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Qualitative Study of Knowledge and Perceptions of Parents or Other Caregivers about Environmental Heat Exposure and Children's Health

A dissertation submitted in partial satisfaction of the

requirements for the degree Doctor of Philosophy

in Nursing

by

Virgin Mary Watters

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ABSTRACT OF THE DISSERTATION

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Other Caregivers about Environmental Heat Exposure and Children's Health

by

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Doctor of Philosophy in Nursing

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Professor Wendie A. Robbins, Chair

In the U. S., predictive climate models indicate temperature increases of 1.7 to 6.7 °C by the year 2100 leading to additional deaths in vulnerable populations including infants and children (Smith, 2019). The World Health Organization predicts child mortality related to climate change will exceed 100,00 deaths per year by 2050 (Smith, 2019). Predicted increases in global temperatures intensify the urgent need to address environmental heat exposures that children encounter through microclimates such as unshaded play areas, and inside vehicles (Vanos, 2014). Young children, exposed to environmental heat inside of a vehicle, may overheat and experience Pediatric Vehicular Heatstroke (PVH) because of the inability to quickly thermoregulate in extreme heat. The National Highway Traffic Safety Administration (NHTSA) identified PVH as the leading cause of non-crash related vehicle fatalities for children under the age of 14 years in the U. S. (Glen et al., 2019).

Currently, there are limited data to guide best approaches for increasing public health awareness and informing clinicians, community, and public health professionals how to promote child safety in relation to environmental heat. To address the need for information to guide best approaches for prevention strategies, this study used qualitative inductive content analysis. The specific aims were to: (1) explore perceptions of adult parents/caregivers about behaviors related to young children and adverse environmental heat, and (2) identify adult parents'/caregivers' knowledge about adverse environmental heat and risks to health of children aged newborn to four-years.

A public health model applied to prevent child maltreatment along with Haddon's Matrix were used as a theoretical framework. Fourteen parents and two non-parent caregivers completed a short demographic survey and participated in a 40-60-minute semi-structured interview. Open-ended questions were asked about child safety, environmental heat exposures, and Pediatric Vehicular Heatstroke (PVH).

The data analysis process utilized open coding, developing categories, abstraction, and memos. The perceptions of the parents and other caregivers of children were derived from the following five categories that emerged: 1) general child safety concerns, 2) physical location and scenarios for environmental heat exposure, 3) parental behaviors and observations, 4) parental experiences and anticipatory fears/feelings, and 5) thoughts about other parents/caregivers. Seven knowledge categories emerged: 1) general knowledge, 2) receiving information about PVH, 3) parents questioning and judging other parents, 4) parental accountability, 5) environmental concerns, 6) social support for parents, and 7) community partnering to increase awareness.

Participants described child safety as an interconnection between home, public, and emotional spaces but did not spontaneously include weather-related heat environments when discussing providing safe environments for young children. They shared perceptions that: parenting can be overwhelming, stressful and full of distractions that may contribute to young children being left in hot environments. Overall, participants shared the perception that it is important for caregivers to receive emotional, physical and educational support to help prevent young children from being left unattended in cars or in unshaded areas on hot days. They also identified societal and cultural forces that may contribute to adverse environmental heat exposures of young children.

Participants expressed having limited knowledge regarding heat exposure on children's health and reported that news or social media was a main source for information about PVH. Overall, participants expressed the need for increasing public awareness and education about environmental heat and young children. Participants suggested partnering with pediatricians, pediatric nurses, community leaders, community organizations, and anyone who works with children. Parents/caregivers provided insights that could help develop strategies to prevent adverse environmental heat exposures in young children. Strategies to pursue include partnering with pediatric clinicians, community organizations, and public health officials to modify practice guidelines for well-baby/child check-ups to include a heat risk assessment, and information on heat microenvironments and PVH. Another strategy is to encourage political engagement to increase green spaces and shaded play areas for children. Policies could be instituted for employees at community parks and other outdoor spaces

where children play to inform them about prevention of adverse heat exposures and how to communicate this information to parents/caregivers.

The dissertation of Virgin Mary Watters is approved.

Felicia S. Hodge

Eunice E. Lee

Paul M. Macey

Wendie A. Robbins, Committee Chair

University of California, Los Angeles

2023

DEDICATION

To my sons for their inspiration and support. To my father and in the loving memory of my mother for their love, spiritual guidance, lifetime of sacrifices, and encouragement. In the loving memory of my paternal grandparents and my maternal grandmother for sharing stories about our family history and setting high academic expectations.

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VITA

EDUCATION

2007 California State University, Los Angeles
School Nurse Credential

2002 University of California, Los Angeles
Master of Science Degree in Nursing
Area of Focus: Nursing Administration/ Occupational & Environmental Health

1992 University of California, Los Angeles
Bachelor of Science in Nursing

PROFESSIONAL LICENSURE AND CERTIFICATION

1992 – present Registered Nurse Licensure, State of California
1992 – present Public Health Nurse Certification, State of California
1998 – present Certified Lactation Educator
2007 – present School Nurse Health Services Credential, State of California

RESEARCH EXPERIENCE

2023 – present Research Assistant for Kristi K. Westphaln, PhD, RN, CPNP-PC Assistant Professor, University of California, Los Angeles
Children's Hospital Los Angeles INIR Grant Qualitative Study

CLINICAL EXPERIENCE

2016 – present Public Health Nurse Supervisor, Los Angeles County Department of Public Health, Department of Children and Family Services Emergency Response Command Post
2014 – 2015 Public Health Nurse, Los Angeles County Department of Children and Family Services
2002 – 2014 Credentialed School Nurse, Los Angeles County Office of Education, Division of Alternative Education
1993 – 2002 District Public Health Nurse, Los Angeles Department of Public Health, Central Health Center and Curtis Tucker Health Center

TEACHING EXPERIENCE

2022 Teaching Assistant, School of Nursing University California, Los Angeles
2021 Teaching Assistant, School of Nursing University California, Los Angeles
2015 – 2016 Certificated Contract Consultant for the Teacher's Special Education Credential Program

MENTORSHIP

2021 – 2022 Mentor, Grad2Grad STRIVE (Supporting Transition and Retention and Inspiring the Value of Education) Program, University of California, Los Angeles
2022 Mentor, SHPEP (Summer Health Professions Education Program), University of California, Los Angeles

AWARDS

2021 – 2023	Jonas Nurse Scholar
2020	Graduate Council Diversity Fellowship, University of California, Los Angeles
2001	Charles F. Scott Fellowship, University of California, Los Angeles
2000	Graduate Fellowship, University of California, Los Angeles
1992	Associate Clinical Professor, University of California, Los Angeles

Chapter 1

INTRODUCTION

Significance

Public health agencies and hospitals in the United States (U. S.) have assumed an active role in addressing the health outcomes and climate-sensitive conditions that are exacerbated by global warming. Global warming has led to an increase in average atmospheric temperatures that are associated with adverse health effects including: asthma, chronic obstructive pulmonary diseases, cardiovascular disease, acute ischemic strokes, waterborne and vector-borne diseases, allergic disorders, depression, anxiety, violence, and accidental/non-accidental trauma injuries (Sorensen et al., 2020). Populations known to be most vulnerable to heat exposure are: infants, children, pregnant women, elderly, and persons who are chronically ill (Paterson & Godsmark, 2020).

In the U. S., predictive climate models indicate temperature increases of 1.7 - 6.7 °C by the year 2100 leading to additional deaths in vulnerable populations including infants and children (Smith, 2019). The World Health Organization (WHO) predicts child mortality related to heat exposure at >100,000 deaths per year by 2050 (Smith, 2019). Predicted global climate change intensifies the urgent need to address environmental heat exposure that children frequently encounter. These encounters can be experienced through microclimates such as unshaded outdoor play areas, and inside hot vehicles (Vanos, 2014). Because infants and young children are unable to manage their own heat risks, they are susceptible to heat entrapment. In addition, young children have different physiologic and developmental differences in thermoregulation than

adults (Mangus & Canares, 2019). Young children's bodies are unable to quickly thermoregulate in extreme heat (Zivin & Shrader, 2016). This can lead to acute heat illness such as heatstroke and there is a short time period to reverse heatstroke.

An example to illustrate this are temperature measurement reports that Pediatric Vehicular Heatstroke (PVH) could take as little as fifteen minutes in an overheated car for a child to suffer (Chua et al., 2018). The first 15-minutes of closed vehicle doors and windows results in the interior temperature rising about 25° above the ambient temperature (Null, 2018). Pediatric Vehicular Heatstroke is defined by nursing and medical science as a body temperature that reaches 40.5 °C, the equivalent of 104.9 °F (Dowd, 2018). As young children move through the various stages of heat illness such as dehydration, heat cramps, and vertigo, they may not be able to communicate symptoms or remove themselves from the life-threatening situation (Mangus & Canares, 2019). The physical presentation of heatstroke in humans includes dehydration, hot/dry skin, lack of perspiration, vertigo, confusion, ataxia, unconsciousness, seizures, and shock. Mortality as a result of heatstroke is reported to be between 17% and 80% (Dowd, 2018).

The National Highway Traffic Safety Administration (NHTSA) has identified PVH as the leading cause of non-crash related vehicle fatalities for children under the age of 14 years in the U. S. (Glen et al., 2019). According to the National Safety Council, a total of 942 children (more than half of them under the age of two years) have died due to PVH between 1998 and 2022 with an average of 38 deaths each year (Null, 2022). There were 53 deaths due to PVH in 2018 and 2019. In 2020, during the Covid-19 Pandemic, a time when families were driving less due to stay at home restrictions, there

were 25 deaths due to PVH (Null, 2020). All deaths were preventable prompting the National Safety Council to prioritize their mission to eliminate these needless deaths (Null, 2018).

The current measures to address PVH include proposed legislation, limited public education campaigns sponsored by the NHTSA and a free online course offered by the National Safety Council (Glenn et al., 2019). The HOT CARS Act of 2019 was introduced to the U. S. House of Representatives and will require new vehicles to have a safety device such as an audible alarm system to alert drivers if someone is on the backseat once the engine is turned off (Glenn et al., 2019). If passed, this legislation would take approximately 10 years for 65% of the ~ 260 million cars/trucks on the roads in the U. S. to get the safety devices (Null, 2018). The greatest impact on saving children's lives will involve a solution that integrates technology with awareness and education campaigns about PVH (Null, 2018).

Increasing awareness about PVH can heighten awareness of other environmental heat exposures that adversely affect children's health. For example, as a result of urbanization, many outdoor play areas, and schools have few trees, grass or other vegetation. These sites are often referred to as urban heat islands (UHI) because of their elevated ambient temperatures and lack of green space. Young children who live in UHI sites are at increased risk of asthma and other adverse health effects due to the elevated ambient temperatures in these metropolitan areas (Heaviside et al., 2017). In addition to asthma, young children exposed to adverse environmental heat in unshaded play areas and schoolyards are at risk for heat stress, heat rash, sunburn, fainting, cramps, heat exhaustion, and life-threatening heatstroke (Vanos et al., 2018).

As a result of the elevated ambient temperature young children may also experience anxiety, depression, asthma, sleep disorders, waterborne and vector-borne disease, dehydration, and obesity due to slower thermoregulation (Burke et al., 2018).

A collective of 100 organizations participate in the Green Schoolyards Action Agenda and are currently working to address adverse environmental heat exposures at unshaded play areas and schoolyards. The vision of these organizations is to design green schoolyards that will offer access to nature in a cool thermal environment for parents, children, and community members (Antoniadis et al., 2020). One way to maximize public knowledge of ambient heat risks and protect the health of young children could involve bringing together the various local, regional, and national entities such as Green Schoolyards, NHTSA, and the National Safety Council to consolidate resources and messaging about heat microenvironments and young children.

Over time, climate change will continue to increase global temperatures and thus will place the health of young children at risk (Smith, 2019). Existing research has led to an understanding of the physiologic basis for increased heat susceptibility in young children and the associated health conditions that result (Vanos et al., 2018). Evidence also exists characterizing the microenvironments that place young children at risk and studies on control measures are ongoing, for example alarms in cars and greening of urban neighborhoods (Vanos, 2014). However, we also know that infants and young children are unable to manage their own microenvironments, thus caregivers are central to avoiding heat entrapment. Limited information exists about caregiver knowledge and perceptions related to heat risks in infants and young children.

Currently, there are limited data to guide best approaches for increasing public health awareness of the adverse effects of environmental heat exposure in young children. The role of parents and health care providers in the area of prevention and education is also lacking. Information on parental perceptions of the risks associated with hot weather and environmental heat exposure in young children could provide a foundation to begin exploring the best approaches for prevention strategies. Qualitative research methods that use the inductive content analysis approach can explore knowledge and perceptions of environmental heat exposure in young children and health outcomes, including PVH and highlight precursors for young children being left unattended in microclimates such as vehicles or unshaded outdoor play areas. This information can provide cues for preventative health education measures that may be useful. There are scant qualitative studies involving parents, health care providers, or rescue responders who describe their individual experiences with child rescue situations, severe child injury, or child death associated with environmental heat exposure. There are also limited qualitative studies that report on parents, health care providers, and rescue responders' perspectives on how to prevent environmental heat exposure in young children. To generate more evidence on which to base prevention strategies, this dissertation utilized qualitative methods in data collection and analysis. Inductive content analysis was conducted with data gathered from 16 individual interviews with parents or other caregivers of children.

Specific Aims

The purpose of this qualitative study was to identify the knowledge and perceptions of parents or other caregivers regarding environmental heat exposures in

children aged newborn to four-years. In addition, the study explored potential modifiable factors related to these situations. The exploration of knowledge, perceptions, and modifiable factors contributed evidence to inform needed steps to guide future research and the development of feasible interventions to prevent and/or minimize the occurrence of adverse environmental heat exposures to infants and young children. The research question and specific aims were:

Research Question: What knowledge and perceptions do parents or other caregivers of children have about adverse environmental heat exposure among newborns and children up to four-years of age?

Specific Aim 1:

Explore the perceptions of adult parents or other caregivers regarding behaviors leading to children's exposure to adverse environmental heat.

Specific Aim 2:

Identify adult parents or other caregivers' knowledge about adverse environmental heat exposure and risks to health of children aged newborn to four-years.

Nursing Implications

A qualitative study, using inductive content analysis to identify parents or other caregivers' knowledge about the risks of environmental heat exposure in children newborn to four-years of age, provided data on the personal, cultural or knowledge factors that influenced parental or other caregivers' perceptions. Findings can guide the development of future studies aimed at identifying behavioral interventions. The information collected embodies the knowledge and experiences of parents or other

caregivers of children that could suggest measures for future exploration in preventing young children from being exposed to damaging environmental heat. This information can guide healthcare providers and nurses about future research and the development of educational materials, for example, about leaving a child in a vehicle on a hot day. Information regarding the risks of environmental heat exposure could be shared with parents or other caregivers of children during prenatal visits, childbirth classes, home visits after newborn discharge, routine well child exams and non-life-threatening hospital visits. In the future, education about prevention of adverse environmental heat exposure could become part of routine anticipatory guidance and child safety conversations between healthcare providers, nurses and parents or other caregivers of children.

