenting Program* and comparable emerging enrichment initiatives have demonstrated positive mitigation of some ACEs with markedly improved behavior in enrolled children and thus should be further integrated into community-related interventions (Larkin, Felitti, & Anda, 2014).

Increasing the knowledge and screening practices of diverse health care providers on the potential impact of ACEs on HRQoL can also facilitate early detection and appropriate referral for professional interventions. Employing primary prevention strategies, such as an interdisciplinary effort in screening for ACEs, can potentially prevent the devastating onset of an intergenerational plague with physiological, psychological, and economic detriments. Pediatric health care providers can, for example, integrate existing ACE clinical surveys such as the *'Safe Environment for Every Kid (SEEK) Questionnaire'* to screen for at-risk patients.

In the context of health care, OHCPs can perform ACE-related screenings by critically evaluating the patient's health history and clinical examination results. For example, analyzing a

patient's social history can reveal key sociodemographic information such as race/ethnicity, biological sex, marital status or parental marital status if minor, health insurance status, employment status, and family composition. A patient's medical history also offers OHCPs insight on presence of diverse systemic health conditions including acute and/or chronic health conditions, substance abuse, mental health illnesses, sexually transmitted infections, utilization of tobacco, etc. A patient's dental history can provide an OHCP insight on orofacial pain, dental utilization patterns, extent of dental treatment received, and patient's prioritization of oral and systemic health. Preliminary extraoral and intraoral examinations can reveal presence of physical abuse, sexual abuse, and medical/dental neglect. A comprehensive oral examination, inclusive of necessary radiographs, can identify oral diseases, abnormal lesions, wounded lacerations, damaged dentition, and fragmented craniofacial skeletal structures. OHCPs largely have the tools to be a proactive practitioner in screening for a wide spectrum of ACEs.

Health policies, as part of the national health care form agenda and the Patient Protection and Affordable Care Act (PPACA) should integrate ACE-related screenings as an *essential health service* for all children. As part of a broader Inter-Professional Education (IPE) endeavor, all care providers and educators should be responsible for completing baseline minimum training requirements on early detection, reporting, and referring cases of suspected ACEs and maintain current in professional continuing education curriculum relative to ACEs. We can successfully counter our ACE-related pandemic through well-coordinated, culturally sensitive, multidisciplinary efforts.

Appendix

Table 1. Missing Observations			
ACE Variables	**Obs.**	**Missing Obs.**	**p-value**
Domestic Violence	93,610	2,067	0.75
Drug Abuse	94,030	1,647	0.82
Financial Hardship	93,810	1,867	0.55
Mental Health Illness	93,839	1,838	0.81
Neighborhood Violence	93,826	1,851	0.16
Parental Death	94,306	1,371	0.70
Parental Divorce	94,021	1,656	0.63
Parental Incarceration	94,095	1,582	0.56
Racial Discrimination	93,834	1,843	0.57
Unfair Treatment	***3,402***	***92,275***	0.35

Note: Data obtained from 2011-2012 National Survey of Children's Health; ttest performed against biological sex

Table 2. Missing Data Patterns		
ACE Variables	**Survey Response**	
	3%	92%
Domestic Violence	1	1
Drug Abuse	1	1
Financial Hardship	1	1
Mental Health Illness	1	1
Neighborhood Violence	1	1
Parental Death	1	1
Parental Divorce	1	1
Parental Incarceration	1	1
Racial Discrimination	1	1
Unfair Treatment	***1***	***0***

Note: Data obtained from 2011-2012 National Survey of Children's Health; 0 = No Response; 1 = Response

Table 3. ACEs Pairwise Correlational Matrix										
Categories	*Financial Hardship*	*Parental Divorce*	*Parental Death*	*Parental Incarceration*	*Domestic Violence*	*Neighborhood Violence*	*Mental Illness*	*Drug Abuse*	*Racial Discrimination*	*Unfair Treatment*
Financial Hardship	**1**									
Parental Divorce	0.1631	**1**								
Parental Death	0.0445	0.0882	**1**							
Parental Incarceration	0.1135	0.2702	0.0997	**1**						
Domestic Violence	0.1231	0.3088	0.0874	0.337	**1**					
Neighborhood Violence	0.1285	0.2074	0.0792	0.2326	0.3602	**1**				
Mental Illness	0.1262	0.2341	0.0841	0.2036	0.2767	0.2374	**1**			
Drug Abuse	0.1344	0.3421	0.1176	***0.3972***	***0.398***	0.2674	0.3498	**1**		
Racial Discrimination	0.0643	0.0623	0.0318	0.0574	0.0847	0.1441	0.0776	0.0731	**1**	
Unfair Treatment	0.0817	-0.0307	0.0144	0.0134	-0.0164	-0.0041	-0.0182	-0.026	.	**1**
Note: Data obtained from 2011-2012 National Survey of Children's Health										

Table 4. Descriptive Statistics		
	Proportion	**S.D.**
Dependent Variables (OHRQoL)		
Untreated Oral Health Needs	0.183	0.387
Preventive Dental Utilization	0.996	0.065
Key Independent Variables (ACEs)		
Financial Hardship	0.499	0.500
Parental Divorce	0.193	0.395
Parental Death	0.031	0.172
Parental Incarceration	0.056	0.229
Domestic Violence	0.063	0.242
Neighborhood Violence	0.079	0.270
Mental Illness	0.096	0.294
Racial Discrimination	0.039	0.193
Mediating Variable		
Family Structure		
*Two Parents-Biological/Adopted**	**1.000**	**1.000**
Two Parents-Stepparents	0.077	0.266
Single Mother	0.150	0.357
Other	0.061	0.239
Exogenous Variables		
Age		
*Ages 1-5 (Deciduous Dentition)**	**1.000**	**1.000**
Ages 6-12 (Transitional Dentition)	0.462	0.499
Ages 13-17 (Permanent Dentition)	0.345	0.475
Sex		
Female	0.488	0.500
Race/Ethnicity		
*Non-Hispanic Whites**	**1.000**	**1.000**
Non-Hispanic Blacks	0.087	0.281
Hispanic	0.121	0.326
Other	0.103	0.304
Annual Family Income		
*<100% Federal Poverty Level**	**1.000**	**1.000**
100-150% Federal Poverty Level	0.081	0.273
>150% Federal Poverty Level	0.802	0.398
Highest Parental Education		
*< High School Diploma**	**1.000**	**1.000**
High School Diploma	0.346	0.476
> High School Diploma	0.520	0.500
Number of Children in Household		
*One Child**	**1.000**	**1.000**
Multiple Children	0.619	0.486
Special Health Care Needs		
Special Health Needs	0.230	0.421
Health Insurance Status		
Health Insurance	0.971	0.167
Note: (n=61,530); Data obtained from 2011-2012 National Survey of Children's Health; *Reference Value		