Summary

This first chapter presents an overview of the dissertation research study and describes the physiological impact of adverse environmental heat exposure on young children. The background and significance of the study, research aims and nursing implications are also provided in chapter one. Chapter two provides a literature review that synthesizes the research findings of data-based articles focused on the following factors surrounding adverse environmental heat exposure: adverse environmental heat exposure, descriptions of the microclimate including vehicles which lead to heatstroke, exploration of technological prevention methods, parental knowledge/behaviors, and physiological changes associated with adverse heat exposure. Chapter three presents the theoretical framework, two public health models that guide the dissertation research. Both, a public health model applied to prevent child maltreatment along with Haddon's Matrix, a commonly accepted injury prevention framework, guide the research for the

purpose of exploring parents or other caregivers' modifiable risk factors associated with adverse environmental heat exposure in young children. Chapter four provides a detailed description of the research methods used to conduct this qualitative dissertation study and describes the ethical standards that were followed to ensure participant confidentiality. Chapter five discusses the results of the dissertation study and addresses each specific aim. Chapter six provides a discussion and conclusion of the major study findings.

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Chapter 2

LITERATURE REVIEW

A review of current literature regarding the adverse effects of environmental heat exposure in young children identified health conditions that may be exacerbated as a result of increased atmospheric temperature. Increased environmental pollution has led to climate changes that negatively impact the health of vulnerable populations such as young children. A key component of environmental air pollution, particulate matter (PM), can increase the risk of asthma, rhinitis and eczema among preschool children (Norback et al., 2019). There are also increased risks of dehydration, fatigue and irritability with environmental heat exposure. Young children are more susceptible than adults to the effects of environmental heat and air pollution due to their immature physiology and higher body surface to mass ratio (Schinasi et al., 2021).

A steady increase in environmental heat over the last 15 years and an expectation that surface temperatures will continue to increase by two to four degree Celsius by the year 2100, highlight a need to improve knowledge related to the adverse effects of environmental heat on children's health (Pachauri et al., 2014). In addition to gaining a better understanding of the impact of environmental heat on children's health, it is important to explore more preventative measures for microclimates that children frequently encounter. Common microclimates where young children are at risk of adverse environmental heat exposure are unshaded outdoor play areas and enclosed vehicles (Vanos, 2014). Many current preventative measures are focused on the problem of children left unattended in vehicles and PVH.

A review of current legislation regarding PVH identified that 21 states have a range of legislation attempting to mitigate the problem of children left in vehicles. Some states have laws for daycare vehicles and school buses to have reminder systems integrated in the vehicles. Under the Good Samaritan Act an individual is allowed to break into a vehicle in order to save a vulnerable individual or pet from a vehicle. There is currently only one bill at the federal level to combat PVH (Glen & Neurauter, 2019).

In May 2019, U. S. Senator Roger Wicker presented the Hot Cars Act, which directs the Department of Transportation to issue a rule requiring all new passenger motor vehicles less than 10,000 pounds to be equipped with rear seat reminder technologies (RSRT). This technology would alert (audibly and visually) individuals inside and outside of a vehicle of the presence of an occupant in the rear seat. According to a review of preventative technologies by the National Surface Transportation Safety Center for Excellence, multiple devices on the market had syncing and connection issues therefore the National Highway Traffic Safety Administration is providing guidance for companies in their development of more robust reminder technology (Glen & Neurauter, 2019).

An initial literature search was conducted in March 2020 and 15 primary data-based articles were reviewed which focused on microclimate conditions in vehicles, prevention technology, physiological changes and parental behaviors associated with PVH. Databases searched included: PubMed, Web of Science, Google Scholar and Cumulative Index to Nursing and Allied Health Literature (CINAHL) for peer-reviewed articles which met the following criteria: 1) written in English, and 2) published within the last five years (2015 – 2020). A seminal peer-reviewed article published in 2013 was included for relevant data about the circumstances surrounding fatal events in which

children were left unattended in vehicles. The following search terms were used in various combinations: children, cars, heatstroke, automobiles, prevention of vehicular heatstroke.

A total of 37 articles were extracted; however, four were excluded due to duplication, six did not meet the inclusion criteria and seven did not have full text available. Inclusion criteria: Journal article reviews of heatstroke in children newborn through four-years of age dated 2015 to 2020, reviews of microclimate within closed vehicles and reviews of prevention technology/strategies for vehicular heatstroke in children. Exclusion criteria: Journal article reviews of heatstroke in adults or children over four years of age and reviews that are not in English or were published before 2015. A Preferred Reporting Items for Systematic Reviews and MetaAnalysis (PRISMA) Flow Diagram has been included. Please see appendix.

After 20 journal articles were identified, 15 primary data-based articles were reviewed which focused on various factors surrounding PVH. The following themes were identified for the 15 data-based articles: descriptions of the microclimate in vehicles which lead to heatstroke, exploration of technological prevention methods, parental knowledge/behaviors associated with PVH and physiological changes associated with heatstroke.

A second literature review was conducted in August 2021 and the following databases were searched: PubMed, Web of Science and Cumulative Index to Nursing and Allied Health Literature (CINAHL) for peer-reviewed articles. The following Boolean phrases were used during the search on CINAHL: heatstroke and children and cars, heatstroke and infants and cars, hot car death and babies, hot car death and children,

hot car injuries and children, heatstroke and babies and automobiles. This search yielded four research articles, two were duplicates from the initial literature search and two did not meet inclusion criteria.

The following terms were used during the search on Web of Science: pediatric vehicular heatstroke, children left in hot cars, vehicular heatstroke, vehicular heatstroke deaths, infants left in hot cars and infants dying in cars. This search yielded 10 research articles, two new articles, four were duplicates from the initial search, four did not meet inclusion criteria.

The following terms were used during the search on PubMed: pediatric vehicular heatstroke, prevention of pediatric vehicular heatstroke, babies left in hot cars, infants forgotten in cars, infant heatstroke in automobiles, children heatstroke in automobiles, child injuries in hot cars, infant deaths in hot cars, infants overheating in cars and pediatric deaths in hot cars. This search yielded 17 research articles, one new article, eight were duplicates from the initial search and eight did not meet inclusion criteria. A total of three new data-based articles were identified through a secondary literature search.

A third literature review was conducted in April 2022 and the following databases were searched: PubMed, Web of Science and Cumulative Index to Nursing and Allied Health Literature (CINAHL) for peer-reviewed articles. The following Boolean phrases were used during the search on CINAHL: ambient heat and adverse health effects and children, environmental heat and adverse health effects and children, environmental heat and health effects and children, environmental heat exposure and health effects and children. This search yielded two research articles and one did not meet inclusion criteria.

The following terms were used during the search on Web of Science: ambient heat exposure in young children and environmental heat exposure in children. This search yielded 4 research articles that did not meet inclusion criteria.

The following terms were used during the search on PubMed: ambient heat and children, children and environmental heat exposure. This search yielded two new research articles. A total of three new data-based articles were identified through a third literature search and 21 data-based articles were included in the literature review.

The following themes were identified for the 21 data-based articles: adverse environmental heat exposure, descriptions of the microclimate in vehicles which lead to heatstroke, exploration of technological prevention methods, parental knowledge/behaviors associated with PVH, and physiological changes associated with heatstroke.

Adverse health effects related to environmental heat exposure

The information presented in three data-based articles provides relevant data about the impact of climate change on the health of vulnerable populations such as infants, young children, pregnant women and chronically ill people. The higher core temperature and lower sweat rates of children affect their ability to thermoregulate (Smith, 2020). As a result of their slower rate of thermoregulation when exposed to adverse environmental heat, young children are at risk of anxiety, depression, asthma, sleep disorders, waterborne and vector-borne disease, dehydration and obesity (Burke et al., 2018). These adverse health effects result from direct and indirect effects of global warming. Data collected from weather stations show that humid heat associated with global warming has doubled over the last 40 years. This environmental heat

exposure triggers different physiological mechanisms that can impact the brain, heart, lungs, kidneys, intestines, liver and other vital organs (Mora et al., 2017). As the climate temperature continues to increase over time, more research is needed to explore the impact of environmental heat on specific chronic childhood health conditions.

A time series analysis of asthma exacerbations among children ages 0-18 living in Philadelphia, Pennsylvania was conducted in 2011-2016 during June, July and August. Data collected from the Children's Hospital of Philadelphia (CHOP) was used to create a time series of daily counts of asthma exacerbations. The exacerbations were defined according to National Heart, Lung and Blood Institute's (NHLBI) criteria of: a face-to-face encounter with a recorded asthma diagnosis and a linked corticosteroid prescription (Schinasi et al., 2021). Data was collected for the mean daily temperature, precipitation, wind speed and humidity from the National Centers for Environmental Information Climate Data Online. Aeroallergen data was also collected from the Asthma Centre in Philadelphia. Counts of exacerbation and counts stratified by sex, age, race, encounter setting, allergic rhinitis comorbidity, eczema comorbidity and payment source were calculated. A total of 7637 asthma exacerbation visits were included in the time series and there was a similar daily average across all clinical settings for exacerbations.

There was a slightly higher number of asthma exacerbations for the emergency (mean (SD): 5.00 (2.65)) and outpatient (mean (SD): 4.80 (3.71)) settings than the hospital (mean (SD): 4.03 (2.34)) (Schinasi et al., 2021). The median of average daily temperatures was similar for all months but highest in July and humidity was highest in August (Schinasi et al., 2021). Findings from this analysis demonstrated that for children

under five years, there was a modest association between asthma exacerbation rates and higher ambient temperatures. This association was substantial in Hispanic and non-Hispanic Black children (Schinasi et al., 2021). Strengths of this analysis include the use of: NHLBI specific definition to identify asthma exacerbations, exploration of non-linear associations, adjustments for time-varying environmental covariates, data stratified by several demographic factors, use of mean daily temperature and restricting analysis to the hottest months (Schinasi et al., 2021). Limitations of this analysis are the use of aeroallergen data collected at a single site that might not represent exposures across Philadelphia, absence of data on daily weather system patterns and potential bias due to residual seasonal confounding (Schinasi et al., 2021).

Overall, the findings from this analysis are consistent with other research studies that identified associations between environmental heat exposure and asthma exacerbation. According to the World Health Organization (WHO), 92% of the world's population is exposed to excessive particulate matter (PM), a key component of environmental air pollution (WHO, 2020). Children are more susceptible to air pollution and elevated PM levels which increase their risk of childhood asthma (Norback et al., 2019). Particulate matter has also been associated with the increased use of rescue medication in children with asthma (Mc Cormack, et al., 2009).

Young children who live in areas commonly described as urban heat islands (UHI) are susceptible to asthma and other adverse health effects due to the elevated ambient temperatures in these metropolitan areas (Heaviside et al., 2017). A comprehensive review of studies presents data regarding the impact of environmental heat stress for children playing at urban schoolyards and outdoor play areas. The

review presented information about urban outdoor areas that are designed based on adult thermal comfort models instead of child comfort designs (Cheng & Brown, 2020). These designs place young children at risk for heat stress based on the physiological differences between children and adults. Children have a higher surface area-to-body mass ratio and a higher metabolic rate compared to adults (Wenger, 2003). The higher body mass ratio increases their heat absorption while the higher metabolic rate produces more heat (Cheng & Brown, 2020). Other physiological differences between adults and young children are the undeveloped sweat glands and lower sweat rate in children (Falk & Dotan, 2008). This physiological difference leads to convective heat loss in children instead of evaporative heat loss that occurs in adults. The convective heat loss increases blood flow to the skin when the ambient temperature is higher than the child's body temperature and this results in heat gain (Vanos, 2015).

Unshaded schoolyards and play areas expose young children to elevated environmental temperatures that can cause heat stress, heat rash, sunburn, fainting, cramps, heat exhaustion and life-threatening heatstroke (Vanos et al., 2018). Urban schoolyards are described as hot in different countries and cities. Factors contributing to elevated ambient temperatures on the urban schoolyards include: heat conducting materials that cover the surfaces such as asphalt, concrete, artificial turf or rubber, the lack of shade and vegetation (Vanos et al., 2016). Geographic Information System software was used to compare and classify land cover on 75 schoolyards in Baltimore, Boston and Detroit, USA. Findings from this classification of the schoolyards were: tree canopy was present on 13%, 24% and 28% had no vegetation and 11% had no green space (Schulman & Peters, 2008).

In order to improve the thermal environment of urban schoolyards and playgrounds, landscaping efforts to plant trees and ground covering are necessary . The use of trees for shading, plant foliage and cool tiles or cool asphalt help improve children's thermal comfort on urban schoolyards. Folding mesh, shade sails and permanent pergolas can also be used to reduce the schoolyard surface temperature (Vanos et al., 2016). The Green Schoolyards Action Agenda consists of 100 organizations with a vision of green schoolyards that are designed by the school community. Green schoolyards will serve as multi-functional places for students and community members to play and have access to nature (Cheng & Brown, 2020). Many design planners have adopted this method to transform asphalt-covered school grounds into green spaces that improve the thermal environment for children (Flax et al., 2020). Transforming schoolyards into green spaces is a measure that can help mitigate adverse environmental heat exposure in young children.

Another comprehensive review presents data regarding the health impacts of ambient temperature exposure, air pollution and ultraviolet radiation on young children within urban microclimates. Children who live in urban low-income areas are more vulnerable to adverse environmental heat exposure. According to the National Health Statistics Report, 147 children less than four years of age, 86 infants and 28 children aged five to fourteen died as a result of heat exposure across the U.S. from 2006 to 2010 (Luber & McGeehin, 2008). There are inconsistencies in the literature regarding excess heat-related mortality in children. Some studies report minimal risk while others report a high risk for heat-related deaths in children (Basu et al., 2008). Many studies focus on the adverse effects of heat exposure in the elderly because the mortality rate is

higher compared to the mortality rate in children. As a result of the focus on heat-related mortality, issues specific to heat stress and illness in young children may be overlooked (Vanos, 2014).

Microclimates such as urban schoolyards, uncovered play areas and closed vehicles are heat stress hazards for young children. Shortwave radiation is a key component of potential heat stress that young children are exposed to while playing in urban schoolyards. The surfaces of the urban schoolyards and playgrounds are impermeable surfaces such as asphalt, brick, concrete, rubber and artificial turf that enhance heating (Vanos, 2014). The risk of heat stress is a concern for children playing close to these hot surfaces (Moogk-Soulis, 2010). Shortwave radiation is also a concern for children who are left unattended in closed vehicles. The vehicle temperature rises quickly as shortwave radiation is absorbed by the child's body and other objects inside the vehicle (Vanos, 2014). The lack of cool air from outside and the child's inability to sweat may lead to a heatstroke (Falk, 1998).