Table 5. Unadjusted Regression with Dental Caries (Stratified by Race/Ethnicity)												
	NHW (n=42,456)			NHB (n=5,332)			Hispanic (n=7,414)			All Other (n=6,328)		
	Prop.	S.D.	p-value	Prop.	S.D.	p-value	Prop.	S.D.	p-value	Prop.	S.D.	p-value
Dependent Variable												
Dental Caries	***n=6,691***			***n=1,248***			***n=1,933***			***n=1,391***		
Key Independent Variables (ACEs)												
Financial Hardship	0.201	0.401	**<0.05**	0.274	0.446	**<0.05**	0.302	0.459	**<0.05**	0.273	0.445	**<0.05**
Parental Divorce	0.211	0.408	**<0.05**	0.266	0.442	**<0.05**	0.283	0.451	**<0.05**	0.278	0.448	**<0.05**
Parental Death	0.254	0.436	**<0.05**	0.308	0.462	**<0.05**	0.303	0.460	0.12	0.288	0.454	**<0.05**
Parental Incarceration	0.267	0.442	**<0.05**	0.351	0.478	**<0.05**	0.312	0.464	**<0.05**	0.326	0.469	**<0.05**
Domestic Violence	0.276	0.447	**<0.05**	0.309	0.462	**<0.05**	0.353	0.478	**<0.05**	0.321	0.467	**<0.05**
Neighborhood Violence	0.270	0.444	**<0.05**	0.313	0.464	**<0.05**	0.338	0.473	**<0.05**	0.350	0.477	**<0.05**
Mental Illness	0.235	0.424	**<0.05**	0.300	0.459	**<0.05**	0.343	0.475	**<0.05**	0.285	0.452	**<0.05**
Racial Discrimination	0.208	0.406	**<0.05**	0.278	0.449	**<0.05**	0.293	0.455	0.08	0.251	0.434	**<0.05**
Preliminary Mediating Variables												
Highest Parental Education												
*< High School Diploma**	0.223	0.416	**<0.05**	0.289	0.454	**<0.05**	0.324	0.468	**<0.05**	0.295	0.456	**<0.05**
High School Diploma	0.166	0.372	**<0.05**	0.231	0.422	**<0.05**	0.229	0.420	**<0.05**	0.220	0.414	**<0.05**
> High School Diploma	0.143	0.350	**<0.05**	0.209	0.407	**<0.05**	0.211	0.408	**<0.05**	0.203	0.402	**<0.05**
Family Structure												
*Two Birth/Adopt Parents**	0.140	0.347	**<0.05**	0.194	0.395	**<0.05**	0.251	0.434	0.07	0.196	0.397	**<0.05**
Two Stepparents	0.208	0.406	**<0.05**	0.234	0.424	**<0.05**	0.264	0.441	0.07	0.310	0.463	**<0.05**
Single Mother	0.221	0.415	**<0.05**	0.257	0.437	**<0.05**	0.281	0.450	0.07	0.261	0.439	**<0.05**
Other	0.217	0.412	**<0.05**	0.303	0.460	**<0.05**	0.289	0.454	0.07	0.245	0.431	**<0.05**
Number of Children in Household												
*One Child**	0.162	0.369	**<0.05**	0.214	0.410	**<0.05**	0.233	0.422	**<0.05**	0.214	0.410	0.34
Multiple Children	0.155	0.362	**<0.05**	0.251	0.434	**<0.05**	0.276	0.447	**<0.05**	0.224	0.417	0.34
Special Health Care Needs												
Special Health Needs	0.190	0.393	**<0.05**	0.252	0.434	0.07	0.275	0.447	0.18	0.254	0.435	**<0.05**
Health Insurance Status												
Health Insurance	0.156	0.363	**<0.05**	0.232	0.422	0.06	0.257	0.437	**<0.05**	0.219	0.414	0.46
Exogenous Variables												
Age												
*Ages 1-5 (Deciduous Dentition)**	0.125	0.330	**<0.05**	0.190	0.392	**<0.05**	0.198	0.399	**<0.05**	0.196	0.397	**<0.05**
Ages 6-12 (Transitional Dentition)	0.181	0.385	**<0.05**	0.243	0.429	**<0.05**	0.304	0.460	**<0.05**	0.247	0.431	**<0.05**
Ages 13-17 (Permanent Dentition)	0.145	0.352	**<0.05**	0.252	0.434	**<0.05**	0.240	0.427	**<0.05**	0.193	0.394	**<0.05**
Sex												
Female	0.152	0.360	**<0.05**	0.243	0.429	0.13	0.266	0.442	0.30	0.224	0.417	0.41
Annual Family Income												
*<100% Federal Poverty Level**	0.290	0.454	**<0.05**	0.325	0.469	**<0.05**	0.342	0.475	**<0.05**	0.322	0.468	**<0.05**
100-150% Federal Poverty Level	0.249	0.432	**<0.05**	0.247	0.432	**<0.05**	0.302	0.459	**<0.05**	0.321	0.468	**<0.05**
>150% Federal Poverty Level	0.141	0.348	**<0.05**	0.195	0.397	**<0.05**	0.209	0.406	**<0.05**	0.187	0.390	**<0.05**
Note: Data Utilized from 2011-2012 National Survey of Children's Health; *Reference Values												

Table 6. Unadjusted Regression with Preventive Dental Utilization (Stratified by Race/Ethnicity)												
	NHW (n=42,456)			NHB (n=5,332)			Hispanics (n=7,414)			All Other (n=6,328)		
	Prop.	S.D.	p-value	Prop.	S.D.	p-value	Prop.	S.D.	p-value	Prop.	S.D.	p-value
Dependent Variable												
Preventive Dental Utilization	***n=42,305***			***n=5,315***			***n=7,363***			***n=6,288***		
Key Independent Variables (ACEs)												
Financial Hardship	0.995	0.067	**<0.05**	0.997	0.057	0.95	0.991	0.094	**<0.05**	0.993	0.083	0.53
Parental Divorce	0.994	0.078	**<0.05**	0.998	0.042	0.33	0.994	0.078	0.69	0.994	0.079	0.98
Parental Death	0.996	0.062	0.90	0.997	0.054	0.93	1.000	0.000	0.18	0.987	0.112	0.21
Parental Incarceration	0.995	0.072	0.21	0.998	0.045	0.62	0.986	0.116	0.06	0.986	0.118	**<0.05**
Domestic Violence	0.991	0.096	**<0.05**	0.995	0.069	0.55	0.990	0.100	0.33	0.993	0.083	0.84
Neighborhood Violence	0.993	0.081	**<0.05**	0.993	0.082	0.07	0.993	0.082	0.98	0.995	0.067	0.55
Mental Illness	0.995	0.073	**<0.05**	0.998	0.048	0.74	0.992	0.088	0.79	0.994	0.077	0.88
Racial Discrimination	0.996	0.060	0.97	0.995	0.072	0.37	0.996	0.061	0.37	0.993	0.083	0.85
Preliminary Mediating Variables												
Highest Parental Education												
*< High School Diploma**	0.996	0.066	0.61	0.994	0.079	0.12	0.991	0.095	0.10	0.994	0.080	0.60
High School Diploma	0.996	0.060	0.61	0.998	0.050	0.12	0.993	0.083	0.10	0.995	0.070	0.60
> High School Diploma	0.997	0.058	0.61	0.998	0.048	0.12	0.996	0.065	0.10	0.993	0.084	0.60
Family Structure												
*Two Parents-Birth/Adopted**	0.997	0.055	**<0.05**	0.997	0.052	0.28	0.993	0.081	0.81	0.994	0.079	0.08
Two Parents-Stepparents	0.996	0.064	**<0.05**	1.000	0.000	0.28	0.994	0.080	0.81	0.996	0.063	0.08
Single Mother	0.994	0.080	**<0.05**	0.995	0.069	0.28	0.991	0.092	0.81	0.996	0.061	0.08
Other	0.996	0.063	**<0.05**	0.998	0.041	0.28	0.995	0.069	0.81	0.985	0.120	0.08
Number of Children in Household												
*One Child**	0.995	0.067	**<0.05**	0.996	0.064	0.27	0.992	0.087	0.58	0.993	0.083	0.62
Multiple Children	0.997	0.054	**<0.05**	0.998	0.049	0.27	0.994	0.080	0.58	0.994	0.077	0.62
Special Health Care Needs												
Special Health Needs	0.996	0.059	0.97	0.997	0.054	0.83	0.996	0.065	0.17	0.995	0.069	0.42
Health Insurance Status												
Health Insurance	0.997	0.057	**<0.05**	0.997	0.055	0.365	0.995	0.071	**<0.05**	0.994	0.076	**<0.05**
Exogenous Variables												
Age												
*Ages 1-5 (Deciduous Dentition)**	0.994	0.080	**<0.05**	0.996	0.065	0.62	0.992	0.088	0.87	0.988	0.111	**<0.05**
Ages 6-12 (Transitional Dentition)	0.997	0.052	**<0.05**	0.998	0.049	0.62	0.993	0.081	0.87	0.996	0.065	**<0.05**
Ages 13-17 (Permanent Dentition)	0.997	0.056	**<0.05**	0.996	0.059	0.62	0.994	0.080	0.87	0.995	0.070	**<0.05**
Sex												
Female	0.997	0.057	0.38	0.998	0.048	0.25	0.994	0.080	0.65	0.995	0.068	0.10
Annual Family Income												
*<100% Federal Poverty Level**	0.994	0.080	**<0.05**	0.995	0.073	0.29	0.991	0.094	0.08	0.996	0.066	0.09
100-150% Federal Poverty Level	0.995	0.068	**<0.05**	0.997	0.055	0.29	0.990	0.101	0.08	0.987	0.113	0.09
>150% Federal Poverty Level	0.997	0.057	**<0.05**	0.998	0.049	0.29	0.995	0.071	0.08	0.994	0.076	0.09
Note: Data Utilized from 2011-2012 National Survey of Children's Health; *Reference Values												