Another factor that affects young children exposed to elevated ambient temperatures is air pollution. Children's higher respiratory rate and under developed respiratory systems make them vulnerable to outdoor air pollution at lower concentrations. A four-year study in Toronto, Canada found that children under 14 years of age who were hospitalized with respiratory infections had lower ambient PM and gaseous pollutants compared to adults. The study findings confirmed that children have a lower threshold for air pollution (Lin et al., 2005). According to the Special Report on Emissions Scenarios (SREAS), elevated ambient temperatures may increase pollen counts in urban areas and lengthen allergy seasons. Airborne allergens may increase

asthma, allergic rhinitis and other respiratory diseases (Beggs, 2010). A secondary pollutant, ozone, was studied in 287 children to examine the effect on lung function. The findings identified an inverse relationship between increasing ozone concentrations and lung function (Krzyzanowski et al., 1992). The SREAS projected that the number of emergency room visits across New York City for ozone-related asthma in children would increase by 2020 (Sheffield et al., 2011). In a five-year study of 3,535 children with no history of asthma, data demonstrated a 20% decrease in the risk of asthma in communities with low ozone concentrations (McConnell et al., 2002).

In addition to the adverse health effects related to ozone exposure, children are exposed to ultraviolet (UV) radiation when outside at unshaded urban play spaces. Small doses of ultraviolet exposure are needed for Vitamin D synthesis whereas large doses can cause skin burns and skin cancer (Geller et al., 2002). Although melanoma skin cancer is rare in children, a cross sectional study on 10, 079 children reported that the incidence of skin cancer is rising (Geller et al., 2002). The UV index is used to estimate overexposure to sunlight and a value of >12 indicates that skin damage can occur as low as 7-16 minutes or less for children (NOAA, 2007). Exposure to UV can be reduced for children by shading outdoor schoolyards and play areas with large trees, using porous surfaces to increase evaporation and vegetation (Santamouris, 2013). Shaded spaces decrease exposure to harmful UV wavelengths.

Microclimate in Vehicles

The information presented in four data-based articles provides fundamental data about how the environmental and vehicle temperatures may impact the occurrence of heatstroke in young children, including temperature conditions that contribute to the

occurrence of PVH and length of time it takes for a young child's body to reach a fatal temperature inside of a hot vehicle. A study using a modified version of Man-Environment Heat Exchange Model (MENEX) for a one-year-old boy was conducted in Athens, Georgia during the summer over a 14-day period (Grundstein et al., 2015). In the study a vehicle with the model of a one-year-old boy inside was placed in full sun exposure with the windows closed for temperatures ranging from 26°C to 46°C during different time intervals.

The study demonstrated the link between the microclimate conditions in an enclosed vehicle and the physiological response to heat exposure. Findings from the data collected demonstrated that heatstroke can occur in under an hour with vehicle temperatures of 26°C and in less than 15 minutes for temperatures starting at 46°C. Also, a child may experience heat related injuries within five minutes of being left in a vehicle with a cabin air temperature greater than 28°C. This study provides a foundation for health experts to increase public awareness about PVH and explain why it is unsafe to leave children unattended in a vehicle. Some limitations that may affect the generalizability of this study are the use of a model which cannot detect neurological changes associated with heatstroke or pre-existing medical conditions that could make a child more vulnerable to heat illness and the use of one model with specific clothing placed in one vehicle type (Grundstein et al., 2015).

A similar study used a model of a two-year-old boy to demonstrate the influence of vehicle type, time of day and sun or shade exposure on the child's core temperature when left in a vehicle (Vanos et al., 2018). A standard energy equation was used to model a two-year-old boy's heat balance and data was collected in Tempe, Arizona

over three days in June and July. Multiple trials were conducted with three pairs of identical vehicles parked in the sun and under a solar canopy shade for 60 minutes. Each vehicle cabin was cooled to equal the outdoor air temperature or to 85 °F. The relative humidity and cabin temperature were monitored at one-minute intervals using sensors and handheld infrared thermometers. The temperature measurements for the model two-year-old boy were estimated to reach 38.2±0.29°C and 39.1±0.41°C with a higher final core temperature in sun exposed vehicles across all days (Vanos et al., 2018). The measured core temperature rise was an average of 2.4 hours to reach 40°C in shaded vehicles and 1.43 hours in sun exposed vehicles (Vanos et al., 2018).

A similarity between this study and the modeling study by Grundstein is the model child's temperature rises rapidly to cause heatstroke when the inside vehicle temperature is elevated. Data from this study provides support for new behavioral and technological interventions to lessen the number of children forgotten in hot vehicles (Vanos et al., 2018). Limitations of this study include: the maximum temperature was based on adults or mice, results will vary by child's sex, size, age and core temperature measurements rising to hyperthermia in young children and infants do not exist because studies on infant core temperature are limited to forensic studies. (Vanos et al., 2018). Although there are limitations with both modeling studies, the data supports the need for new behavioral and technological interventions to lessen the number of children forgotten in hot vehicles. Further research is required to improve understanding of infants and small children's heat exchange in hot conditions (Vanos, 2018).

Additional information that describes the temperature inside of vehicles includes a review of literature used to promote public awareness about the dangers of children

being left unattended in parked vehicles located in India. The review described how the cabin temperature of vehicles parked in the sun was 20°C above the ambient temperature and exceeded 70°C on hot days (Hingane, 2018). Additionally, cabin temperatures for vehicles in direct sunlight reached values that were 8°C - 19°C greater than vehicles in the shade. The temperature increase in the vehicle is caused by a greenhouse effect associated with a radiation imbalance and reduced ventilation. The review also discussed information about cabin temperatures reaching deadly levels with lower temperatures on a cloudy day (Hingane, 2018). This information helps to clarify that closed vehicles can reach high temperatures even when it is not a hot sunny day.

Although the literature review was reporting on vehicles in India, the information supports previous studies in the U.S. about the effects of warm weather on vehicle cabin temperature. This information is useful for educating parents or other caregivers of children about the hot temperature levels that occur when closed vehicles are parked in the sun and the threat this poses for young children who are left unattended in these vehicles. Vehicle cabin temperatures rise to deadly levels when the closed vehicles are parked in the sun. A limitation of this review is the absence of information about instrumentation that was used to measure the vehicle temperatures.

A literature review of a study examined hot temperature ranges in a closed midsize vehicle in San Francisco over 16 days in the summer with outside temperatures ranging from 72 to 96°F (Null, 2018). The vehicle was parked in the sun with closed windows and was cooled to approximately 70°F. A thermometer was placed in the vehicle away from direct sunlight and it transmitted five-minute readings to a Davis instrument that also recorded the outside temperature (Null, 2018). Findings from this

study demonstrated that within the first 15 minutes of the vehicle being closed, the interior temperature rises about 25°F above the outside temperature. On a 70°F summer day the vehicle's interior temperature can reach 120°F and 11% of heatstroke deaths in children occur when the outside temperature is less than 80°F (Null, 2018). The rapid rise in the vehicle interior temperature is similar to the findings in the Grundstein and Vanos modeling studies and provide data which support the physical dangers associated with temperature elevations.

The strengths of the study are the multiple temperature measurements over two weeks with a range of outside temperatures which captured natural variations in the weather that allowed for the collection of data in a naturalistic setting. Another strength is the data about PVH occurrence at ambient temperatures less than 80°F. This information is useful for increasing the public's awareness that PVH is not limited to high temperatures and can occur in milder weather. The limitations of the study are the use of one car type for temperature measurements and one setting, direct sunlight was used to collect data. This may limit generalizability to other settings.

Preventative Technology

After reviewing data about the microclimate conditions in vehicles which contribute to PVH, it is imperative to explore data about technological interventions that may help to prevent the occurrence of PVH. An experimental test study with a child in a car seat used multiple sensors to discover the best placement for detection of a child left alone in a vehicle. The test study was conducted in Malaysia and a human test subject held a receiver while walking away from the vehicle (Chua et al., 2018). Multiple sensors were evaluated to determine the distance from the vehicle that the receiver

could pick-up signals. The experiment was repeated five times and an average of the sensors range/response time was recorded. Test study results determined that the ultrasonic sensor with a range > two meters, time of 2.9 seconds and the passive infrared (PIR) motion sensor with a range > two meters, time of 5.0 seconds were the most suitable for the detection system (Chua et al., 2018).

Findings from the study determined the best placement for the ultrasonic sensor was above the child seat and the best placement for the motion sensor was the middle ceiling of the vehicle. The motion sensor was able to detect movements anywhere in the vehicle (Chua et al., 2018). The strengths of this study are the sensors tested in a setting with human subjects and were able to detect the presence of a child left alone in the vehicle. The receiver was able to transmit signals to inform the human test subject that the child was in the vehicle. These findings may serve as a baseline for future experimental test studies involving technology to detect a child left in a vehicle. The limitations of this study include that it was a single experiment with a small test group and it was conducted in one country, Malaysia. The cost of the sensor system may affect marketability to other countries and the small single test group limits generalizability to other countries/populations.

A similar modeling study used a low-power, mm-wave multi-input-multi-output (MIMO) frequency-modulated continuous-wave (FMCW) radar sensor to detect the presence or absence of a living body in a vehicle. A proposed presence-absence detection (PAD) algorithm was based on breathing cycles that create consistent motions (Abedi et al., 2021). The main goal of the study was to develop a radar-based technology to trigger an alarm when children or pets are left alone in parked cars with

closed windows and doors (Abedi et al., 2021).

The experiment used dolls and phantoms with oscillating metal plates to mimic the breathing motion of a small child. The oscillating metal plates had 16-18 cycles per minute, with 2cm backwards and forwards motion. The phantom was placed in child, infant and booster car seats in seven-seat vans. The different car seats were placed behind the first row and for more complicated tests, the dolls were placed on the floor under seats (Abedi et al., 2021). Measurements of 65 different scenarios were tested for more than 3 minutes per scenario and the proposed PAD algorithm identified the presence of a live subject in all scenarios with 100% accuracy. The proposed PAD was also able to detect the doll that was placed under seats (Abedi et al., 2021). Other tests were conducted to determine if the proposed PAD algorithm detected that no living subject was inside the car. Random motions of the car shaking or movements of items in the car did not result in a false positive and the algorithm correctly identified the absence of a live subject. Overall, the study demonstrated that the proposed algorithm was reliable in detecting phantoms that mimicked children in all scenarios without false alarms and that it is a low-cost radar sensing technology that may help to address PVH in the future (Abedi et al., 2021).

An experimental test study conducted a usability analysis of a Hyperthermia Alarm for Children in Cars (HACC). The HACC system consists of a car surveillance system which constantly checks the car temperature, detects the presence of a child inside the car, has a smartphone application that allows parents or other caregivers of children to monitor the child inside the car and take appropriate action (Abulkhair et al., 2017). The HACC application alerts parents or other caregivers of children about an

unsafe temperature inside the car and will automatically open the car's windows when there is no response. It will also sound an alarm to alert people to get help for the child. The application is designed to work if a child is left in the car unintentionally or intentionally by using an alarm sound notification sent through the smartphone to alert parents or other caregivers of children (Abulkhair et al., 2017).

The HACC application was also tested with five volunteers to determine if it was user friendly among experts. Volunteers downloaded the HACC application to their android mobile phones first and were then asked to perform several basic tasks on the application. Results from the five usability tests identified 80% of the volunteer testers completed the task easily, while 20% of them could not complete tasks such as responding to an alert by opening the windows and turning the alert off. Also, 80% of the volunteers reported that they were very confident about completing the task, while 20% were fairly confident. The results support that the application is user friendly (Abulkhair et al., 2017). The HACC system was compared to the Cars-N-Kids car seat monitor which is able to sense a child's presence in a car seat inside of the car. Through comparison it was determined that the Cars-N-Kids seat monitor is only able to detect a child if he/she is actually sitting in the car seat. The HACC system is able to check the presence of a child anywhere inside the car through the use of a motion sensor (Abulkhair et al., 2017). The results from the usability analysis identified that HACC is designed as an interactive system to save children from hyperthermia through smartphone application sound alerts for parents or other caregivers of children, bystanders and emergency agencies (Abulkhair et al., 2017).

A cross-sectional study explored parents' willingness to use a smartphone application to remind them that their child is in the vehicle (Albert & Kerbis, 2019). The study was conducted in Israel via an internet- based questionnaire in 2017 and a convenience sample of 92 parents with children under age 10 were recruited from email lists and social media. The study sample consisted of 59 females and 33 males. The mean age of the participants was 36 years and 28% held a master's degree, 45% held a bachelor's degree, 24% had a high school diploma and 3% had an elementary school education (Albert & Kerbis, 2019). Data was collected for a month via a 23-item questionnaire framework based on the Technology Acceptance Model (TAM) proposed by Venkatesh and Davis. In addition, 10 participants were excluded from further analysis due to incomplete surveys. The questionnaire contained personality, socio-economic, perception, attitudes and behavioral items to assess intentions toward using technology. The instrument scale ranged from one to four with four indicating agree and one indicating disagree (Albert & Kerbis, 2019).

Findings from the cross-sectional study identified 85% of the sample did not use a smartphone application or system to remind them not to forget a child in the vehicle, 12% of the sample used a smartphone application as a reminder, and 3% stated their car was equipped with a system (Albert & Kerbis, 2019). A significant relationship was identified between perceived usefulness and attitude toward the instrument use, ($r = 0.25$, p-value < 0.01). This result implies a more positive attitude towards use. The relationship between anxiety and attitude towards use was also significant ($r = 0.24$, p-value < 0.05). The higher degree of anxiety implies a more positive attitude toward using and between anxiety. The significant relationship between behavioral intention to

use, ($r = 0.18$, p-value < 0.05) and a higher degree of anxiety, implies a higher intention to use (Albert & Kerbis, 2019). Women show a significantly more positive attitude toward using technology (Albert & Kerbis, 2019). A strength of the study is perceived usefulness of this technology is significantly and positively correlated with usage attitudes (Albert & Kerbis, 2019). Limitations of the study include: the small convenience sample which limits generalizability to other populations, further explanation of parents' intention to use technology must be tested, barriers may affect parents' willingness to use this type of technology and reproducibility of this study in other countries is suggested (Albert & Kerbis, 2019).

Physiology Related to Heatstroke

An important element for future studies involving technology is exploring the physiological changes that precede heatstroke in young children. These physiological changes can help provide information about the types of technology that may prove helpful in preventing PVH by alerting parents before life threatening physiological changes occur in a young child left alone in a vehicle. In a study that examined such physiological changes a descriptive record reviewed retrospective autopsy results that presented clinical findings for seven children who died in parked cars (Adato et al., 2016). A forensic pathologist re-examined the original autopsy reports for these seven children whose bodies were taken to the Israel National Center for Forensic Medicine (INCFM). The children were ages seven months to six years old with a median age of 3.1 years and a 1:1 male to female ratio. The median time of entrapment in vehicles was four hours for five of the children and unknown for two of the children (Adato et al., 2016).

Findings from the autopsy reports revealed petechiae and hemorrhages of serosal membranes were common for the entire age range. Skin burns of various degrees and lung congestion was found in three children. The autopsy findings were comparable to diffuse hemorrhages and lung congestion seen in soldiers who died from environmental heatstroke (Adato et al., 2016). The strengths of this study include the autopsy report findings are consistent with the data about the children's entrapment in parked cars and comparable to autopsy findings for soldiers who died from heatstroke. These findings help rule out other causes of death for the children and suggest that heatstroke is a feasible cause of death. Limitations of this study are the small sample size, retrospective examination, and the comparisons of physiological results with adult autopsy results (Adato et al., 2016). Although the autopsy findings were compared to adults, the information is useful for educating parents or other caregivers of children about the risks associated with children entrapped in hot vehicles and the importance of swift intervention in order to prevent fatal heatstroke. The findings also emphasized the importance of future autopsy exams to study the effects of fatal heatstroke in children (Adato et al., 2016).

Another literature review focused on the differences in child-adult thermoregulation and the impact of changes in the climate. The aim of this literature review was to emphasize the adverse impact of climate change on thermoregulation, physiological function and overall health in children with a focus on risk reduction strategies (Smith, 2019). Climate change is a focus of the literature review since U.S. predictive models indicate increases of 1.7- 6.7 °C by the year 2100 for global temperatures (Smith, 2019). Children have increased vulnerability to the effects of heat

stress with increased morbidity and mortality versus healthy adults. Age groups of greatest risk are adults age ≥ 75 years and young children ages zero through four years. Death rates are 4.2 per million in infants and younger children due to being restrained in vehicles and their inability to operate locks of vehicles when ambient temperature is elevated. The World Health Organization predicts child mortality related to heat exposure at greater than 100,000 deaths per year by 2050 (Smith, 2019).

A physiological difference which increases young children's vulnerability to heat exposure is their total body surface area (BSA). Children have a larger BSA to mass ratio with more dry heat loss and evaporative efficiency than adults which is advantageous in cooler and moderate conditions (Smith, 2019). The larger BSA affects thermoregulation and provides a greater surface area to absorb heat in hot environments which may increase the risk of heat illness (Smith, 2019). Due to a larger BSA, children ages zero through four years are high risk for experiencing heat illness or heatstroke when left alone in a hot vehicle.

Findings from the literature review identify obesity as a widely recognized risk factor for heat-related illness and injury in both adults and children. According to the National Health and Examination Survey (NHANES) in 2015-2016, 35% of 2-19-year-olds were overweight (BMI $\geq 85^{th}$ CDC percentile) and 24.5% were obese (BMI $\geq 95^{th}$ percentile). Recent estimates from the U.S. indicate that the prevalence of childhood obesity continues to increase (Smith, 2019). Several studies in children demonstrate the physiological disadvantage of adiposity during exercise. Obese children typically have a greater total body mass compared to lean children which leads to greater heat production (Smith, 2019). The larger BSA coupled with obesity in children ages zero

through four years are identified physiological factors which affect their ability to thermoregulate.

Another physiological risk factor which increases children's susceptibility to heat illness is fluid intake. Hypohydration is a major risk factor in the development of heat illness and life- threatening heatstroke (Smith, 2019). Young children feel a limited need to replenish fluids even when intake is insufficient which leads to voluntary dehydration and a rise in core temperature. The rise in young children's core temperature reduces tolerance to heat and affects their ability to thermoregulate (Smith, 2019). A greater rise in core temperature occurs in young children versus adults. As the climate changes, the risk of dehydration among children may increase therefore it is important to encourage preventative habits to maintain pediatric fluid intake (Smith, 2019). It is important for both adults and young children to replace both electrolytes and water during exercise or warm weather to prevent dehydration, heat illness or heatstroke (Smith, 2019). The American Academy of Pediatrics recommends the following risk reduction strategies to address climatic heat stress and exercising children: reduced exercise intensity with high temperatures, ensure adequate hydration, increasing rest periods and child education on heat illness and hydration to help raise awareness of prevention (Smith, 2019). Although these recommendations are for older children, they provide information which can help alert parents that precautions are necessary for children of all ages when climate temperatures are elevated.

Strengths of this literature review include the identification of physiological risk factors that affect young children's susceptibility to heatstroke and the description of how climate change impacts the risk factors. This data can help provide a physiological

explanation, for parents or other caregivers, about young children's susceptibility for heat illness or heatstroke.

Limitations of the literature review include limited research about the relationship between fluid intake and childhood obesity and limited data about sweat composition in children and adolescents. Also, hydration guidelines for children are derived from adult data (Smith, 2019). The long-term impact of children's exposure to heat, ultraviolet radiation and sunlight on physiological function are not fully understood. Efforts between climate/thermal physiologists, epidemiologists and policymakers are necessary to produce more comprehensive heat protection policies which incorporate technology and behavioral adaptations (Smith, 2019). Development of future heat protection policies will need to consider data collected for child fatalities as a result of PVH. PVH is the leading cause of non-traffic related vehicle fatalities for children under the age of 14 years in the U. S.

A descriptive study based on media reports described the frequency of non-traffic incidents, injuries and fatalities to children. The non-traffic injuries and fatalities were tracked for children ages zero through 14 years in the U. S. from January 1990 to December 2014 (Zonfrillo et al., 2017). Data was collected from media reports, accounts from families of affected children, medical examiner reports, police reports, child death review teams, medical/legal professionals and other modes of publication. Findings from the study described 3,115 children were left unattended in hot vehicles which resulted in 729 deaths from PVH. There were 2,251 vehicle backovers resulting in 1,232 deaths and 1,439 frontovers resulting in 692 deaths (Zonfrillo et al., 2017).

Strengths of this study include it was the first study to describe a broad spectrum of nontraffic injuries and deaths in children over a 25-year period in the U. S. and it provided significant data about the number of deaths specifically related to PVH (Zonfrillo et al., 2017). The data that was collected about PVH helped to increase public awareness of this preventable tragic event. Limitations of this study include the use of retrospective data which may present a bias for the identification of incidents and every case of non-traffic incidents was not collected due to limited surveillance of records. Future descriptive studies may increase comprehensive collection of data through review of police records, electronic health records and media reports (Zonfrillo et al., 2017). The number of deaths as a result of PVH and other non-traffic incidents are underestimated due to limited data collection sources. In order to reach a comprehensive understanding of the impact of PVH, it is crucial to obtain accurate data.

Parental Knowledge/Behaviors

A descriptive study, based on internet searches during May 2011- August 2012, summarized the circumstances surrounding fatal events in which parents or other caregivers of children forgot or intentionally left their children in parked vehicles (Ferrara et al., 2013). This seminal study provides some of the first data about the reasons children are left in vehicles. The study describes 16 cases of death/illness in children left unattended in parked cars located on the streets of Italy (Ferrara et al., 2013). Children included in the study were less than 11 years old and in 14 of the cases, the children were $\leq$ 3 years. The data was collected from internet searches, newspapers and news websites about children who were left intentionally or unintentionally in a parked vehicle

(Ferrara et al., 2013). Data was collected on 16 children, seven males, five females and four cases where gender was unknown.

Findings of the study identified that 12 out of the 16 children were left intentionally and 75% of these parents who left the child intentionally went to work, to the store, clubbing or a bar. There were three children who were left unintentionally and accounted for 18% of the cases (Ferrara et al., 2013). The mother was responsible for the child in four cases, the father in two cases and both parents in nine cases. There were 18.7% cases where the parent forgot to drop the child off at daycare or the children were forgotten in the car (Ferrara et al., 2013). Death did not occur in 13 out of the 16 cases (Ferrara et al., 2013). A strength of this descriptive study include the collection of data about some of the reasons children are forgotten or left intentionally in parked vehicles. Another strength is the identification of the need for parental educational programs about the risks of PVH (Ferrara et al., 2013). The study also indicated that legislative efforts may not help to prevent children being left in vehicles because most of the cases were unintentional (Ferrara et al., 2013). Limitations of the study include the small sample size and limited data sources that may affect generalizability to other populations.

Another study collected data about the incidence of children left in parked vehicles and parental behaviors surrounding the occurrence of these events. This case study investigated the incidence of children left in parked vehicles in Brazil. Data were collected from news reports in Brazil as well as, on websites such as Google, Bing and Yahoo (Costa & Grundstein, 2016). Information about the date, location, age, gender of child, circumstances surrounding being left in the vehicle, the occurrence of a fatality

and length of time the child was left in the vehicle was collected during 2006 to 2015 for 31 cases (Costa & Grundstein, 2016). The data was collected for children left in parked vehicles near Sao Paulo, Brazil and 58% of the children were less than two years of age, and 75% were less than three years of age. The gender reported for the children was: 50% male, 47% female and 3% unknown (Costa & Grundstein, 2016).

Findings of the case study indicate there were 21 incidents of fatalities and 10 children were discovered before death. Seventy-one percent involved a parent forgetting the child in the vehicle, 23% were left intentionally, 3 % gained access to the vehicle and in 86% of fatal cases, the child was forgotten (Costa & Grundstein, 2016). Statistical significance was achieved for a parent being more likely to leave a child unattended in a vehicle ($p= 0.001$) than an unrelated caregiver and the average time a child was found in fatal cases was five hours compared to two hours for nonfatal incidents (Costa & Grundstein, 2016). The findings differed from U. S. data with regards to the number of fatal incidents for children forgotten on the backseat of a vehicle and less children were left in the vehicle intentionally. Also, incidents were not limited to one season as in the U. S. study where 70% of fatalities occur in the Summer (Costa & Grundstein, 2016).

Similarities between this study and the descriptive study conducted in Italy (Ferrara et al., 2013) are more than half of the children are male, between the ages of two and three years of age and they were forgotten in a vehicle by a parent. Strengths of the study are a need for public awareness/education about PVH and a need for reminders to check the backseat were identified (Costa & Grundstein, 2016).

A descriptive study of coroner's reports collected data to identify the incidence of PVH across Canada and examine the contributing factors. Each Canadian providence provided the incidence of vehicular hyperthermia or heatstroke fatalities for children zero through 18 years (Ho et al., 2019). Data was collected from all provincial/territorial coroner's offices and vital statistics agencies across Canada from 2013 through 2019. Data was also collected from online archived news articles in 2013 (Ho et al., 2019). Findings from the descriptive study identified six child deaths caused by vehicular hyperthermia since 2013. There were three deaths from PVH in July 2013 with one death/year in 2016, 2017 and 2018. The age range for children in this study is less than one year through three years. The reported contributing factors to the deaths were: change in routine, caregiver fatigue, caregiver divided attention and a parked unlocked vehicle. (Ho et al., 2019). Data revealed that four of the six deaths led to charges of criminal negligence and three of the charges resulted in convictions (Ho et al., 2019).

A strength of the study is that an anticipatory guidance document was created for parents in Canada which provided recommendations such as always check the backseat before locking, create reminders, never leave a child unattended in a vehicle, even for a minute and ask the childcare provider to call if a child does not arrive at the location. The number of deaths related to PVH may be underestimated as the data is not published in Canada for the incidence of pediatric deaths due to vehicular hyperthermia (Ho et al., 2019).

A parental behavior that has been identified in several of the studies and that impacts the occurrence of PVH is memory failure. A case study to describe parental loss of awareness involved a nine-month-old male who was forgotten in a vehicle by his

mother and died from a heatstroke. The incident took place in Virginia while the mother worked (Diamond, 2019). The case study reviewed Prospective Memory (PM) and the interaction of brain structures that may increase the occurrence of PM failure. Factors which may increase the occurrence of PM failure were identified and an opinion was explored about whether a memory failure qualifies as a criminal offense (Diamond, 2019). Findings of the case study identified two types of memory: Retrospective (RM) which involves processing, storage and retrieval of information from the past. Prospective Memory involves the use of stored information to plan and execute an action for the future (Diamond, 2019). A strength of the case study is the identification of factors that contribute to a failure of PM: sleep deprivation, stress, absence of a reminder cue and multitasking. Studies which examine the circumstances surrounding PVH have identified some of the children were unintentionally forgotten therefore, it is important to consider the significance of PM in these situations. In addition to the impact that PM may have on these situations, parental knowledge/beliefs about PVH are factors that warrant consideration. Memory impairment is unique for each person and requires individualized evaluation (Diamond, 2019).

A similar study examines the impact of parental memory on children being forgotten in vehicles. The case study focuses on how the working memory (WM) of parents may contribute to the phenomenon of Forgotten Baby Syndrome (FBS). Although FBS is an expression that is not accepted in the scientific field and does not have a precise definition, it has been referred to in literature when discussing the clinical conditions associated with the death of children in parked vehicles (Anselmi et al., 2020). The sources of information for FBS are limited to media and news reports which

have questionable validity for summarizing incidence and related factors because all occurrences are not reported (Anselmi et al., 2020). As a result of the limited information sources for FBS, the circumstances surrounding the death of a child are rarely analyzed in scientific research, instead, the main focus is on clinical conditions that cause death (Anselmi et al., 2020).

Through monitoring FBS in the U. S., the study identified that out of a total of 171 cases, 73% of the children were left in the vehicle and half of the adults were unaware, or had forgotten the child (Anselmi et al., 2020). The role of the WM was explored to determine its relevance to the parents or other caregivers of children's behavior. Working Memory is responsible for managing long-term memory and the perception of information from the current environment. Neuroimaging tools have been used in research to confirm that the prefrontal cortex (PFC) plays an essential role in how auditory and visual information is processed in the WM (Anselmi et al., 2020). When assessing the cases of death where children were forgotten in vehicles, most were positioned in the back seat and asleep. As a result of this positioning, the sensory information does not include signals of the child's presence which is a risk factor for the quality of the WM performance. In most cases where children die as a result of being forgotten in vehicles, it can be assumed that the performance of WM is deficient (Anselmi et al., 2020). This WM deficiency along with other stressors may affect a parent's behavior and decision making regarding driving the car to work without taking the child to daycare because there are no present signs of the child in the vehicle. The strengths of this study are it serves as an initial step in assessing the circumstances surrounding FBS and supports research for technological devices that remind parents

or other caregivers of children that the child is in the vehicle (Anselmi et al., 2020). More research is needed to identify and analyze the circumstances surrounding the incident of FBS. The approach for analyzing FBS will require the identification of the individual, psychological, social and cognitive variables for these events (Anselmi et al., 2020).

In addition to identifying how parents or other caregivers of children's PM or WM may affect their decision-making process, it is important to assess their knowledge of PVH. A cross-sectional study to assess parents' knowledge/beliefs about PVH and assess the associated factors of leaving children inside locked cars involved parents at the pediatric outpatient clinic at King Abdullah Specialist Children's Hospital in Saudi (Alowirdi et al., 2019). A structured questionnaire was administered to 209 parents, 116 women and 85 men. Parents' educational levels were college or higher with 52.68% for mothers and 53.96% for fathers. The mean age of the parents was 36 years and the mean number of children was four. Parents were asked to self-complete the questionnaire which had two sections: Section A designed to collect parents' demographic data. Section B is designed to assess parental knowledge/attitude about PVH and the dangers of leaving children alone in locked vehicles (Alowirdi et al., 2019). Parents also attended a short presentation by medical students about heatstroke in children and the dangers of leaving children alone in locked vehicles.