Table 7. Adjusted Logistic Regression with Dental Caries (Stratified by Race/Ethnicity)												
	NHW (n=42,456)			NHB (n=5,332)			Hispanic (n=7,414)			All Other (n=6,328)		
	O.R.	S.E.	p-value	O.R.	S.E.	p-value	O.R.	S.E.	p-value	O.R.	S.E.	p-value
Dependent Variable												
Dental Caries												
Key Independent Variables (ACEs)												
Financial Hardship	1.510	0.029	**<0.05**	1.476	0.072	**<0.05**	1.442	0.061	**<0.05**	1.406	0.069	**<0.05**
Parental Divorce	0.973	0.050	0.59	1.012	0.087	0.89	1.008	0.086	0.93	1.037	0.097	0.71
Parental Death	1.285	0.078	**<0.05**	1.170	0.131	0.23	1.042	0.148	0.78	1.219	0.156	0.20
Parental Incarceration	1.048	0.062	0.45	1.467	0.108	**<0.05**	0.987	0.112	0.91	1.135	0.116	0.28
Domestic Violence	1.188	0.059	**<0.05**	1.044	0.123	0.73	1.283	0.107	**<0.05**	1.116	0.116	0.35
Neighborhood Violence	1.428	0.052	**<0.05**	1.172	0.096	0.10	1.177	0.095	0.09	1.590	0.102	**<0.05**
Mental Illness	1.223	0.044	**<0.05**	1.033	0.119	0.79	1.394	0.098	**<0.05**	1.024	0.103	0.82
Racial Discrimination	1.004	0.111	0.97	1.293	0.104	**<0.05**	1.097	0.105	0.38	1.029	0.097	0.76
Preliminary Mediating Variables												
Highest Parental Education												
*< High School Diploma**	**1.000**	**1.000**	**-----**	**1.000**	**1.000**	**-----**	**1.000**	**1.000**	**-----**	**1.000**	**1.000**	**-----**
High School Diploma	0.840	0.048	**<0.05**	0.803	0.087	**<0.05**	0.730	0.072	**<0.05**	0.733	0.098	**<0.05**
> High School Diploma	0.776	0.048	**<0.05**	0.770	0.089	**<0.05**	0.692	0.070	**<0.05**	0.741	0.095	**<0.05**
Family Structure												
*Two Birth/Adopt Parents**	**1.000**	**1.000**	**-----**	**1.000**	**1.000**	**-----**	**1.000**	**1.000**	**-----**	**1.000**	**1.000**	**-----**
Two Stepparents	1.195	0.062	**<0.05**	1.004	0.130	0.97	0.914	0.112	0.42	1.344	0.125	**<0.05**
Single Mother	1.150	0.054	**<0.05**	1.096	0.086	0.29	0.945	0.080	0.48	0.958	0.097	0.66
Other	1.170	0.067	**<0.05**	1.353	0.119	**<0.05**	1.004	0.127	0.97	0.842	0.134	0.20
Number of Children in Household												
*One Child**	**1.000**	**1.000**	**-----**	**1.000**	**1.000**	**-----**	**1.000**	**1.000**	**-----**	**1.000**	**1.000**	**-----**
Multiple Children	0.937	0.029	**<0.05**	1.184	0.069	**<0.05**	1.110	0.060	0.08	0.942	0.065	0.36
Special Health Care Needs												
Special Health Needs	1.138	0.031	**<0.05**	1.012	0.076	0.88	1.027	0.070	0.7	1.093	0.075	0.23
Health Insurance Status												
Health Insurance	0.705	0.078	**<0.05**	0.788	0.197	0.23	0.884	0.108	0.26	0.985	0.172	0.93
Exogenous Variables												
Age												
*Ages 1-5 (Deciduous Dentition)**	**1.000**	**1.000**	**-----**	**1.000**	**1.000**	**-----**	**1.000**	**1.000**	**-----**	**1.000**	**1.000**	**-----**
Ages 6-12 (Transitional Dentition)	1.496	0.041	**<0.05**	1.300	0.091	**<0.05**	1.784	0.072	**<0.05**	1.302	0.081	**<0.05**
Ages 13-17 (Permanent Dentition)	1.076	0.044	0.10	1.318	0.100	**<0.05**	1.269	0.083	**<0.05**	0.886	0.095	0.20
Sex												
Female	0.931	0.027	**<0.05**	1.091	0.066	0.19	1.071	0.054	0.21	1.075	0.062	0.25
Annual Family Income												
*<100% Federal Poverty Level**	**1.000**	**1.000**	**-----**	**1.000**	**1.000**	**-----**	**1.000**	**1.000**	**-----**	**1.000**	**1.000**	**-----**
100-150% Federal Poverty Level	0.884	0.063	**<0.05**	0.699	0.110	**<0.05**	0.887	0.083	0.15	1.001	0.114	0.99
>150% Federal Poverty Level	0.590	0.049	**<0.05**	0.627	0.084	**<0.05**	0.641	0.070	**<0.05**	0.630	0.091	**<0.05**
Note: Data Utilized from 2011-2012 National Survey of Children's Health; *Reference Values												

Table 8. Adjusted Logistic Regression with Preventive Dental Utilization (Stratified by Race/Ethnicity)												
	NHW (n=42,456)			NHB (n=4,861)			Hispanics (n=7,163)			All Other (n=6,328)		
	O.R.	S.E.	p-value	O.R.	S.E.	p-value	O.R.	S.E.	p-value	O.R.	S.E.	p-value
Dependent Variable												
Preventive Dental Utilization												
Key Independent Variables (ACEs)												
Financial Hardship	0.742	0.179	0.10	1.251	0.525	0.67	0.496	0.356	**<0.05**	0.825	0.348	0.58
Parental Divorce	0.448	0.288	**<0.05**	2.100	0.798	0.35	1.551	0.459	0.34	1.004	0.513	0.99
Parental Death	1.132	0.523	0.81	1.111	1.070	0.92	0.000	N/A	N/A	0.497	0.653	0.29
Parental Incarceration	1.439	0.368	0.32	1.952	1.070	0.53	0.396	0.463	**<0.05**	0.317	0.503	**<0.05**
Domestic Violence	0.499	0.295	**<0.05**	0.667	0.821	0.62	0.683	0.525	0.47	1.169	0.662	0.81
Neighborhood Violence	0.740	0.293	0.31	2.697	0.603	0.10	1.293	0.536	0.63	1.738	0.697	0.43
Mental Illness	0.955	0.257	0.86	1.756	1.076	0.60	0.812	0.523	0.69	1.178	0.588	0.78
Racial Discrimination	1.462	0.726	0.60	0.486	0.670	0.28	1.793	0.739	0.43	0.664	0.506	0.42
Preliminary Mediating Variables												
Highest Parental Education												
*< High School Diploma**	**1.000**	**1.000**	-----	**1.000**	**1.000**	-----	**1.000**	**1.000**	-----	**1.000**	**1.000**	-----
High School Diploma	1.030	0.296	0.92	2.524	0.593	0.12	1.051	0.365	0.89	1.131	0.562	0.83
> High School Diploma	1.064	0.291	0.83	2.560	0.610	0.12	1.511	0.391	0.29	0.699	0.524	0.50
Family Structure												
*Two Parents-Birth/Adopted**	**1.000**	**1.000**	-----	**1.000**	**1.000**	-----	**1.000**	**1.000**	-----	**1.000**	**1.000**	-----
Two Parents-Stepparents	1.564	0.382	0.24	0.000	N/A	N/A	0.836	0.598	0.76	1.714	0.815	0.51
Single Mother	1.134	0.310	0.68	0.657	0.606	0.49	0.715	0.386	0.39	2.106	0.602	0.22
Other	1.898	0.424	0.13	2.217	1.160	0.49	1.379	0.777	0.68	0.484	0.544	0.18
Number of Children in Household												
*One Child**	**1.000**	**1.000**	-----	**1.000**	**1.000**	-----	**1.000**	**1.000**	-----	**1.000**	**1.000**	-----
Multiple Children	1.528	0.171	**<0.05**	1.636	0.509	0.33	1.246	0.300	0.46	1.230	0.332	0.53
Special Health Care Needs												
Special Health Needs	1.074	0.200	0.72	1.324	0.587	0.63	1.567	0.451	0.32	1.398	0.439	0.45
Health Insurance Status												
Health Insurance	4.953	0.265	**<0.05**	2.389	1.050	0.410	6.424	0.320	**<0.05**	3.209	0.550	**<0.05**
Exogenous Variables												
Age												
*Ages 1-5 (Deciduous Dentition)**	**1.000**	**1.000**	-----	**1.000**	**1.000**	-----	**1.000**	**1.000**	-----	**1.000**	**1.000**	-----
Ages 6-12 (Transitional Dentition)	2.578	0.204	**<0.05**	1.756	0.626	0.37	1.221	0.348	0.57	2.904	0.378	**<0.05**
Ages 13-17 (Permanent Dentition)	2.575	0.213	**<0.05**	1.449	0.662	0.58	1.285	0.403	0.53	2.724	0.440	**<0.05**
Sex												
Female	1.161	0.165	0.90	1.820	0.512	0.24	1.155	0.286	0.62	1.655	0.331	0.13
Annual Family Income												
*<100% Federal Poverty Level**	**1.000**	**1.000**	-----	**1.000**	**1.000**	-----	**1.000**	**1.000**	-----	**1.000**	**1.000**	-----
100-150% Federal Poverty Level	1.351	0.379	0.43	1.690	0.812	0.52	0.816	0.389	0.60	0.330	0.623	0.08
>150% Federal Poverty Level	1.274	0.279	0.39	1.902	0.617	0.30	1.077	0.364	0.84	0.647	0.574	0.45
Note: Data Utilized from 2011-2012 National Survey of Children's Health; *Reference Value												

Table 9. Unadjusted Path Analysis (ACEs ---> Family Structure)									
Mediating Variable	**Family Structure**	**Two Step-Parents**			**Single Mother**			**Other**	
		R.R.R.	**S.E.**	**p-value**	**R.R.R.**	**S.E.**	**p-value**	**R.R.R.**	**S.E.**	**p-value**
Key Independent Variables (ACEs)	*Parental Divorce*	80.391	9.283	**<0.05**	51.998	5.662	**<0.05**	64.971	8.469	**<0.05**
	Parental Death	14.468	3.051	**<0.05**	17.573	3.281	**<0.05**	33.660	6.348	**<0.05**
	Parental Incarceration	2.625	0.501	**<0.05**	1.944	0.325	**<0.05**	3.285	0.606	**<0.05**
	Domestic Violence	2.538	0.455	**<0.05**	2.841	0.463	**<0.05**	3.258	0.568	**<0.05**
	Neighborhood Violence	1.392	0.199	**<0.05**	1.430	0.163	**<0.05**	3.083	0.207	**<0.05**
	Mental Illness	1.235	0.159	0.10	1.299	0.141	**<0.05**	1.405	0.210	**<0.05**
	Racial Discrimination	0.887	0.165	0.52	0.893	0.133	0.45	1.563	0.210	0.54
Exogenous Variables	**Age**									
	*Ages 1-5 (Deciduous Dentition)**									
	Ages 6-12 (Transitional Dentition)	2.525	0.321	**<0.05**	1.057	0.095	0.54	1.322	0.177	**<0.05**
	Ages 13-17 (Permanent Dentition)	2.875	0.367	**<0.05**	1.063	0.099	0.51	1.193	0.174	0.22
	Sex									
	Female	0.831	0.070	**<0.05**	1.007	0.067	0.92	0.821	0.080	**<0.05**
	Annual Family Income									
	*<100% Federal Poverty Level**									
	100-150% Federal Poverty Level	0.708	0.111	**<0.05**	0.461	0.054	**<0.05**	0.608	0.098	**<0.05**
	>150% Federal Poverty Level	0.417	0.050	**<0.05**	0.147	0.013	**<0.05**	0.391	0.052	**<0.05**
	Race/Ethnicity									
	*Non-Hispanic Whites**									
	Non-Hispanic Blacks	3.501	0.470	**<0.05**	8.168	0.772	**<0.05**	5.398	0.689	**<0.05**
	Hispanic	1.331	0.191	**<0.05**	1.381	0.145	**<0.05**	1.060	0.189	0.74
	Other	1.467	0.183	**<0.05**	1.854	0.215	**<0.05**	1.561	0.251	**<0.05**