Findings of the cross-sectional study identified that 75.12% of parents never left their children in a locked car on a sunny day, 79% heard about accidental deaths related to children being left alone in locked vehicles, 81.34% knew children were more sensitive to heat, 77.40% had knowledge of temperature increases in vehicles and 56.52% did not use car seats (Alowirdi et al., 2019). For the parents who never left a

child in a locked vehicle, 51.7% knew a child must not be left alone and only 10.1% of the parents, who left their children alone in a vehicle, knew children must not be left alone (Alowirdi et al., 2019). Univariate logistic regression analysis indicated older age, less paternal education and increased number of children were associated with higher occurrences of children being left alone in vehicles. Also, 14% of mothers compared to 10% of fathers left their children in locked vehicles (Alowirdi et al., 2019).

Strengths of the cross-sectional study include it was the first study to investigate parents' awareness of PVH and an association was identified between age, paternal education and number of children with a higher occurrence of children left alone in vehicles. Limitations of the study include: convenience sampling of participants limits generalizability to larger populations, a threat to internal validity related to the historical event of Saudi women being allowed to drive in June 2018, and the need for further studies in different countries with larger populations. Prior to this date, women sat in the back of the vehicle with the child (Alowirdi et al., 2019).

A similar study examined parents or other caregivers of children's knowledge about children left in hot vehicles. A comparative analysis method addressed the gap in literature by examining components that parents or other caregivers of children and experts identified as important for children forgotten in hot vehicles. The participant group included 25 parents or other caregivers of children that were recruited from health facilities in Athens-Clarke County, Georgia and seven experts with backgrounds in meteorology, epidemiology, psychology and child injury prevention (Williams & Grundstein, 2018). Experts were emailed and asked if they would participate in a telephone interview. Parents or other caregivers of children were interviewed with open-

ended and semi-structured questions about their knowledge/opinions regarding children left in hot vehicles. Interviews lasted from 16 to 45 minutes and were conducted in April - May of 2015. The open-ended questions were content coded and the consistency between coders was evaluated using Cohen's Kappa statistic. A random subsample of parents or other caregivers of children's response was 0.816 which indicates the content analysis is reliable (Williams & Grundstein, 2018).

Findings of the study include the majority of participants denied they could forget their child in a hot vehicle and acknowledged the perception that unfit parents or lifestyle factors increase a parents' risk of forgetting a child. Parents or other caregivers of children and experts agreed that healthcare/childcare providers were a potential source of information for PVH (Williams & Grundstein, 2018). Experts discussed pamphlets, posters and other passive messaging that were in various healthcare facilities during the study. Strengths of the study include identification of the need for future research to evaluate and quantify the risk perceptions of parents or other caregivers of children. A second strength is parents in the study expressed a preference for receiving future safety information about PVH via social media such as Facebook or YouTube (Williams & Grundstein, 2018). Limitations of the study include the mental models approach examines the knowledge of a few individuals regarding a particular issue and cannot generalize the results to all parents or other caregivers of children. Another limitation is the mental models approach is unable to identify specific actions that promote behavioral change among the parents (Williams & Grundstein, 2018). The absence of specific actions which may promote parental behavioral change is an area in need of further exploration by nursing research. The focus of research surrounding PVH has

been on microclimate conditions in vehicles, preventative technology and parental knowledge. Limited research has focused on public health messaging and public health education involving health care providers discussing PVH with parents of young children (Williams & Grundstein, 2018).

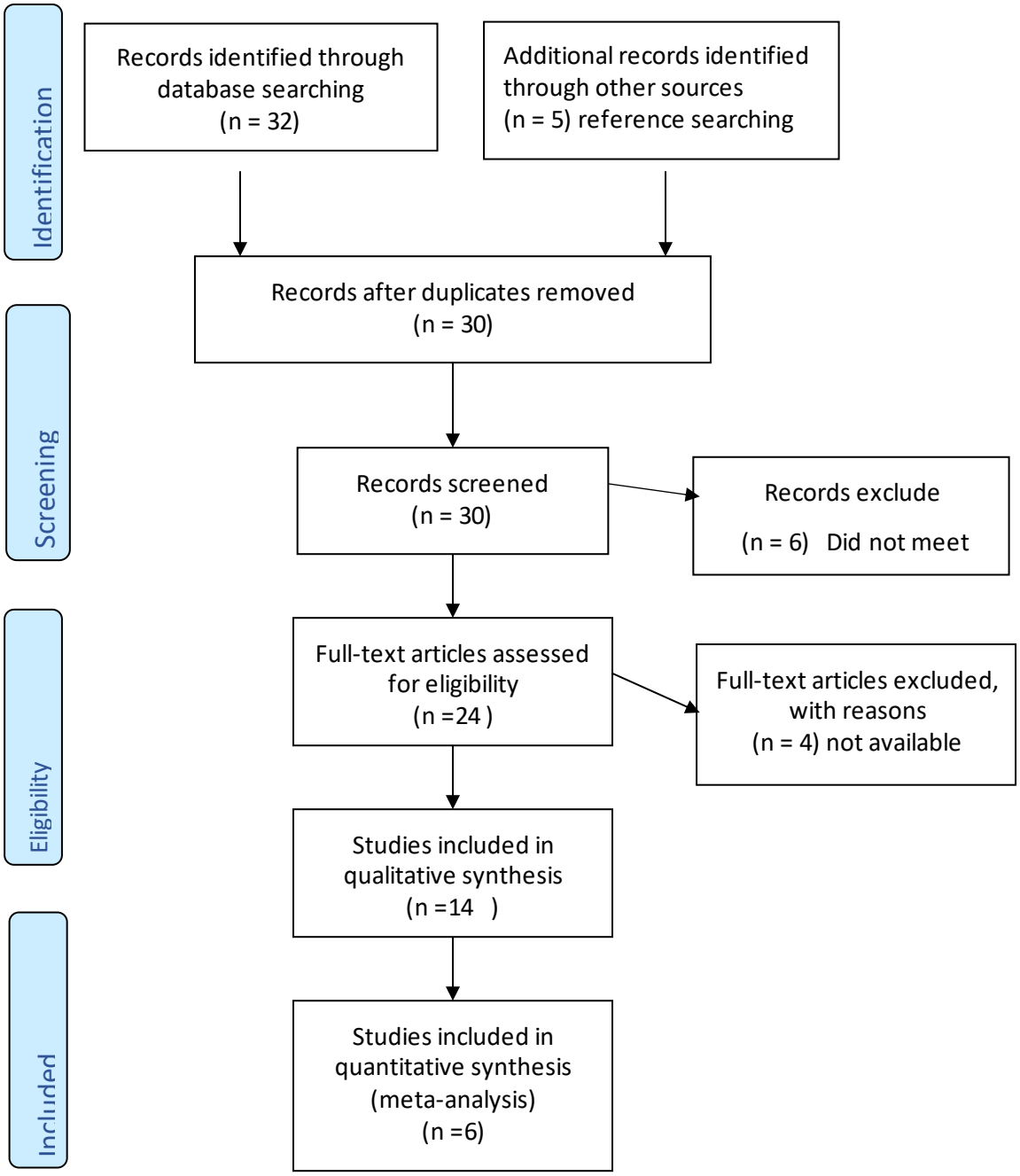
Synthesis

Many current quantitative studies focus on microclimate conditions, modeling studies to explore the physiological effects of PVH, ambient temperatures and asthma, parental attitudes towards use of technology alert devices, and technology sensors for cars. Current qualitative studies focus on data collected from child death reviews, autopsy reports, media reports, literature reviews of the physiological findings surrounding PVH, literature reviews of outdoor microclimates, and the thermal environment of urban schoolyards. The qualitative studies also focus on data about whether the parent or caregiver intentionally or unintentionally left the children in the vehicles and the circumstances surrounding the event.

There are limited qualitative studies involving parents, health care providers and rescue responders who describe their personal experiences with child death, severe child injury or child rescue situations associated with adverse environmental heat exposures. There are limited qualitative studies in which parents, health care providers, and caregivers, who have experience with adverse environmental heat exposure, provide their insight regarding possible preventative measures. There are no published studies in which parents and other caregivers of young children share their personal knowledge and perceptions about environmental heat exposures and best ways to prevent them.

Qualitative nursing research can provide a first step to guide future studies that address the need for prevention of adverse environmental heat exposures. Such studies could explore the integration of various local, regional and national public health agencies and primary care clinicians to increase public awareness about injuries caused by adverse microenvironments and empower communities to effect change (Smith et al., 2016).

PRISMA 2009 Flow Diagram



Moher, D. et al., The PRISMA group (2009)

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Chapter 3

Theoretical Framework

A public health model applied to prevent child maltreatment along with Haddon's Matrix, a commonly accepted injury prevention framework, guided this dissertation research. This study explored knowledge and perceptions among parents or other caregivers of young children, of adverse heat exposure in young children and potential modifiable factors associated with these events that could guide future prevention. Haddon's Matrix closely examines injury prevention according to how, when and where the severity can be reduced (Scott et al., 2016). Haddon's Matrix also examines interventions across universal, secondary and tertiary services while analyzing the injury according to pre-event, event and post-event stages (Scott et al., 2016). The public health model identifies specific risk and protective factors for an identified problem to minimize the impact. The public health approach can be applied to protect children from harm (Scott et al., 2016).

Public Health Model to Prevent Child Maltreatment

Child maltreatment was identified as a priority for public health in 2005 when a shift occurred in funding and laws associated with child injuries. The focus shifted from treating injuries sustained by children as a result of abuse, neglect or violence, to preventing childhood injuries (Covington, 2013). This focus on prevention led to the application of a public health model to develop interventions that would prevent child maltreatment and promote child well-being for a large population of families (Covington, 2013). The public health approach to child maltreatment is important because it includes primary prevention which can impact more children than secondary and tertiary

prevention (Covington, 2013). The public health approach for preventing child maltreatment involves the following steps: defining problems, identifying risk and protective factors, examining the impact of problems and developing/testing preventative plans (Covington, 2013). In addition to these steps that are used to examine the complexities involved with child maltreatment, public health methodology provides a foundation for analyzing relationships between the identified key factors impacting child safety.

Public health methodology focuses on the concepts of the host, agent and environment which are in constant interaction with one another. A host is defined as a person or population with a condition or a population at risk for a condition. An agent is the causal factor which can be a toxicant, organism, psychosocial or physical issue. The environment is the surrounding where the host and agent interact (Scott et al., 2016). The three concepts impact each other and must be considered when developing public health interventions. Public health interventions are developed to target the relationship between at least two of the concepts (Scott et al., 2016).

Figure 1. Three factors of public health interventions.

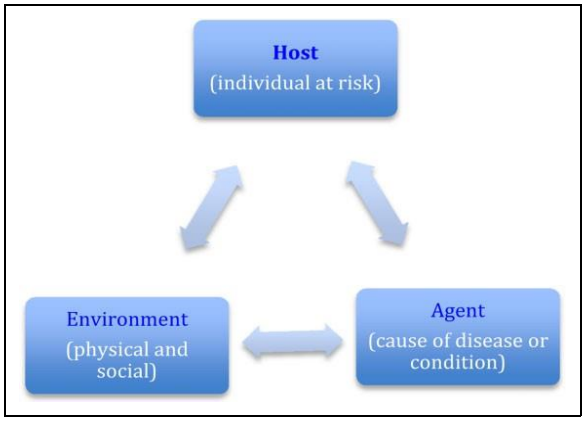
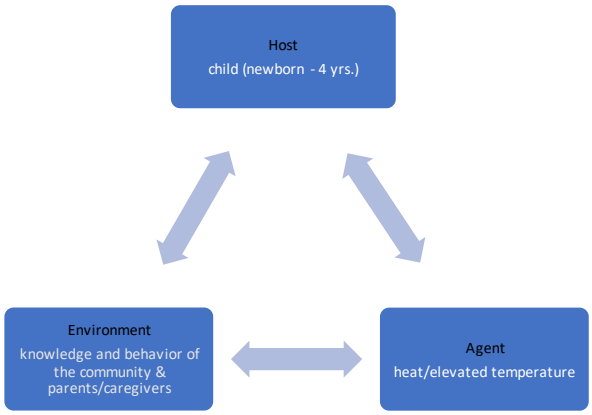


Figure 2. Example of three factors interacting in the public health model related to adverse environmental heat exposure.



An interference with the relationship between two of the public health model concepts affects the transmission of diseases or the impact of a condition. The outcomes associated with this interference depend on the level at which the intervention is introduced to the host, agent or environment. Public health interventions occur at the primary, secondary, and tertiary levels (Scott et al., 2016). The primary level of intervention for the public health approach to child maltreatment focuses on preventing abuse or neglect before it occurs. Primary interventions include parent education, community education and policy/organizational changes (Covington, 2013). The secondary level of prevention focuses on preventing further harm to children who are at risk of experiencing abuse or neglect and involves interventions such as home visit programs, parenting support groups and foster care (Covington, 2013). The tertiary level of prevention focuses on assessing the needs of children who have been seriously injured as a result of abuse or neglect and preventing further injuries to these children. Tertiary interventions include medical care, counseling services, and the filing of child abuse/neglect reports (Covington, 2013).

Public health interventions at the primary, secondary, and tertiary levels can be explored to determine how they may impact the host, agent and environment in relation to adverse environmental heat exposures in young children. The identified host in this dissertation research is a vulnerable child population, ages newborn through four-years, the agent is the heat/elevated temperature and the environment is the state of knowledge and behavior of parents or other caregivers of children. The qualitative research design in this dissertation will explore knowledge and perceptions that parents or other caregivers of children have about factors that lead to children being exposed to adverse environmental heat. This initial data could then be used in development of further research with the goal of identifying prevention strategies such as parent education awareness programs sponsored by healthcare agencies/pediatricians and multi-media advertisements that highlight the risks associated with leaving young children unattended in vehicles or outdoors in the heat for any length of time.

Primary interventions such as these are not commonly used for environmental heat exposure but could help expand the audiences for this preventative information. These primary interventions may provide initial steps towards addressing the identified gaps in literature surrounding public health messaging and public health education by health care providers. The overall goal of these primary interventions is to provide parents or other caregivers of children with information about the risks of microclimates such as leaving their children unattended in a vehicle or unshaded outdoor play area. Developing primary interventions has the potential to impact the host-agent relationship by educating the public about how quickly the inside temperature of a vehicle rises and can cause severe injuries or a fatal heatstroke in young children.

Haddon's Matrix

Haddon's Matrix is the second public health framework that will guide this dissertation research. The focus of this framework is to identify how, when and where interventions will most effectively prevent or reduce an injury (Scott et al., 2016). Haddon's Matrix analyzes injury events according to time such as pre-event, event and post-event (Scott et al., 2016). The pre-event stage involves the application of universal strategies to prevent accidents/injuries. These strategies may include licenses, education courses about acceptable and unacceptable behaviors, fines, laws, and safety improvements to the surrounding environment (Scott et al., 2016). The event stage is the occurrence of the actual injury/accident. The environment is modified to minimize the effects of the injury/accident. The post-event stage occurs after the injury/accident has taken place and focuses on minimizing further injuries or complications (Scott et al., 2016). Each stage is evaluated in relation to the host, agent, and environment that influences the interventions at each level.