Note: (n=61,530); *Indicates reference category; Two Biological Parent household served as the reference group for family structure; R.R.R. indicates Relative Risk Ratio

Table 9.1. Unadjusted Path Analysis (Family Structure ---> Dental Caries)				
Dependent Variable	**Dental Caries**	**O.R.**	**S.E.**	**p-value**
Mediating Variable	**Family Structure**			
	*Two Biological/Adopt Parents**			
	Two Step-Parents	1.279	0.106	**<0.05**
	Single Mother	1.127	0.0736	0.07
	Other	1.177	0.124	0.12
Exogenous Variables	**Age**			
	*Ages 1-5 (Deciduous Dentition)**			
	Ages 6-12 (Transitional Dentition)	1.732	0.119	**<0.05**
	Ages 13-17 (Permanent Dentition)	1.311	0.099	**<0.05**
	Sex			
	Female	1.056	0.051	0.26
	Annual Family Income			
	*<100% Federal Poverty Level**			
	100-150% Federal Poverty Level	0.977	0.087	0.80
	>150% Federal Poverty Level	0.521	0.035	**<0.05**
	Race/Ethnicity			
	*Non-Hispanic Whites**			
	Non-Hispanic Blacks	1.482	0.1068	**<0.05**
	Hispanic	1.624	0.116	**<0.05**
	Other	1.3	0.0986	**<0.05**
Note: (n=61,530); O.R. indicates Odds Ratio; *Indicates reference category				

Figure 3. Unadjusted Path Model (Family Structure)

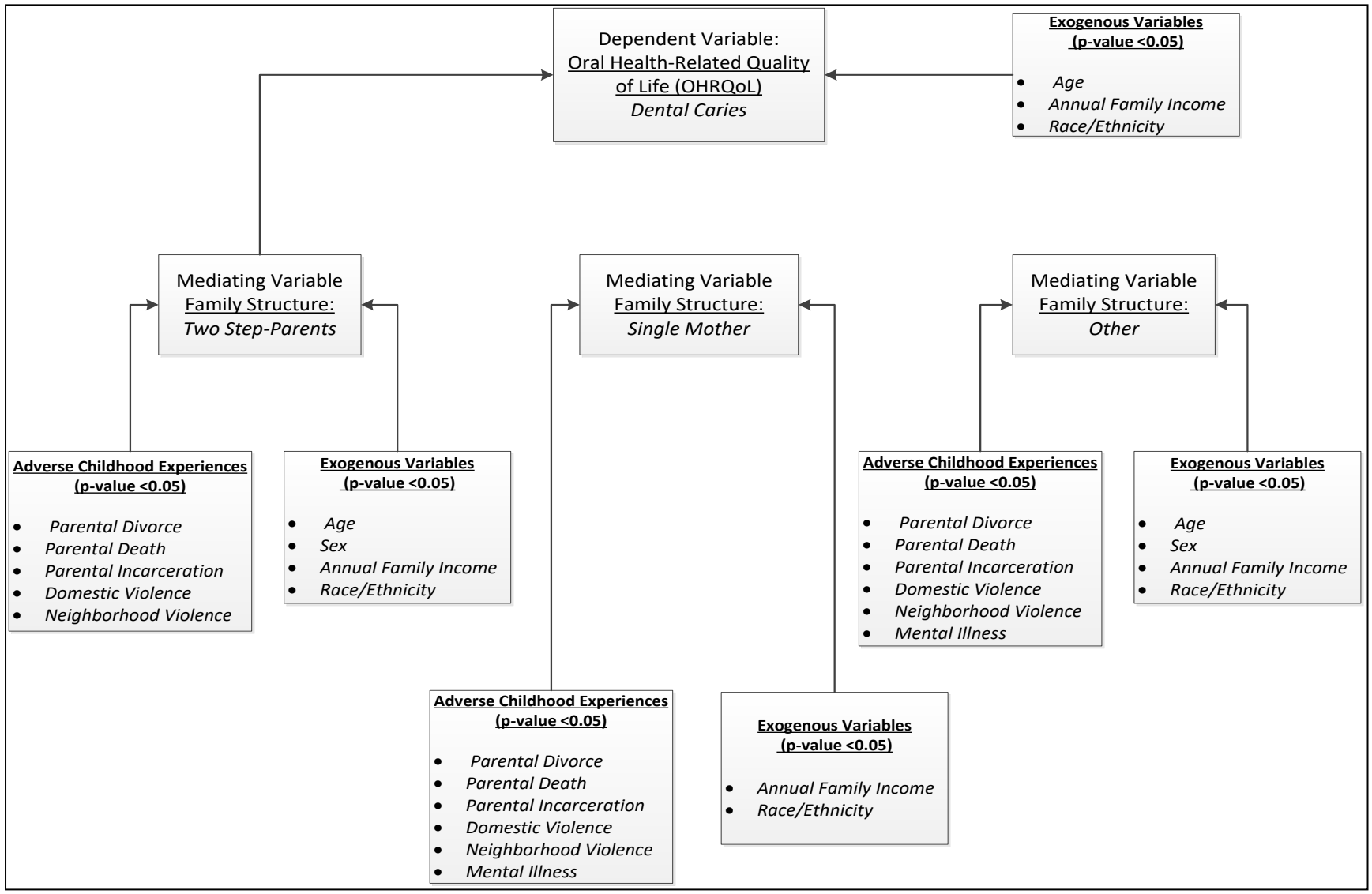


Table 10. Unadjusted Path Analysis (ACEs ---> Highest Parental Education)							
Mediating Variable	**Highest Parental Education**	**HS Graduate**			**>HS Graduate**		
		R.R.R.	**S.E.**	**p-value**	**R.R.R.**	**S.E.**	**p-value**
Key Independent Variables (ACEs)	*Parental Divorce*	1.187	0.946	**<0.05**	1.194	0.096	**<0.05**
	Parental Death	0.890	0.122	0.40	0.813	0.113	0.14
	Parental Incarceration	1.105	0.136	0.42	0.978	0.117	0.85
	Domestic Violence	0.903	0.116	0.43	0.960	0.124	0.75
	Neighborhood Violence	0.932	0.103	0.53	0.847	0.092	0.12
	Mental Illness	0.936	0.109	0.57	1.026	0.121	0.59
	Racial Discrimination	1.151	0.182	0.37	1.549	0.240	**<0.05**
Exogenous Variables	**Age**						
	*Ages 1-5 (Deciduous Dentition)**						
	Ages 6-12 (Transitional Dentition)	0.793	0.068	**<0.05**	0.659	0.054	**<0.05**
	Ages 13-17 (Permanent Dentition)	0.691	0.063	**<0.05**	0.492	0.044	**<0.05**
	Sex						
	Female	0.952	0.059	0.43	0.972	0.059	0.64
	Annual Family Income						
	*<100% Federal Poverty Level**						
	100-150% Federal Poverty Level	1.391	0.139	**<0.05**	1.739	0.179	**<0.05**
	>150% Federal Poverty Level	3.230	0.251	**<0.05**	6.559	0.507	**<0.05**
	Race/Ethnicity						
	*Non-Hispanic Whites**						
	Non-Hispanic Blacks	0.625	0.055	**<0.05**	0.504	0.045	**<0.05**
	Hispanic	0.131	0.011	**<0.05**	0.114	0.009	**<0.05**
	Other	0.556	0.062	**<0.05**	0.682	0.073	**<0.05**

Note: (n=61,530); *Indicates reference category; <HS Graduate served as the reference group for parental education; RRR indicates Relative Risk Ratio

Table 10.1. Unadjusted Path Analysis (Highest Parental Education ---> Dental Caries)				
Dependent Variable	**Dental Caries**	**O.R.**	**S.E.**	**p-value**
Mediating Variable	**Highest Parental Education**			
	*<HS Graduate**			
	HS Graduate	0.725	0.053	**<0.05**
	>HS Graduate	0.695	0.051	**<0.05**
Exogenous Variables	**Age**			
	*Ages 1-5 (Deciduous Dentition)**			
	Ages 6-12 (Transitional Dentition)	1.750	0.121	**<0.05**
	Ages 13-17 (Permanent Dentition)	1.324	0.099	**<0.05**
	Sex			
	Female	1.051	0.051	0.30
	Annual Family Income			
	*<100% Federal Poverty Level**			
	100-150% Federal Poverty Level	0.997	0.090	0.97
	>150% Federal Poverty Level	0.549	0.037	**<0.05**
	Race/Ethnicity			
	*Non-Hispanic Whites**			
	Non-Hispanic Blacks	1.501	0.106	**<0.05**
	Hispanic	1.417	0.103	**<0.05**
	Other	1.288	0.096	**<0.05**
Note: (n=61,530); *Indicates reference category; O.R. indicates Odds Ratio				

Figure 4. Unadjusted Path Model (Highest Parental Education)

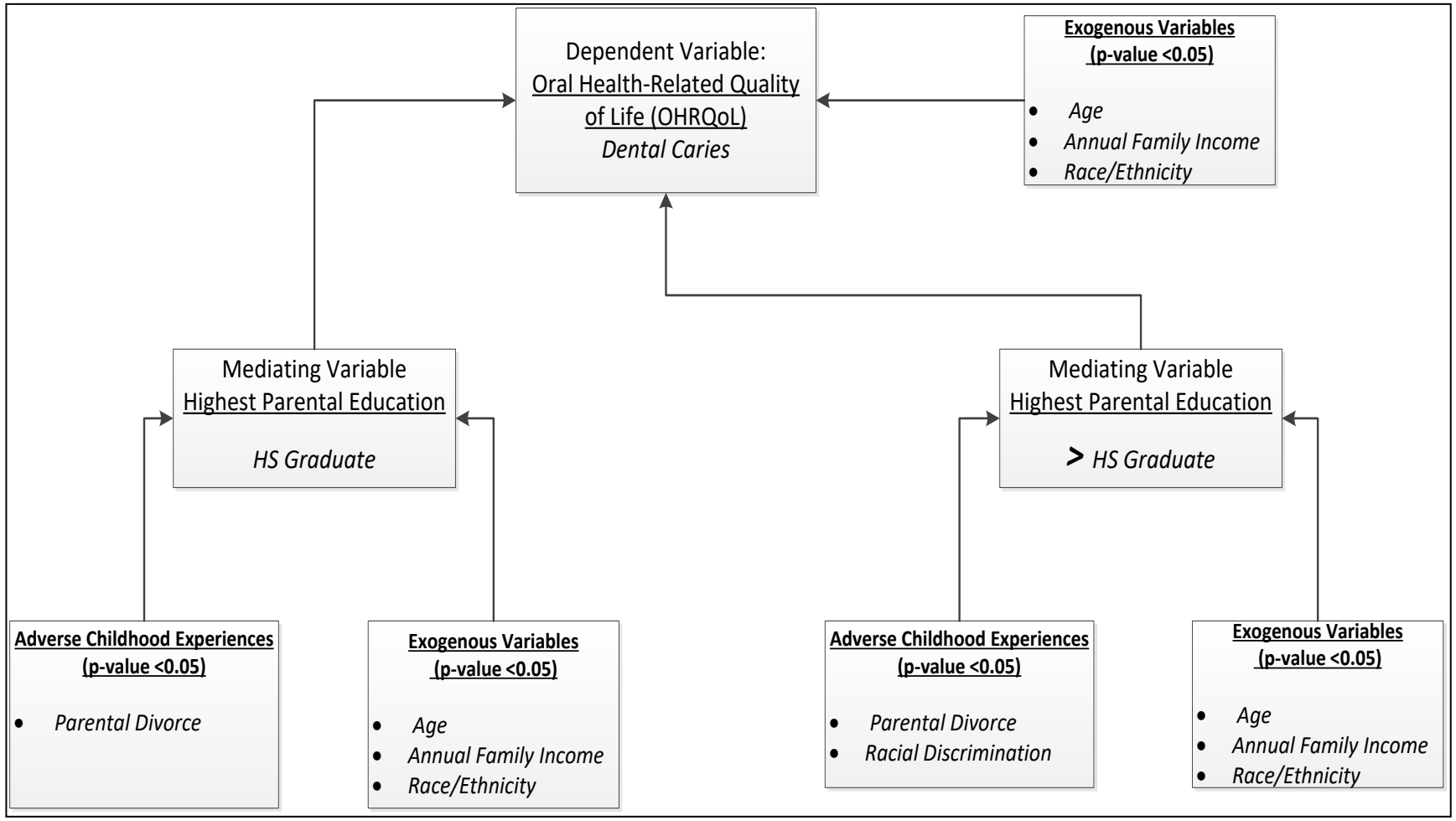


Table 10.2. Unadjusted Path Analysis (ACEs ---> Highest Parental Education Binary)				
Mediating Variable	**Highest Parental Education**	**>HS Graduate**		
		R.R.R.	**S.E.**	**p-value**
Key Independent Variables	**Adverse Childhood Experiences**			
	Parental Divorce	1.022	0.051	0.66
	Parental Death	0.919	0.091	0.40
	Parental Incarceration	0.889	0.074	0.16
	Domestic Violence	1.105	0.096	0.25
	Neighborhood Violence	0.921	0.068	0.26
	Mental Illness	1.064	0.072	0.36
	Racial Discrimination	1.290	0.124	**<0.05**
Exogenous Variables	**Age**			
	*Ages 1-5 (Deciduous Dentition)**			
	Ages 6-12 (Transitional Dentition)	0.804	0.040	**<0.05**
	Ages 13-17 (Permanent Dentition)	0.676	0.036	**<0.05**
	Sex			
	Female	1.022	0.037	0.56
	Annual Family Income			
	*<100% Federal Poverty Level**			
	100-150% Federal Poverty Level	1.189	0.094	**<0.05**
	>150% Federal Poverty Level	2.176	0.124	**<0.05**
	Race/Ethnicity			
	*Non-Hispanic Whites**			
	Non-Hispanic Blacks	0.779	0.045	**<0.05**
	Hispanic	0.484	0.029	**<0.05**
	Other	1.109	0.071	0.11

Note: (n=63,425); *Indicates reference category; ≤HS Graduate served as the reference group for parental education; RRR indicates Relative Risk Ratio

Table 10.3. Unadjusted Path Analysis (Highest Parental Education Binary ---> Dental Caries)				
Dependent Variable	**Dental Caries**	**O.R.**	**S.E.**	**p-value**
Mediating Variable	**Highest Parental Education**			
	*≤HS Graduate**			
	>HS Graduate	0.902	0.433	**<0.05**
Exogenous Variables	**Age**			
	*Ages 1-5 (Deciduous Dentition)**			
	Ages 6-12 (Transitional Dentition)	1.746	0.118	**<0.05**
	Ages 13-17 (Permanent Dentition)	1.346	0.098	**<0.05**
	Sex			
	Female	1.046	0.049	0.34
	Annual Family Income			
	*<100% Federal Poverty Level**			
	100-150% Federal Poverty Level	0.928	0.080	0.39
	>150% Federal Poverty Level	0.497	0.032	**<0.05**
	Race/Ethnicity			
	*Non-Hispanic Whites**			
	Non-Hispanic Blacks	1.477	0.101	**<0.05**
	Hispanic	1.582	0.109	**<0.05**
	Other	1.333	0.100	**<0.05**
Note: (n=63,425); *Indicates reference category; O.R. indicates Odds Ratio				

Figure 4.1. Unadjusted Path Model (Highest Parental Education Binary)