Haddon's Matrix provides a foundation for the purpose of exploring the precursors to adverse health outcomes related to environmental heat exposure from the perspective of parents or other caregivers of children. According to Haddon's Matrix, precursors belong to the pre-event stage and influence the host, agent, and environment. In the pre-event stage, it is imperative to explore parental knowledge and perceptions of events surrounding extreme environmental heat and health outcomes. Through exploration of parental knowledge and perceptions, qualitative data will be collected from a diverse group of parents or other caregivers of young children that will help provide a more in depth understanding of the precursors to environmental heat

exposure.

In addition to gaining an understanding about pre-event interventions, Haddon's Matrix was useful for exploring event-stage interventions. Parents or other caregivers of children who had experience or heard about rescues of young children from an extreme heat exposure event, for example a child left unattended in a vehicle in the heat, were able to provide valuable insight about actions that contributed to the event. Shared information about their experiences surrounding young children exposed to adverse heat microenvironments can aid in the identification of environmental and behavioral conditions associated with the occurrence of injuries or deaths associated with the event stage. Current interventions that address the event stage, for example heat exposure in vehicles, are limited by technological applications that are not available in all vehicles or car seats therefore, these interventions are not largely accessible to parents or other caregivers of children. Collecting data from parents or other caregivers of young children about their knowledge and perceptions or individual experiences with rescuing young children from adverse heat microenvironments, may provide details that will be useful for future development of event stage interventions.

Table 1. Example of Haddon's Injury Prevention Matrix Applied to PVH

	Host	Agent	Physical Environment	Social Environment
Pre-event	Children ages newborn to 4-years of age	Parent/caregiver behavior Community awareness & engagement	Enclosed vehicle during hot days, elevated temperatures	Lack of parental knowledge and awareness; lack of community campaigns and legislation
Event	Young child rescued from hot vehicle, prevent death or severe injuries to the child	Adult bystander recognizes unattended child, Technological devices in newer vehicles that are not available in older vehicles, car alerts/alarms, broken car windows	Bystanders nearby, public location, limited time to rescue child from enclosed hot vehicle, active search to locate parent/caregiver	Good Samaritan, Paramedics, Law enforcement officers, Firefighters, Child protective services notified, Parent/caregiver questioned about event
Post-event	Young child sustains serious injuries or dies as a result of PVH or environmental heat exposure	No vehicle alarms or alert devices, absence of protective adults, child undetected in hot vehicle	Seriously injured or deceased child located in a hot vehicle, Paramedics/911, hospital/health care providers	Distraught parent/caregiver, News/media reporters, Grief counseling/support groups, Criminal charges, stigmatization of parent/caregiver

This dissertation research used narrative inquiry methodology to guide the exploration of precursory knowledge and perceptions of parents and other caregivers of young children. The focus in this study was to have participants share information about their past and/or present knowledge and perceptions with adverse environmental heat exposures in young children. Parents and other caregivers were able to describe the impact of interactions with others, and the physical environment in this regard. Semi-structured interviews and field notes were used to capture what participants shared about the meaning of the phenomena within the constructs of their world.

Qualitative data collected through narrative inquiry methodology for this dissertation study is an initial step towards allowing parents or other caregivers of children to inform the direction of future work on prevention. Through allowing parents or other caregivers of children to share their perceptions, the principal investigator (PI) gained more insight about past and present actions, interactions with others, and the physical environment that influenced behaviors surrounding young children and adverse environmental heat exposures.

Narrative Inquiry

The Narrative Inquiry method of qualitative research was used in this dissertation research to explore knowledge and perceptions of parents or other caregivers of children related to modifiable behaviors and health effects of adverse environmental heat exposures in young children. Narrative inquiry methodology allows participants to discuss their personal perceptions and experiences without constraint (Wang & Geale, 2015). In Narrative Inquiry, participants' stories surrounding their experiences help identify patterns in their life associated with a phenomenon (Wang & Geale, 2015).

Narrative inquiry captures the social, cultural and environmental influences on human experiences and allows the researcher to gain a more in depth understanding of the participants' world (Haydon et al., 2017). Narrative inquiry methodology is frequently used in sociology and education (Haydon et al., 2017). Connelly and Clandinin used narrative inquiry in the field of educational research to assist with curriculum development and to describe the personal stories of teachers (Wang & Geale, 2015) . Connelly and Clandinin's approach to narrative inquiry is based on philosopher, John Dewey's three-dimensional structure that includes: interaction, continuity and situation (Wang & Geale, 2015). This three-dimensional approach involves the personal experiences and social interactions of the participant, considers the participant's past, present and future actions and evaluates the physical environment (Wang & Geale, 2015). The three-dimensional approach helps the researcher learn about the participant's personal experience related to a specific phenomenon.

Narrative inquiry is used in nursing research to gain an understanding of patients' experiences, health care issues and to analyze nurse-patient relationships (Wang & Geale, 2015). Narrative inquiry is also used in nursing to help improve patient care because people are allowed to share personal experiences of their illness with the healthcare team (Haydon et al., 2017). Patient's shared personal experiences provide information about their individual health/psychosocial needs, family support systems and barriers to treatment. The healthcare team can use this information to acknowledge the patients' needs and provide person centered care (Haydon et al., 2017).

Content Analysis

Content analysis was used to gain knowledge about the phenomenon of heat and children's health. The content analysis method was initially used in the 19th century to analyze newspaper and magazine articles (Harwood & Gary, 2003). Throughout the years, the use of content analysis expanded into the fields of psychology, sociology, communication, business, journalism and nursing (Neundorf, 2002). Today within the field of nursing, content analysis is commonly used in studies of acute and chronic care nursing practice, nursing education, palliative care, nursing ethics, telehealth, public health and most recently nurses and Covid-19. Nurse researchers often use content analysis to analyze sensitive topics that are frequently encountered in nursing practice. The flexibility and content-sensitivity of this method is useful for nursing researchers because it enables them to collect qualitative data in natural settings and gain a deeper understanding of a phenomenon (Elo & Kyngas, 2007).

The concepts related to the phenomenon are broken down into smaller units that are coded, named and grouped according to content. The content is analyzed to identify themes and patterns that frequently reoccur or are noteworthy (Polit & Beck, 2018). In addition to identifying themes and patterns, the meaning of the content is interpreted to gain an in depth understanding of what is being communicated (Polit & Beck, 2018). The process that is used to analyze the content follows an inductive or deductive approach, depending on the purpose of the research study. If the purpose of the study is to test an established theory, a deductive approach is used. If the purpose of the study is to collect more information about a phenomenon that is new or not completely understood, an inductive approach is used (Elo & Kyngas, 2007).

For both the deductive and inductive approaches, there are three main phases of content analysis. The first phase is preparation which involves deciding the theme, words or sentences that will be analyzed. The second phase of content analysis entails organizing the data and trying to gain a sense of what is happening. Lastly, after the data has been reviewed several times, the third phase begins with reporting the results of the analysis (Elo & Kyngas, 2007). Content analysis is flexible and allows the researcher to proceed with the process according to what is most appropriate for their research question (Weber, 1990).

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Chapter 4

Methodology

This dissertation research utilized narrative inquiry and inductive content analysis methodology to identify knowledge and perceptions of parents and other caregivers of young children regarding the health effects and factors related to adverse environmental heat exposures in young children. Qualitative data was collected from a diverse community of parents and other caregivers of children. The purpose of the study was to develop a deeper understanding of the phenomena surrounding parents or other caregivers of children as to their perceptions of young children left unattended in microclimates such as vehicles or unshaded outdoor play areas. The goal was to inform future research studies that may impact clinical and public health practice and help mitigate adverse outcomes from environmental heat exposure in children newborn to four-years of age.

Setting

Data was collected through a 40-60-minute semi-structured interview and a demographic survey. The interviews were conducted over UCLA secured Zoom to protect privacy for the participants. The PI conducted the interviews over Zoom while in a private room with a closed door to prevent others from hearing the conversation. The participants were in their homes during the interviews and were advised to seek out a private room to prevent being overheard.

Sample Size

A purposive sample of 16 parents or other caregivers of children was recruited through posting internet flyers and snowball referrals. Purposive sampling, a method

used in qualitative research and content analysis, allows the researcher to select participants based on who will be most informative (Moser & Korstjens, 2018). This method allows for the flexibility of interviewing participants from a variety of settings who can provide rich data. Saturation of data occurs when new concepts are no longer emerging from the data and maximum information about the phenomenon has been collected (Moser & Korstjens, 2018). Reaching saturation in qualitative analysis usually occurs at less than 25 participants. Saturation occurred with a sample of 16 adult participants in this study.

Inclusion Criteria

Eligibility criteria included being parents or other caregivers of children; caregivers had to be aged 18-years and older and had to be caring for children ages newborn to four-years. All participants had to speak, read and write English and be willing to participate in a 40-60-minute interview. Only one adult parent or other caregivers of children from the same household were allowed to participate in the study.

Exclusion Criteria

Parents or other caregivers of children who were under the age of 18 and unable to speak, read and write English were excluded from the study. Parents and other caregivers of children living outside of Southern California were also excluded from the study.

Recruitment

A purposive sample of 16 parents or other caregivers of children was recruited through posting internet flyers on the following websites: Nextdoor, SLACK and Linkedin. Study participants were also recruited through snowball referrals. Study flyers

were also electronically disseminated to co-workers and colleagues who were asked to disseminate to parents or caregivers they thought might be interested in participating. Phone calls were made and email flyers were sent to four pediatric health care providers and five childcare providers to ask them to share information about the study with parents or other caregivers of children. All internet flyers contained a brief description about the purpose of the study, inclusion criteria, participant confidentiality and contact information for the PI of the study. Email addresses and phone numbers for the pediatric health care providers and childcare providers were obtained from public websites that provide contact information for these providers.

A registered nurse, from one of the four pediatric health care providers, responded via email and expressed interest in the research study. The PI contacted the registered nurse to conduct screening questions and provide study consent information. An interview date and time was established however, the registered nurse did not follow through with the interview. The PI emailed the registered nurse to inquire about re-scheduling the interview and there was no response. Email flyers that were sent to the four pediatric health care providers did not yield any research study participants. There were two childcare providers, out of the five who were sent research study flyers, who agreed to participate in the semi-structured interview. A total of 23 parents who received the study flyer through snowball referrals, co-workers, and the SLACK website emailed the PI to inquire about the research study. There were four parents who did not respond to the PI email requests to schedule a time to conduct the screening questionnaire. There were three parents who completed the screening questionnaire and met inclusion criteria however, they did not follow through with the scheduled interview. Several

follow-up emails were sent to the parents asking if they would like to reschedule the interviews, however they did not respond. There were 14 parents and two non-parent caregivers who met the inclusion criteria and agreed to participate in the semi-structured interviews.

During the recruitment process, all study participants were informed about confidentiality rights for information that was discussed during the semi-structured interview and collected on the demographic survey. A screening script was used when potential participants contacted the PI to inquire about the study (Appendix B). The PI determined eligibility for the study based on the responses of the potential participants. After eligibility was established and upon agreement to participate in the interview, oral informed consent was obtained including consent to allow audio and video recording of the interview (Appendix C). Participants were informed that participation in the study was voluntary and that they could end the interview at any time. Personal identifying information was collected to schedule the interview. Once the interview was completed, all personal identifying information was destroyed. No personal identifying information was linked to the content of the interview. During the interview, participants were asked not to use their name or the name of others, instead to use pseudonyms. A demographic survey was administered via email to all parents or other caregivers of children before the interview. The following questions were included in the survey: age, gender, number of children, education level, ethnicity, city of residence, and occupation.

Compensation for Participant Time

Each participant was emailed a $25.00 Amazon or Starbucks gift card after the interview for their time and any expenses they incurred.

Data Collection

A semi-structured interview guide was developed based upon review of the literature and it consisted of open-ended questions about PVH, child safety in vehicles, and other environmental heat exposures (Appendix D). The interview guide was reviewed by the dissertation chair and one dissertation committee member before its use with study participants to ensure validity. The interview guide was used to help engage interview participants and promote discussion. Interview questions helped to facilitate in-depth conversations about their thoughts, perceptions, experiences, and knowledge surrounding adverse environmental heat exposures. Interview participants were asked follow-up questions that allowed them to elaborate about their experiences or related topics that they were comfortable discussing during the interview. It is important to let the participants guide the interview and provide additional information about their thoughts or experiences (Corbin & Strauss, 2015).

Data was collected during a 40-60-minute Zoom interview. Interviews were conducted by the PI in the mornings, afternoons or evenings during the week and on the weekend to accommodate participants' work and childcare schedules. The interviews were recorded via a secure laptop computer with participant consent. Participant interviews were transcribed via Zoom. After the interviews were completed, the Zoom transcripts were reviewed by the PI for accuracy while listening to the recordings. Interview recordings were deleted after verifying that the transcriptions were accurate. All identifying information such as names, age, occupation and city location were removed from the transcribed documents during the review process. Pseudonyms were used for each study participant to ensure confidentiality. Each participant was

given the opportunity to review their interview transcript for accuracy and allowed to correct or clarify information.

Field notes, without identifying information, were written before and after each interview in a journal that was stored in a locked file cabinet. The field notes were used to describe observations about: the surroundings, interesting or problematic interview discussions, the participants' language and actions during the interviews (Charmaz, 2014).

Ethics

The research study was approved via expedited review by the University of California, Los Angeles (UCLA) South General Institutional Review Board (SGIRB) within the UCLA Office of Research Administration Human Research Protection Program. The PI and research personnel completed all training required by the UCLA SGIRB prior to submitting the study application for review and approval.

Data Analysis

Data collected during the semi-structured interviews was analyzed using the following inductive content analysis process: open coding, creating categories and abstraction. Before open coding, the PI reviewed the interview transcripts for accuracy by listening to the audio recordings while reading each line of the interview text. During open coding, the transcripts from the interviews were reviewed line by line and notes were typed in the margins of the text. The notes were used to describe what was going on in the data and to make headings in the margins. The headings were used to distinguish the meaning of data and to identify differences or similarities with the data (Moser & Korstjens, 2018). After the headings were created, they were placed on a

coding sheet to form preliminary categories. After the preliminary categories were formed, the data was clustered together based on similarities and differences.

The next step was to create higher order categories based on comparisons and observations between the data. These comparisons, along with the PI's interpretation of the data, helped to identify specific higher order categories for the data (Moser & Korstjens, 2018). Each higher order category was given a name based on its content. The categories were created to help generate knowledge and understanding of the phenomenon (Elo & Kyngas, 2007). After the higher order categories were created, abstraction was used to identify subcategories to help describe the phenomenon. The subcategories were grouped together according to similarities. These subcategories were grouped into categories to generate main categories (Moser & Korstjens, 2018). The abstraction process of grouping categories according to similar events and information continued until a reasonable understanding of the phenomenon was reached (Appendices H-J). The dissertation chair assisted with reviewing the coding sheets, subcategories and main categories for reliability to ensure that the data reflected the participants words (Elo & Kyngas, 2007). The transcripts were reviewed several times to ensure they were accurate and reflective of the total interview. In order to demonstrate trustworthiness of the data, authentic citations from the participant interviews were used to formulate the categories without identifying the participant (Elo & Kyngas, 2007). Trustworthiness was also demonstrated by using charts and tables to illustrate the links between participant data and the categories that were formulated (Elo & Kyngas, 2007).