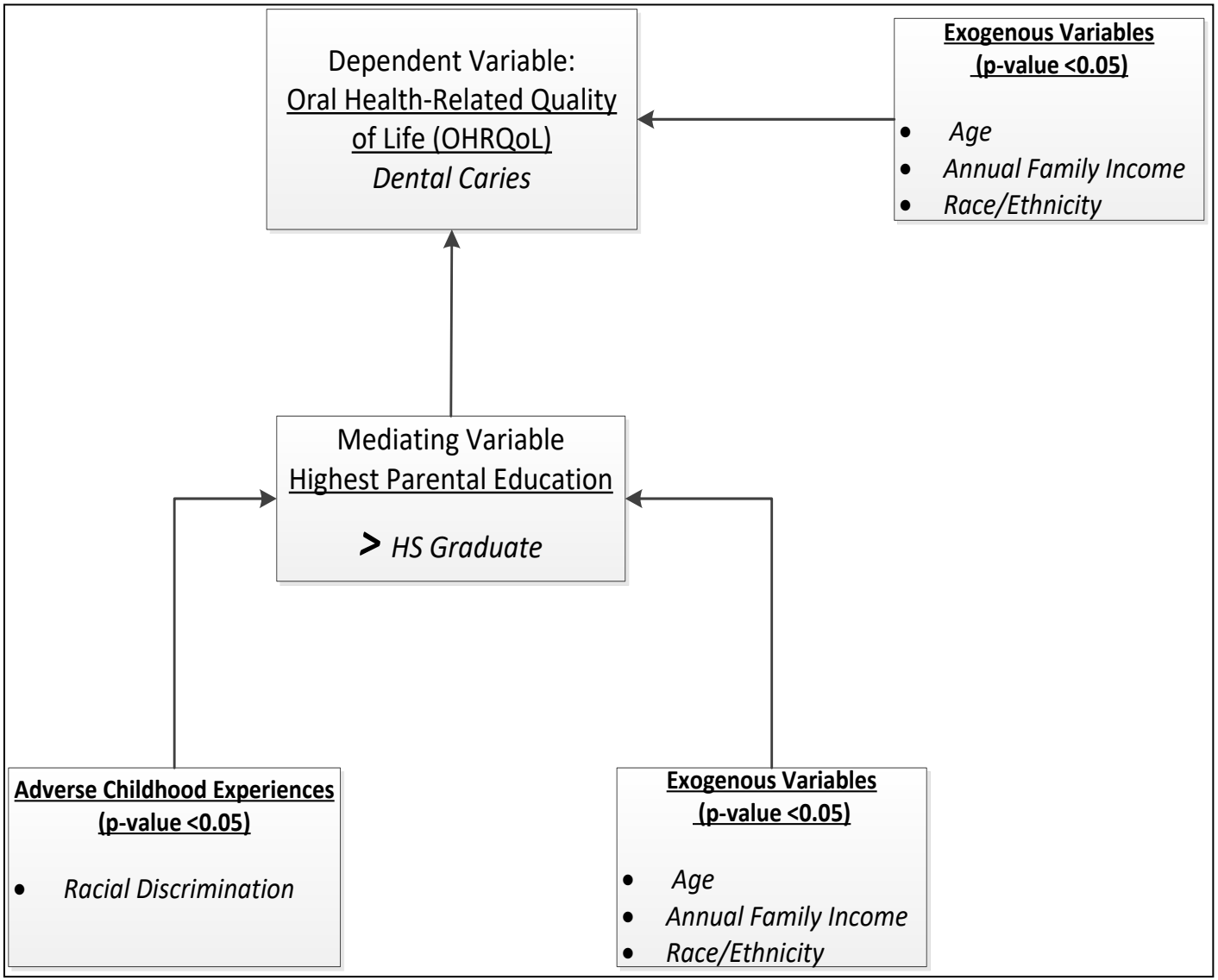


Table 11. Unadjusted Path Analysis (ACEs ---> Health Insurance)				
Mediating Variable	**Health Insurance**	**O.R.**	**S.E.**	**p-value**
Key Independent Variables (ACEs)	*Parental Divorce*	0.904	0.134	0.50
	Parental Death	0.675	0.160	0.10
	Parental Incarceration	0.986	0.248	0.96
	Domestic Violence	0.886	0.216	0.62
	Neighborhood Violence	0.808	0.171	0.31
	Mental Illness	1.149	0.230	0.49
	Racial Discrimination	0.939	0.265	0.82
Exogenous Variables	**Age**			
	*Ages 1-5 (Deciduous Dentition)**			
	Ages 6-12 (Transitional Dentition)	0.741	0.130	0.09
	Ages 13-17 (Permanent Dentition)	0.705	0.132	0.06
	Sex			
	Female	1.100	0.124	0.40
	Annual Family Income			
	*<100% Federal Poverty Level**			
	100-150% Federal Poverty Level	0.707	0.139	0.08
	>150% Federal Poverty Level	1.517	0.243	**<0.05**
	Race/Ethnicity			
	*Non-Hispanic Whites**			
	Non-Hispanic Blacks	0.893	0.188	0.59
	Hispanic	0.422	0.057	**<0.05**
	Other	1.015	0.166	0.93

Note: (n=61,530); *Indicates reference category; O.R. indicates Odds Ratio

Table 11.1. Unadjusted Path Analysis (Health Insurance ---> Dental Caries)				
Dependent Variable	**Dental Caries**	**O.R.**	**S.E.**	**p-value**
Independent Variable	**Health Insurance**	0.752	0.103	**<0.05**
Exogenous Variables	**Age**			
	*Ages 1-5 (Deciduous Dentition)**			
	Ages 6-12 (Transitional Dentition)	1.765	0.121	**<0.05**
	Ages 13-17 (Permanent Dentition)	1.350	0.101	**<0.05**
	Sex			
	Female	1.055	0.051	0.27
	Annual Family Income			
	*<100% Federal Poverty Level**			
	100-150% Federal Poverty Level	0.959	0.085	0.64
	>150% Federal Poverty Level	0.504	0.033	**<0.05**
	Race/Ethnicity			
	*Non-Hispanic Whites**			
	Non-Hispanic Blacks	1.528	0.106	**<0.05**
	Hispanic	1.595	0.114	**<0.05**
	Other	1.305	0.098	**<0.05**
Note: (n=61,530); *Indicates reference category; O.R. indicates Odds Ratio				

Figure 5. Unadjusted Path Model (Health Insurance)

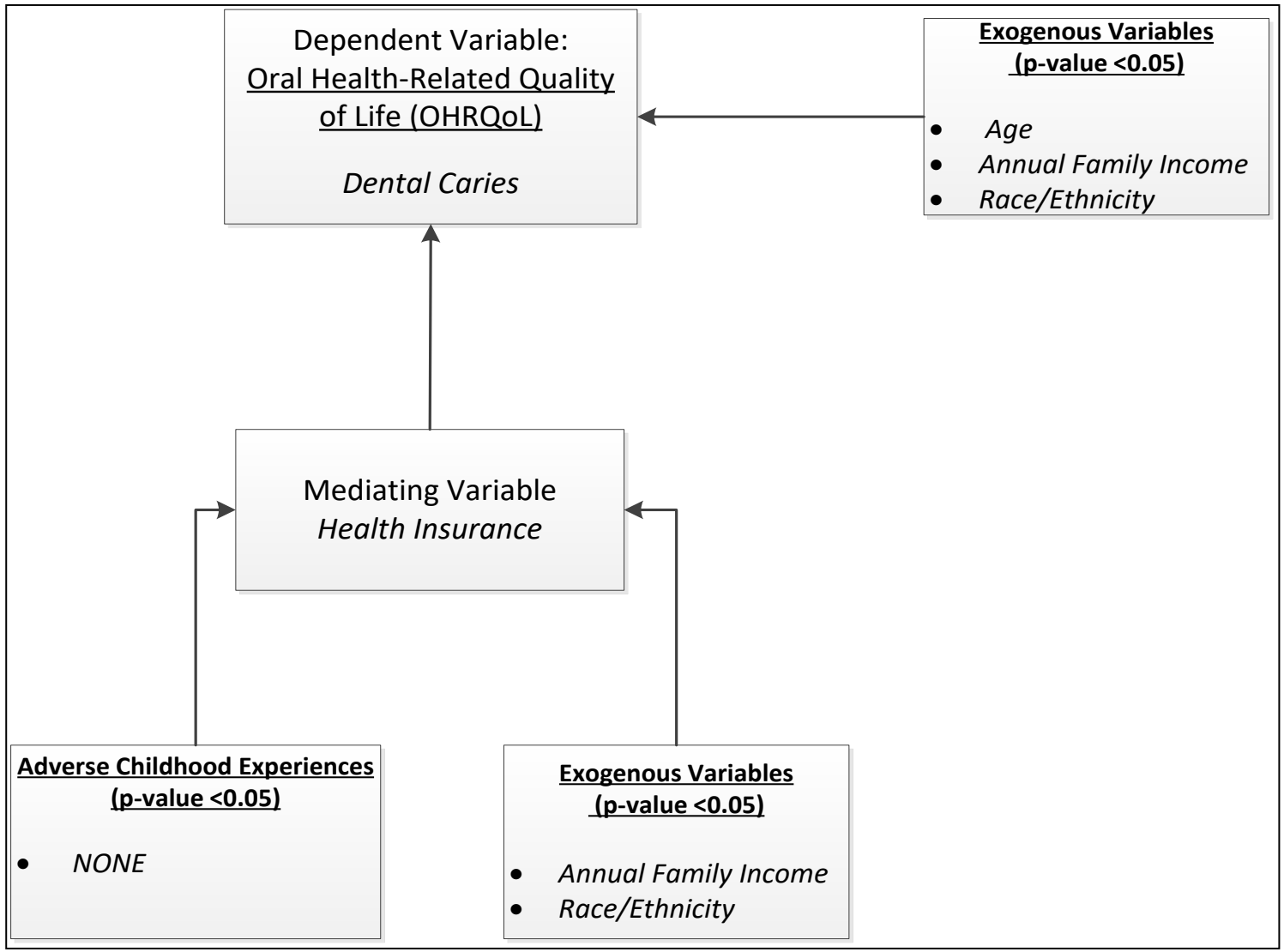


Table 12. Unadjusted Path Analysis (ACEs ---> Special Health Care Needs)				
Mediating Variable	**Special Health Care Needs**	**O.R.**	**S.E.**	**p-value**
Key Independent Variables (ACEs)	*Parental Divorce*	1.171	0.065	**<0.05**
	Parental Death	0.950	0.101	0.63
	Parental Incarceration	1.289	0.113	**<0.05**
	Domestic Violence	1.260	0.106	**<0.05**
	Neighborhood Violence	1.385	0.104	**<0.05**
	Mental Illness	1.866	0.134	**<0.05**
	Racial Discrimination	1.307	0.132	**<0.05**
Exogenous Variables	**Age**			
	*Ages 1-5 (Deciduous Dentition)**			
	Ages 6-12 (Transitional Dentition)	1.632	0.107	**<0.05**
	Ages 13-17 (Permanent Dentition)	1.774	0.123	**<0.05**
	Sex			
	Female	0.712	0.031	**<0.05**
	Annual Family Income			
	*<100% Federal Poverty Level**			
	100-150% Federal Poverty Level	0.875	0.077	0.13
	>150% Federal Poverty Level	0.795	0.053	**<0.05**
	Race/Ethnicity			
	*Non-Hispanic Whites**			
	Non-Hispanic Blacks	1.028	0.070	0.69
	Hispanic	0.654	0.053	**<0.05**
	Other	0.886	0.064	0.09
Note: (n=61,530); *Indicates reference category; O.R. indicates Odds Ratio				

Table 12.1. Unadjusted Path Analysis (Special Health Care Needs ---> Dental Caries)				
Dependent Variable	**Dental Caries**	**O.R.**	**S.E.**	**p-value**
Independent Variable	**Special Health Care Needs**	1.121	0.062	**<0.05**
Exogenous Variables	**Age**			
	*Ages 1-5 (Deciduous Dentition)**			
	Ages 6-12 (Transitional Dentition)	1.756	0.121	**<0.05**
	Ages 13-17 (Permanent Dentition)	1.340	0.100	**<0.05**
	Sex			
	Female	1.061	0.051	0.22
	Annual Family Income			
	*<100% Federal Poverty Level**			
	100-150% Federal Poverty Level	0.967	0.086	0.71
	>150% Federal Poverty Level	0.505	0.033	**<0.05**
	Race/Ethnicity			
	*Non-Hispanic Whites**			
	Non-Hispanic Blacks	1.528	0.107	**<0.05**
	Hispanic	1.629	0.116	**<0.05**
	Other	1.307	0.099	**<0.05**
Note: (n=61,530); *Indicates reference category; O.R. indicates Odds Ratio				

Figure 6. Unadjusted Path Model (Special Health Care Needs)

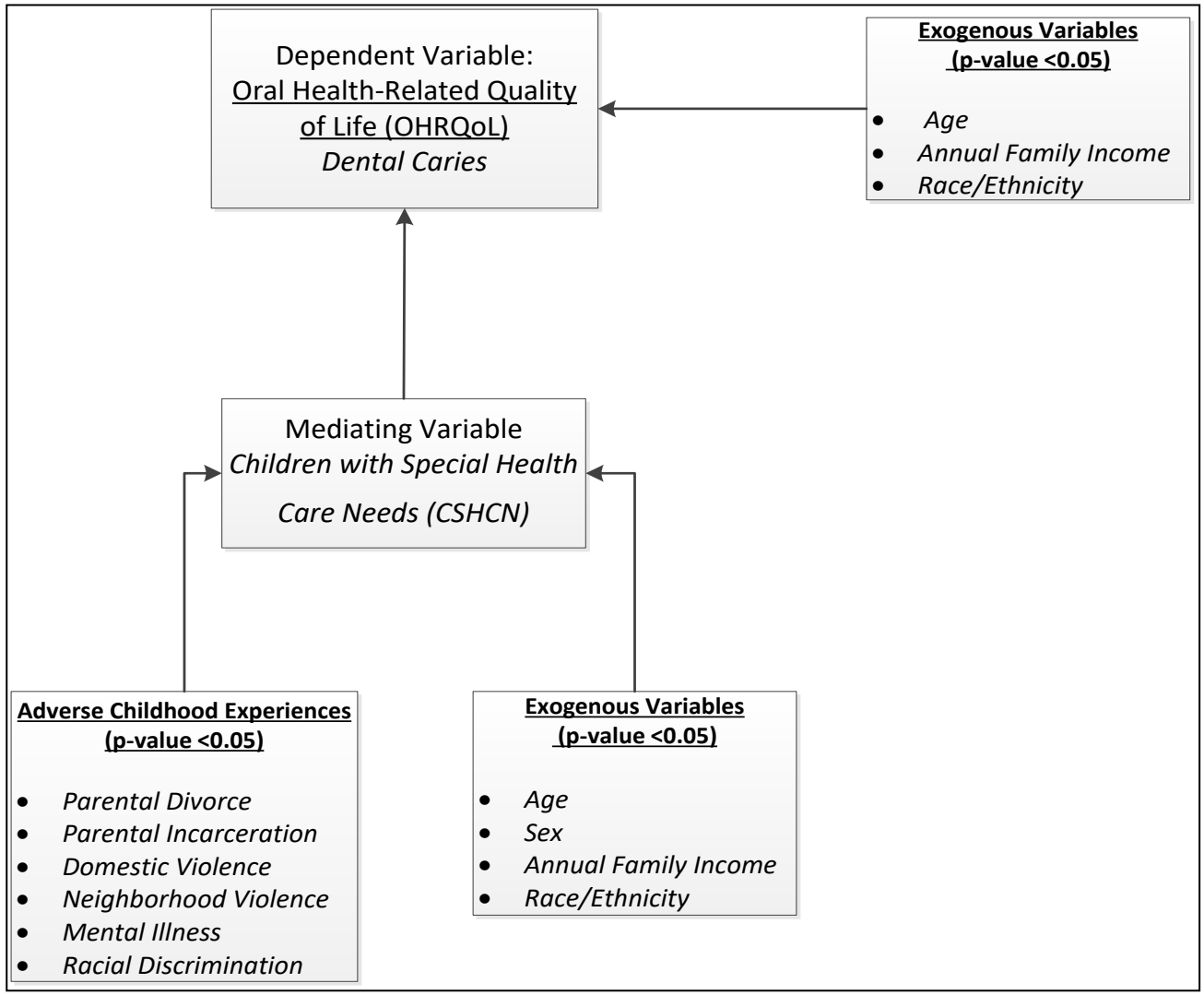


Table 13. Unadjusted Path Analysis (ACEs ---> Number of Children in Household)				
Mediating Variable	**Multiple Children**	**O.R.**	**S.E.**	**p-value**
Key Independent Variables (ACEs)	*Parental Divorce*	0.773	0.041	**<0.05**
	Parental Death	0.612	0.064	**<0.05**
	Parental Incarceration	0.977	0.094	0.81
	Domestic Violence	1.012	0.104	0.91
	Neighborhood Violence	0.798	0.062	**<0.05**
	Mental Illness	1.000	0.065	0.99
	Racial Discrimination	0.865	0.085	0.14
Exogenous Variables	**Age**			
	*Ages 1-5 (Deciduous Dentition)**			
	Ages 6-12 (Transitional Dentition)	1.433	0.078	**<0.05**
	Ages 13-17 (Permanent Dentition)	0.755	0.042	**<0.05**
	Sex			
	Female	0.949	0.037	0.18
	Annual Family Income			
	*<100% Federal Poverty Level**			
	100-150% Federal Poverty Level	0.793	0.069	**<0.05**
	>150% Federal Poverty Level	0.599	0.040	**<0.05**
	Race/Ethnicity			
	*Non-Hispanic Whites**			
	Non-Hispanic Blacks	0.671	0.041	**<0.05**
	Hispanic	0.973	0.066	0.68
	Other	0.710	0.047	**<0.05**

Note: (n=61,530); *Indicates reference category; O.R. indicates Odds Ratio; Single child served as refernce category for number of children in household.

Table 13.1. Unadjusted Path Analysis (Number of Children in Household ---> Dental Caries)				
Dependent Variable	**Dental Caries**	**O.R.**	**S.E.**	**p-value**
Independent Variable	**Multiple Children**	0.998	0.052	0.96
Exogenous Variables	**Age**			
	*Ages 1-5 (Deciduous Dentition)**			
	Ages 6-12 (Transitional Dentition)	1.773	0.122	**<0.05**
	Ages 13-17 (Permanent Dentition)	1.357	0.102	**<0.05**
	Sex			
	Female	1.053	0.051	0.28
	Annual Family Income			
	*<100% Federal Poverty Level**			
	100-150% Federal Poverty Level	0.963	0.086	0.68
	>150% Federal Poverty Level	0.501	0.033	**<0.05**
	Race/Ethnicity			
	*Non-Hispanic Whites**			
	Non-Hispanic Blacks	1.529	0.107	**<0.05**
	Hispanic	1.612	0.115	**<0.05**
	Other	1.304	0.098	**<0.05**

Note: (n=61,530); *Indicates reference category; O.R. indicates Odds Ratio; Single child served as refernce category for number of children in household.