During the abstraction process the data was reread to identify missing information and to reflect upon what was seen in the data (Moser & Korstjens, 2018). Additional methods that are commonly used to review the data for missing information, similarities, differences or patterns are memo writing and comparative analysis. Memos were written before and after coding data collected from each interview to discover ideas about what was heard and sensed. The memos encourage development of new ideas, critical reflexivity and provide a space to compare data, codes and categories (Charmaz, 2014). Memo writing was also used to help identify patterns among the data and missing information. In addition to memo writing, comparative analysis was used to assess interview data for similarities and differences. Comparative analysis is a method often used in anthropology, sociology and grounded theory that can be applied to large or small groups. It was used to compare data and identify replications of facts among interview participants. Replication of these facts help to provide validation and increase credibility (Glaser & Strauss, 1967).

Rigor

Trustworthiness of this study was established through providing tables that outline how the data was analyzed to generate initial categories, secondary categories, and final categories. The tables provide transparency regarding the process that was used to reorganize the interview data from the initial broad thoughts and themes to more specific groups that captured the experiences of the participants. Each category was linked to the transcript data that was collected during the participant interviews through the use of direct quotes and repeated or significant themes that emerged from the data. The transcripts for each participant were reviewed several times to identify

patterns of thoughts, feelings, experiences, or ideas expressed during the interviews. Authentic citations were also included to demonstrate the data used in formulating the categories (Elo & Kyngas, 2007).

Another process that helped to establish trustworthiness was the review of interview data by another researcher. The dissertation chair assisted with reviewing the coding sheets, subcategories and main categories for reliability to ensure that the data reflected the participants words and ideas. After the data was reviewed by the dissertation chair, a discussion was held with the PI to provide input about reorganizing the final categories to ensure that they represented the participants' experiences and thoughts. This process helped to identify biases that may have affected the data analysis process and themes that overlapped in the categories that were generated. Categories with overlapping themes were reorganized. Reflexive memos were written before and after each participant interview and during the data analysis process to identify any personal biases or assumptions (Charmaz, 2014).

Conclusion

In content analysis, it is imperative that data collected during the semi-structured interview is accurate and reflects the participants' experience related to the phenomena of interest. The view of the phenomena is different for each person and depends upon what it means to them based on their relationships with people, objects or events (Gergen, 2009). This view allows room for creativity and individuality for each person.

Inductive content analysis was appropriate for the dissertation research because each participant's experience and perception of child safety in adverse environmental heat situations was unique to them. Their views and perceptions were formed by past

and present experiences, relationships, geographical location , or knowledge associated with, for example, child safety in vehicles. It was important to hear and learn about each participant's unique story in order to obtain data that reveals a solution to help prevent children from harm. The solution may emerge from the data and will have relevance to the world that has been constructed by the participants. The data collected from the participants during semi-structured interviews was used to identify new concepts, relationships between the concepts, themes, and to develop categories. This study aimed to gain an in-depth understanding of the participants' knowledge and perceptions about potential modifiable behaviors associated with leaving young children exposed to adverse environmental heat that will inform future research and development of preventative interventions.

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Chapter 5

Results

Study Overview

The purpose of this qualitative study was to identify the knowledge and perceptions of parents or other caregivers regarding the health effects of environmental heat exposures in children aged newborn to four-years, and to explore potential modifiable factors related to this behavior. Parents and caregivers provided in-depth descriptions of personal experiences surrounding the phenomena of PVH and other adverse environmental heat exposures that were familiar within the constructs of their world. As they shared their personal experiences, similarities and differences between the qualitative data emerged.

Parents and caregivers also shared their knowledge about behavioral and environmental factors that could impact young children exposed to adverse environmental heat. These factors were superimposed on the public health model to gain a more in-depth understanding of the interactions between the young children and their surroundings. The public health model encompasses a host, agent/causal factor, and environment (Scott et al., 2016). The specific aims of the study were: (1) to explore the perceptions of adult parents or other caregivers regarding behaviors leading to children being exposed to adverse environmental heat and (2) to Identify adult parents or other caregivers' knowledge about adverse environmental heat exposure and risks to health of children aged newborn to four-years.

Participant Characteristics

The research study participants included 14 parents and two caregivers of children. The participants included 13 female (81.3%) and three male (18.8%). Participants' ages were reported in the following categories: 18-24 (6.3%), 25-34 (56.3%), 35-44 (25%), 45-54 (0%), 55-64 (6.3%), and 65 or over (6.3%). Over half of the participants (62.5%) identified as Black or African American, while four (25%) identified as White, and two (12.5%) participants identified as other. Most of the participants resided in the city of Inglewood (33.3%), followed by (13.3%) residing in the city of Los Angeles and (13.3%) residing in Upland. The remaining participants resided in Compton (6.7%), Edwards Air Force Base (6.7%), Gardena (6.7%), Pasadena (6.7%), Rialto (6.7%), San Pedro (6.7%) and one participant did not provide their city of residence on the demographic survey.

Parents and other caregivers of children frequently reported caring for one (37.5%) child, while eight reported caring for two (25%) or three children (25%). There was one participant (6.3%) caring for four children and another participant (6.3%) caring for five children. Educational levels of the participants included seven participants with bachelor's degrees (43.8%), four participants with master's degrees (25%), four participants with some college credit, no degree (25%), and one participant with a high school diploma (6.3%). Occupations of the participants included: two substitute teachers, a school aid, licensed child care provider, registered nurse, social worker, account manager, fraud investigator who is also a foster care provider, information systems analyst, development coordinator, project manager, real estate agent, patient

care coordinator, clinical research coordinator, contract manager, and one participant did not provide their occupation on the demographic survey.

Table 2: Participant Characteristics

Participants	Age Group	Educational Level	Occupation	Key Responses	Culturally Sensitive Experiences
OM	18-24	Some college, no degree	Not provided	Feeling there should be more classes for the stages of baby, toddler, kid, more parenting and safety classes	No
Ms. A	25-34	Some college, no degree	Substitute Teacher	Described videos about deadly temperatures in cars, left children in running car to grab things from house	No
TM	25-34	Bachelor's degree	Registered Nurse	Identified kids can not regulate their body temperatures, discussed pediatricians providing information about environmental health	No
PM	25-34	Some college, no degree	Substitute Teacher	Daughter hospitalized for heat exhaustion, scary experience	No
SG	25-34	Master's degree	Account Manager	Talking to parents instead of firsthand blaming, wondering about parents mental awareness	No
EM	25-34	Bachelor's degree	Systems Analyst	Thinking we should have an Amber Alert and more covers on the playgrounds	No
SM	25-34	Master's degree	Social Worker	Observing kids/babies outside in the heat without covering or hats, thinking dogs left in cars get more	Excuse among her inner circle is they do not need sunscreen

				attention than kids sometimes	because they have melanin
FM	35-44	Bachelor's degree	Development Coordinator	Described parents leaving kids in cars a lot when he was growing up, experienced being left in the car for a few minutes by his mom	No
ND	35-44	Some college, no degree	Project Manager	Experiencing being left in the car as a child, feeling super uncomfortable and like being tortured	Observed people run in the store and leave kids in cars, described that no one would say anything if the kid looked like him
CM	25-34	High school	Patient care	Knowing babies get more asthma and trouble with respiratory issues	No
CC	55+	Bachelor's degree	Child care	Took classes to learn signs of overheating in children	No
CG	55+	Bachelor's degree	Fraud investigator	Thinking climate change affects learning, outside environment provides more shade	No
BD	25-34	Master's degree	Real Estate	Believing extreme cold might be more harmful than heat because of snow	Lack of parental support in African-American communities
JM	25-34	Bachelor's degree	Clinical Research	Feeling confused about why this keeps happening, there is literature proving that it is dangerous to leave kids in a car	Knowing some black people think they do not need sunscreen
NM	35-44	Bachelor's degree	Campus Aide	Parked and left her one- month-old in the car for about 10 seconds	No

QM	35-44	Master's degree	Contract Manager	Stated she did not know anything specific about children and climate change	No

Specific Aim 1: Perceptions of adult parents or other caregivers regarding behaviors leading to children being exposed to adverse environmental heat

Adult parents or other caregivers' perceptions of behaviors leading to children being exposed to adverse environmental heat were elicited with the use of a semi-structured interview guide to help promote in-depth conversations. The parents and other caregivers of children shared their thoughts and experiences regarding PVH, child safety in vehicles, child safety in non-shaded outdoor play areas, and other environmental heat exposures. There were five main categories that emerged from the interview data: (1) general child safety concerns; (2) physical location and scenarios for environmental heat exposure; (3) parental behaviors and observations; (4) parental experiences and anticipatory fears; and (5) feelings and thoughts about other parents or caregivers.

General child safety concerns

Parents and other caregivers of children identified their priorities for keeping children safe included childproofing the home environment by: ensuring that cabinets are locked to keep unsafe objects out of the children's reach, constantly monitoring what the children are doing, checking foods the children eat to prevent choking, and being present when children are bathing or around animals/pets. TM, mother of four children, shared that she monitors her children when they are in the kitchen around the stove or cabinets, when they are playing with the dogs, bathing or playing outside. TM also shared that she ensures her children are buckled in their car seats and strollers

whenever they go on outings. TM expressed the importance of keeping an eye on her children as they move around her home or play outside. TM shared her personal view of safety for her children:

> And so, I think a safety thing is just making sure that the doors are shut and like we have safety locks on our cabinet, so they can't get into our glass dishes or ceramic dishes. They can't get into chemicals. We have a gas stove oven, so they finally can reach like the little knobs. And so, you know it's making sure that someone is always there like never leaving the stove top unattended. I mean we have dogs, so making sure that the kids don't climb over the dogs, like let them play with them, but don't like, invade their space…Car seats buckling them up appropriately. I still buckle them in the stroller, even though they're big enough …

Both caregivers, CG, foster mother and CC, licensed childcare provider, shared similar views to TM about children and safety. They discussed how their homes had to be approved and how they were required to meet safety standards because they are childcare providers. CG shared her thoughts about how important it was to childproof her home before becoming a foster parent and the importance of carefully watching the children at all times:

> Um and with me being a caregiver there is a lot of things that I had to put in place, and then the things that I had to put in place to have my house approved I thought was good safety measures to protect the child while he's in my care. I think that if you have young children or say if you care for someone in the house, that your house needs to be child proof that you need to make sure that you are

> watching the kids, at all times, especially if they're young kids because anything can happen to them…

CC shared her experience with child-proofing the home environment based on the age of the children and the outside surroundings of the home:

> Well, depending on your location at that particular time. If it's in-home childcare or in a facility childcare, you have to make sure that it's safe also based on the ages of the children. If you're outside, you got to be concerned about different things on the outside. If you have a swimming pool, if you have a dog, just have to have all these things in mind…

Both caregivers and TM described similar actions that they take to keep their children safe while they are inside the home, outside playing, or near pets. They emphasized the importance of closely monitoring young children at all times in various settings.

Another area of general child safety that parents expressed concern over was safety in public places, streets, schools, daycare, and outside. They described the importance of making sure their children are properly secured in car seats when taking them on outings. Parents also mentioned making sure the children are not left alone in cars and that they are watched closely while outside in public places. OM, a new mother, compared her role of monitoring her child in public places to the role of a "security guard" because she constantly monitors her child. She expressed some concern about observing kids walking far away from their parents while they are in public places. OM shared:

> I think safety with children is probably the most important because well, kids don't really know what they're doing. So, it's like you kind of have to be there like security guards 24/7 like you know you're just their backbone. So, yeah, and I think the most important it would probably be to me at least, is like just public safety, like I see I'm not gonna lie. I see many parents just let their kids walk around free like and like they are so far away from their kids I just literally just feel like I don't know.

While OM compared her role as a mother to a security guard, Ms. A and JM discussed not wanting to take on the role of helicopter moms. They both expressed how important it is to make sure their children are safe by using a hands-on approach without being too overbearing. Ms. A, mother of three children, described her approach: "… watching myself at parks, you know, or whatever in comparison to other moms. I let my kids do a lot more than they do so I don't know. I want them to be safe, but I want them to be healthy, but I also want them to learn and grow and build their own confidence, too." Ms. A's desire to keep her children safe and build their confidence aligned with other parents' thoughts about ensuring the emotional safety of their children. Parents discussed the topic of protecting their children from emotional harm in the home and public environment. They identified their role to protect children beyond the physical aspects. Parents expressed that their children's emotional safety is equally as important as their physical safety. They described the child as a whole being with emotional and physical needs that must be addressed.

BD, father of two children, described his view of emotional safety: "…One is that they are around the right people that love them and care for them and treat them like

their own. Like any individual that's around them will have to be someone who's going to love them and treat them like their own. Anyone other than that cannot be around the children." BD expressed that he would protect his children from emotional harm by closely monitoring the people who have access to his children.

Another parent, NM, mother of five children, expressed that a child's emotional safety encompasses being heard by their parents and being allowed to express themselves. NM described her view of emotional safety:

> So, I think for the most part what's important for a child to feel safe is to be heard and have, of course, basic needs. So, you know, adequate food clothing and the emotional part which is being heard. So, if there's anything that the child needs, if they need a special type of therapy because maybe their sensory issues or things like that, that's what safety is about…I think overall it's just important for a child to feel heard, feel like they're able to express themselves and you know having that freedom and knowing that the parent is gonna reciprocate that you know that expression.

Overall, the parents and other caregivers of children perceived general safety for young children as a multifaceted experience that encompasses the home environment, public spaces, and an emotional component. Parents and caregivers expressed the importance of closely monitoring the children's activity while at home or in public places, and while in the presence of other adults. The parents and caregivers' perception of general safety for children was different from the concept of child safety described in the research literature related to environmental heat exposure in young children. The literature describes child safety in relation to hot weather, hot cars, and unshaded

playgrounds. The parents and caregivers did not describe general child safety concerns related to environmental heat exposure.

Physical location and scenarios for environmental heat exposure

The locations and scenarios for environmental heat exposure most frequently discussed by parents were: outdoor playgrounds and school yards without coverings from sun exposure, cars, homes/apartments without air conditioning, backyards, gardens, outdoor pools, attending sports events or sports practices in the summer, vacation locations, and amusement parks in warm weather. Parents identified that young children are exposed to environmental heat when they are outside for too long in the direct sunlight without any covering. They described scenarios where children at schools, parks, playgrounds, beaches, sports practices, and pools experienced sunburn because there was no shade or covering to protect them from the hot sun. PM, mother of three children who works at a school, expressed her concerns about outdoor playgrounds without shade and play equipment that gets hot enough to burn children's skin. PM shared that she touches the playground equipment before allowing children to play on it when it is hot outside in order to protect them from getting burned. PM described:

> Yeah, the playground, that's another thing that is a huge issue. The equipment gets hot, the slides are hot. The monkey bars are hot, the chains on the swings are hot. All that stuff is hot once it hits about 80 or 90 degrees and you're in direct sunlight. It's hot, uh it could burn a kid…I have heard about kids from different schools that get burned like not people that I know personally…

Several parents had children under four-years of age and children that were in elementary school who played soccer or baseball. They described that the soccer and baseball fields were not covered. Parents discussed how they constantly monitor the young children while in the heat at their older siblings sports practices or games. Parents also shared that they ensured the young children were hydrated when they sat outside in the heat to watch their older siblings' play sports.