Figure 7. Unadjusted Path Model (Number of Children in Household)

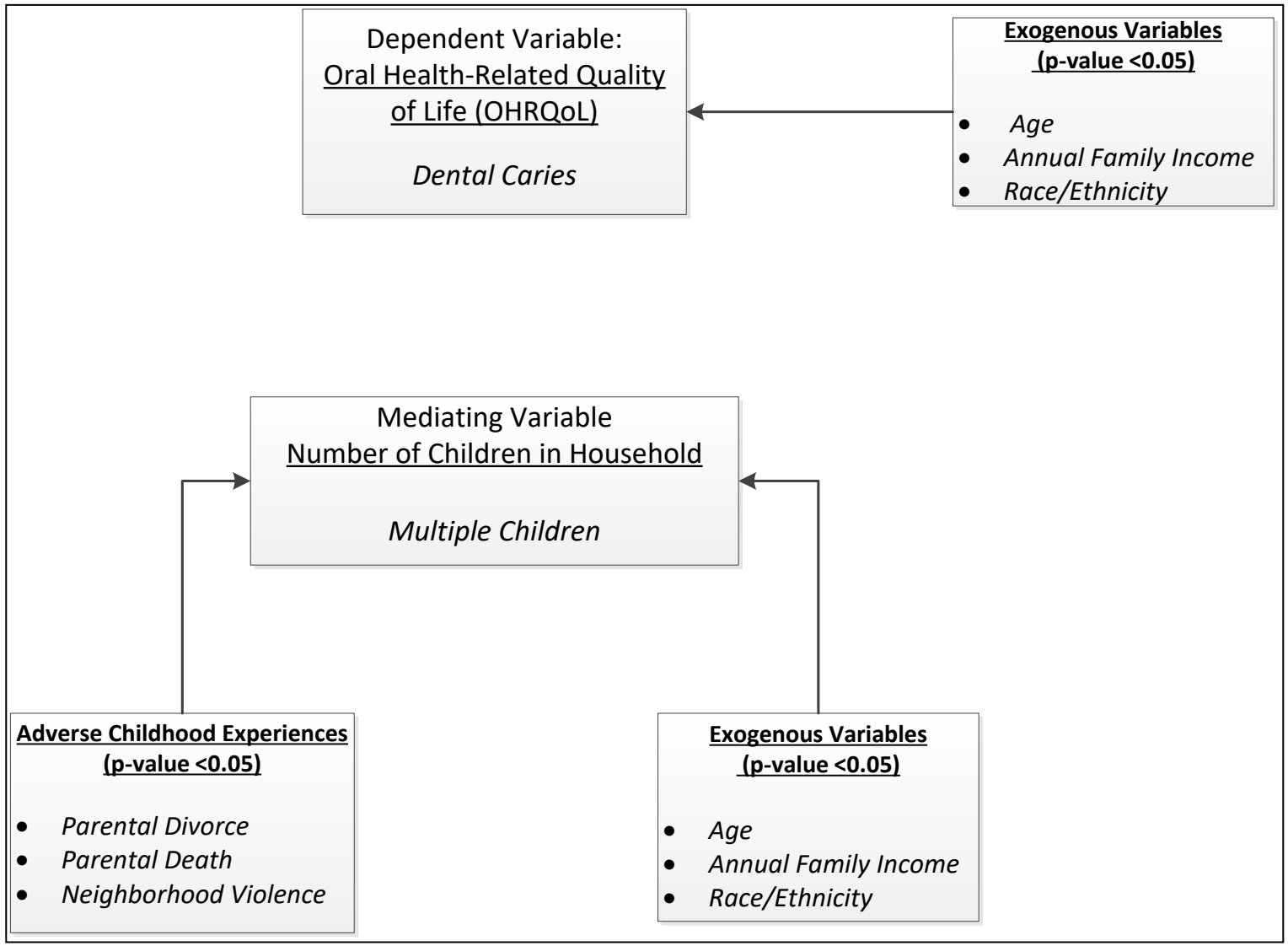


Table 14. Adjusted Path Analysis (ACEs ---> Family Structure)

Mediating Variable	**Family Structure**	**Two Step-Parents**			**Single Mother**			**Other**		
		R.R.R.	**S.E.**	**p-value**	**R.R.R.**	**S.E.**	**p-value**	**R.R.R.**	**S.E.**	**p-value**
Key Independent Variables (ACEs)	*Parental Divorce*	81.043	9.467	**<0.05**	54.005	5.964	**<0.05**	69.381	9.156	**<0.05**
	Parental Death	14.621	3.207	**<0.05**	17.242	3.445	**<0.05**	32.696	6.561	**<0.05**
	Parental Incarceration	2.474	0.473	**<0.05**	1.865	0.310	**<0.05**	3.192	0.579	**<0.05**
	Domestic Violence	2.484	0.448	**<0.05**	2.852	0.461	**<0.05**	3.139	0.575	**<0.05**
	Neighborhood Violence	1.361	0.194	**<0.05**	1.347	0.152	**<0.05**	1.303	0.191	0.07
	Mental Illness	1.229	0.162	0.12	1.267	0.141	**<0.05**	1.570	0.218	**<0.05**
	Racial Discrimination	0.892	0.163	0.53	0.859	0.128	0.31	0.841	0.205	0.48
Exogenous Variables	**Age**									
	*Ages 1-5 (Deciduous Dentition)**									
	Ages 6-12 (Transitional Dentition)	2.585	0.331	**<0.05**	1.149	0.107	0.14	1.424	0.195	**<0.05**
	Ages 13-17 (Permanent Dentition)	2.851	0.371	**<0.05**	1.042	0.100	0.67	1.125	0.168	0.43
	Sex									
	Female	0.85	0.071	**<0.05**	1.019	0.068	0.78	0.813	0.08	**<0.05**
	Race/Ethnicity									
	*Non-Hispanic Whites**									
	Non-Hispanic Blacks	3.451	0.42	**<0.05**	8.085	0.78	**<0.05**	5.194	0.673	**<0.05**
	Hispanic	1.504	0.224	**<0.05**	1.645	0.183	**<0.05**	1.053	0.202	0.79
	Other	1.475	0.185	**<0.05**	1.782	0.21	**<0.05**	1.507	0.248	**<0.05**
	Highest Parental Education									
	*<High School Diploma**									
	High School Diploma	1.511	0.204	**<0.05**	1.474	0.154	**<0.05**	0.919	0.131	0.55
	> High School Diploma	1.174	0.161	0.24	1.395	0.155	**<0.05**	0.703	0.112	**<0.05**
	Annual Family Income									
	*<100% Federal Poverty Level**									
	100-150% Federal Poverty Level	0.699	0.107	**<0.05**	0.422	0.050	**<0.05**	0.596	0.096	**<0.05**
	>150% Federal Poverty Level	0.388	0.048	**<0.05**	0.117	0.011	**<0.05**	0.361	0.052	**<0.05**
	Number of Children									
	*Single Child**									
	Multiple Children	0.870	0.081	0.14	0.326	0.023	**<0.05**	0.313	0.032	**<0.05**
	Special Health Needs	1.117	0.114	0.28	1.234	0.100	**<0.05**	2.042	0.553	**<0.05**
	Health Insurance	1.178	0.323	0.55	1.303	0.311	0.27	0.045	0.014	**<0.05**

Note: (n=61,530); *Indicates reference category; Two Biological Parent household served as the reference group for family structure; R.R.R. indicates Relative Risk Ratio

Table 14.1. Adjusted Direct Path (Family Structure ---> Dental Caries)				
Dependent Variable: Dental Caries		**O.R.**	**S.E.**	**p-value**
Mediating Variable	**Family Structure**			
	*Two Biological Parents**			
	Two Step-Parents	1.291	0.108	**<0.05**
	Single Mother	1.153	0.075	**<0.05**
	Other	1.162	0.124	0.16
Exogenous Variables	**Age**			
	*Ages 1-5 (Deciduous Dentition)**			
	Ages 6-12 (Transitional Dentition)	1.681	0.116	**<0.05**
	Ages 13-17 (Permanent Dentition)	1.253	0.095	**<0.05**
	Sex			
	Female	1.063	0.051	0.21
	Race/Ethnicity			
	*Non-Hispanic Whites**			
	Non-Hispanic Blacks	1.448	0.105	**<0.05**
	Hispanic	1.423	0.103	**<0.05**
	Other	1.287	0.972	**<0.05**
	Highest Parental Education			
	*<High School Diploma**			
	High School Diploma	0.715	0.052	**<0.05**
	> High School Diploma	0.689	0.051	**<0.05**
	Annual Family Income			
	*<100% Federal Poverty Level**			
	100-150% Federal Poverty Level	1.015	0.092	0.87
	>150% Federal Poverty Level	0.584	0.042	**<0.05**
	Number of Children			
	*Single Child**			
	Multiple Children	1.030	0.055	0.58
	Special Health Needs	1.127	0.062	**<0.05**
	Health Insurance	0.756	0.104	**<0.05**
Note: (n=61, 530); *Indicates reference category; O.R. indicates Odds Ratio				

Table 14.2. Adjusted Direct Path (Family Structure ---> Preventive Dental Utilization)				
Dependent Variable: Preventive Dental Utilization		**O.R.**	**S.E.**	**p-value**
Mediating Variable	**Family Structure**			
	*Two Biological Parents**			
	Two Step-Parents	0.594	0.285	0.28
	Single Mother	0.726	0.229	0.31
	Other	0.548	0.260	0.20
Exogenous Variables	**Age**			
	*Ages 1-5 (Deciduous Dentition)**			
	Ages 6-12 (Transitional Dentition)	2.364	0.727	**<0.05**
	Ages 13-17 (Permanent Dentition)	2.001	0.721	**<0.05**
	Sex			
	Female	0.935	0.222	0.78
	Race/Ethnicity			
	*Non-Hispanic Whites**			
	Non-Hispanic Blacks	2.501	1.053	**<0.05**
	Hispanic	0.737	0.213	0.29
	Other	1.268	0.370	0.42
	Highest Parental Education			
	*<High School Diploma**			
	High School Diploma	0.952	0.356	0.90
	> High School Diploma	0.932	0.293	0.82
	Annual Family Income			
	*<100% Federal Poverty Level**			
	100-150% Federal Poverty Level	1.103	0.472	0.82
	>150% Federal Poverty Level	1.167	0.462	0.70
	Number of Children			
	*Single Child**			
	Multiple Children	2.077	0.513	**<0.05**
	Special Health Needs	1.780	0.488	**<0.05**
	Health Insurance	7.680	2.525	**<0.05**
Note: (n=61, 530); *Indicates reference category; O.R. indicates Odds Ratio				

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