Other parents discussed how young children may be exposed to environmental heat in the car and home. EM, mother of two children, described that children and pets are left in cars. She shared her viewpoint that it is not right that children and dogs are left in the car alone. EM shared:

> It could be school, home, like if your house is too hot, or in the park. It could be daycare. It could be in the car, especially because some people leave their kids in the car and we know that's not right just like people leave the dog. Those are all places where you can be exposed and not have adequate water or resources.

A new mother, CM provided her viewpoint about heat exposure in cars:

> I do feel like the car is really hot. You could be out of a car and it'll be sitting with no AC in the car and you'll go in. You'll be out of the car for like 10 min. you'll go back in and it gets really hot in there so that's me. I think a baby should not be in a freaking hot car just waiting or sitting in there alone, or without any AC running...

CM shared her knowledge about how cars heat up within a few minutes and that a young child should not be left alone. She also described that the heat in the car is too

hot for her so a child should not be left sitting in a car. CM recalled her personal experience of being in a hot car for a few minutes as feeling uncomfortable therefore she was able to relate to how a young child left in a hot car feels.

Both caregivers, CG and CC described different scenarios than the parents regarding environmental heat exposure in children. CG, foster mother, shared thoughts about the outside environment having more trees and shade. She described that the source of heat outside was the sun's reflection from the street and sidewalk. CG, described:

> Oh, I mean if the first thing coming to my mind a little bit will probably be. You talk about the environment, I mean heat that is to come to sidewalk or streets, or something. That's like in the environment and you know outside and that's the only thing that I can think of that if you're on, some type of surface that reflects heat um like I said the sidewalk on the street I'll try to see what else. Hmm. Most of the time I'm thinking of environment outside kinda provides more shade or trees that's kind of shady.

Whereas, the other caregiver, CC, licensed childcare provider, described a scenario where a family was on a boat with their young child. She shared that the child and the parents got sunburned because the boat did not have any covering: "I had a family that actually went to the lake and all of them actually got burned and they're out in the you know, in a boat on the water…so this baby got sunburned." Both caregivers described outdoor environments where young children were exposed to environmental heat. CG describes an environment with both elements of heat exposure and heat protection. She identified that trees may provide some protective shade for children whereas CC

described that the lack of shade or protective covering led to a sunburn in a young child. The various scenarios and places for environmental heat exposure that the parents and caregivers discussed, reflected their personal experiences, surroundings, and interactions. Their shared experiences of locations where young children were exposed to environmental heat are consistent with current research literature that identified vehicles, unshaded parks/school playgrounds, and homes without air conditioning as sources of adverse heat for young children.

Parental behaviors and observations

There were three parents, among the 16 parents and other caregivers interviewed, who described their personal observations of children left in cars or children left unattended while playing outside in the heat. The other parents and caregivers of children described hearing stories on the news or social media about children left unattended in cars. Many of the parents expressed hearing about children left in cars frequently on the news.

JM, mother of two children, shared her thoughts about news stories reporting on children left in cars. JM shared that she frequently heard news stories in the past: " I mean thankfully, not personally but I feel like growing up I feel like it was on the news every other week during the summer that a child had been left in the car and had died due to heat exposure. I'm blessed to say that I don't know anyone personally, but I mean I've heard the stories. It seems like it's unfortunately not uncommon."

FM, a new father, also discussed hearing stories on the news: "Have I witnessed it or heard about it? I mean I hear stuff on the news all the time. I think you know people

have been more, I guess they've been cracking down on it so, I haven't seen it lately, but I know like growing up you know parents would do that a lot, you know."

Both JM and FM shared they have not personally seen a child left unattended in a car however, they recall hearing stories on the news when they were younger about children left in cars. FM shared his perspective that when he was growing up, parents would frequently leave their children alone in cars. JM shared that from her perspective, children being left alone in cars is a common occurrence. JM explained that she initially heard about it when she was younger. EM, mother of two children, also shared that she has seen numerous news stories about children left in cars: "I don't think I've ever seen a kid left like with my own eyes. I've heard it on the news multiple times…"

Although most parents described that they did not have personal experiences with observing a child left unattended in a car, they shared the common experience of hearing news reports about this unfortunate event. The parents also described their current and past experiences with hearing information on the news about children left unattended in cars. These parents shared the perspective that the news reports about children left in cars were too common and have been occurring over several years.

Other parents described their personal experiences with observing children left unattended in cars or outside in an unshaded area. BD, father of two children, described that he has seen children playing at the park during hot weather without a parent. He described:

> Oh, yeah, it was not someone I know. But I've seen it before, like people have their kids in the car at the park and it's hot with no the shade, you know. So. yeah, I've seen it before, I definitely have and there were kids by themselves like

a parent wasn't around you know, I don't know exactly where the parent was, but you know, it was hot where it was at the time and kids were still playing out there.

A new mother, OM, shared her experience about seeing young children left unattended in cars. She described seeing it more than once. OM shared: "Unfortunately, yes, I have many times more than I want to but yeah there's been times where I've seen parents or guardians leave their kids in the car and because they wanna make a quick stop. But it's like that's not really an excuse to leave them in the car." Both BD and CM observed situations where children were exposed to adverse environmental heat as a result of negligent parental behaviors.

ND, an African American father of one child, provided a unique perspective regarding the bystanders reactions to the children left unattended in cars. ND described how the bystander's reactions varied depending on the ethnicity of the child:

> Oh, yeah, in my early twenties. I used to work at a grocery store, and it wasn't common but you did see it sometimes, where you know, you would see people run in and get things and depending on who it was, you would see that you know the outrage. For example, if it was someone that looked like me no one would say anything you know what I mean. But if it was a kid that maybe had a lighter hue to them. Then, you know, there would be a little more uh, people will be, their arms would be in the air, or if it was a dog you know a dog sometimes, if a dog's in a car….then people will come and wag their fingers at them and make a big deal but if it was someone like me, you know we didn't get that much love for some reason I don't know why…

ND shared that from his perspective, the bystanders made a big deal and were upset when the child that was left in the car was not African American. He also expressed that the bystanders would get more upset about dogs left in the cars than an African American child. ND expressed that he does not know why the bystanders reacted in that manner and showed very little concern when African American children were left unattended in cars. ND observed this difference and he shared that some of his co-workers noticed a difference in the reactions of the bystanders when the child was African American. ND shared that his co-workers would have discussions about their observations of the different reactions. He also described the level of sensitivity that the bystanders had for dogs that were left unattended in cars compared to the African American children who were left unattended. ND's experience with observing children left unattended in cars differed from the other parents' experiences because he described how the ethnicity of the children had an influence on bystanders' reactions whereas the other parents provided descriptions of the settings where the children were left unattended. His personal observation of the bystanders' reactions based on children's ethnicity were not described in current research literature. When bystanders were described in current research literature it was related to rescue actions to help children left unattended in vehicles.

Parental experiences and fears

A few parents shared their personal experiences with leaving their children in the car and two parents described their childhood experiences with being left in the car by family members. Ms. A, mother of three children, discussed that she has seen videos that demonstrate how fast cars heat up inside and warn parents not to leave their

children in the car. After sharing this information about the videos, Ms. A described how she left her children in the car to run into the house:

> So, I've definitely learned more with children and you know if I leave them in the car. It's just I'm right there and the car is always running. I would like if I have to run home and grab something. I'll leave them in the car if they're already buckled up. I'll leave them in the car and run inside. But I would not especially, living in the desert like I would never, never, never like go into a store, because it gets really hot really, quickly.

TM, mother of four children, describes how she has left her children in the car to run in somewhere for five minutes because she does not want to take all the children out of the car:

> But I mean I definitely don't leave my kids alone like that. If I leave them in the car, the car is on like I won't, I will risk having somebody come to my car because they're gonna see 4 kids, and they're gonna leave them in the car like, they're not gonna take 4 kids (laughing). Now that my oldest is 7 and so when I do have to go somewhere, and I mean usually I'm talking like just running in somewhere for like 5 min or something, and instead of like hauling them all out and like it's. I can just I leave them in there I lock the door when I leave, and my son knows like the only person that he can unlock the door for is me but like the air conditioning is on… So, again, I guess probably not the safest but I mean it's a lot. It's a way to survive, I guess.

TM expressed awareness that her action of leaving the children locked in the car with air conditioning on is not the safest decision. However, she made the decision based on convenience. TM also discussed relying on her seven-year-old to keep the car doors locked and not touch anything when she left the younger children in the car with him. Although Ms. A and TM have both left their children in the car, they have different perspectives about the situation. Ms. A explained that she would never leave her children in the car to go into a store because she lives near the desert and it gets hot. TM expressed that she left her children in the car for at least five minutes to "run in somewhere." TM rationalized her behavior with the belief that no one will take her car when they see four children in the car and that she is only leaving them in the car for a few minutes. She acknowledges that her behavior may not be a safe choice however, it is made out of convenience. Both mothers shared the belief that the short time period that the children were left in the car, made it less of a risky situation. Their choice to intentionally leave the children in the car for a few minutes is inconsistent with current research data that identified more children are forgotten in vehicles and less children are left intentionally with regards to the number of fatal incidents for children in cars. Although Ms. A and TM's action of intentionally leaving their children in cars did not result in a fatal incident, they both made a conscious decision to take a risk that could have a negative outcome under different circumstances.

Another parent, NM, mother of five children, described how she forgot her one month old baby in the car:

> She was probably like a month old, and then my toddler was with my mom, so I was trying to get back to them, and I left her in the car. I left her and I had already

> gotten home. I parked, and I left her in the car with say you know, like maybe 10 seconds from when I walk to my car to my door at the door, and I tell myself, oh, my gosh, I'm forgetting something and that split second to myself. Now I know how certain parents do that and not intentionally okay…I just I knew I have a lot going, but I'm missing something, but I'm like I don't know oh, my gosh! I had already shut the door, and I'm like Oh, my gosh! I left her in the car. I realized that just a second No, but I did. I felt horrible.

NM's experience with forgetting her baby in the car helped her understand how parents can forget their child in a car. She expressed how it happened in a matter of seconds for her because she was focused on getting home after dropping off her older children at sports practice. NM shared that her baby was safe because she returned to her car within a few seconds to get her. NM's experience is similar to situations that are frequently described in the current research literature where parents/caregivers were multitasking and forget the child in the car. In contrast to her experience, many of the situations described in the literature resulted in a child's death because the parents/caregivers did not remember the child was in the car until hours later.

PM, a mother of three children, expressed that she has not left her children in the car however, her daughter was hospitalized for heat exhaustion after playing outside on an unshaded playground at school. PM described her experience:

> So, we were in the hospital for about 3 days with her. So, and I mean I could, I can understand why, you know they weren't drinking plenty of water throughout the day. They were just having free play all day and she was out there for hours

playing...So, the heat exhaustion, and just heat in general with kids is like it, it was very scary and for me it's like no I am petrified.

After this frightening situation, PM shared that she spoke with the staff at her daughter's school to request that her daughter is allowed to stay inside when it is hot outside. PM shared that as a result of this conversation, the school implemented a practice of keeping the children inside for temperatures over 90 degrees. PM's willingness to speak with the school staff about her daughter's heat exhaustion, helped motivate the school to institute a preventative environmental heat exposure measure for all the children.

The other parents described their past childhood experiences with being left in the car. FM, new father, shared that he remembers being left in the car: " It even happened to me as a kid. You know my mom might, you know she may run to the store or something like that, for you know, a couple of minutes, or anything like something like that. But it was nothing like a long time, though." FM recalled being left in the car for a few minutes and did not describe how he felt about this experience.

ND, new father, recounted his childhood experience of being left in the car:

Yeah, as a kid like I remember like my mom you know, leaving me to like other people like you know if it's an aunt or a cousin, or whatever, and then I would have to be watched by them and then you know maybe they're going to a store and say you know I'll be right back, and then, you know, it's the middle of summertime and I'm burning up and just super uncomfortable and you know they're in there a lot longer than you would think, and you're just being tortured.

That's what I remember as a kid so I know, I know how uncomfortable that can be.

ND described how uncomfortable it was to sit in the hot car during the summer and compared it to being “tortured”. He also mentioned that children need an advocate because they do not always have the words to express themselves or deal with adults. ND expressed that he was not able to advocate for himself when he was left in the car because he was young and did not know how to talk to his aunt about this situation.

Feelings and thoughts about other parents or caregivers

Parents and other caregivers of children shared their feelings or thoughts about parents who have left children unattended in cars. The range of feelings included sadness, anger, confusion, sympathy, and lack of compassion. The following thoughts about other parents were shared: irresponsible, overwhelmed, distracted, or having struggles with parenting.

JM expressed that she has feelings of confusion and anger because she feels there is enough information available that describes the risks associated with leaving children unattended in cars. JM also expressed that she is angry because people should understand how heat in cars affects children. JM shared:

I completely get that parenting can be overwhelming, and I try to have some, I guess, understanding but honestly my feeling is confusion and a little bit of anger, because I don't, I think we've seen enough cases in which we understand what the heat can do to a car. You know, leaving a car closed is much more hotter than the environmental heat. Inside the car so then you know you're

> heating up your child in a way that's just unbearable, and I don't even think it's okay to leave them in there to run in for 1 second…

CC had questions similar to JM. She shared that she wonders what happened and what caused them to leave their child in the car? CC also expressed: “I kinda like always you know wonder why, you know what caused them to leave their child in the car. That's the first question that I, you know ask is like what you know happened? You know that they did that, and maybe this is not right or wrong, but I have less compassion when I hear that the child was left in the car because the mom went to party.”

Other parents described the parents who left their children in the car as being crazy and irresponsible.

> CM expressed: Oh , that is crazy. I don't know, I sometimes think about them, I don't know how people I don't know how people in their mind do things like that. Personally, I don't because I don't see myself again, like maybe because I wasn't brought up like that…I feel like the baby should be the priority…

CM reflected on growing up and hearing her mother talk about not leaving a baby alone. From her perspective it is difficult to conceptualize how parents leave their kids in the car. CM expressed that she cannot see herself leaving a baby in a car alone because she was not brought up that way. Ms. A described how her perspective about parents who leave their children in the car has changed since becoming a mother. She expressed that she is more understanding now because there are so many things that can distract parents. Although Ms. A expressed that she understands how it happens, she shared her thoughts about parents being irresponsible:

Ms. A shared: I mean before kids, I would have said, oh, my gosh that's so irresponsible, and you know what terrible you know. But now, with kids I can see how they can easily get distracted and oh, I'm just running in for a minute I'm gonna leave them. I'm just grabbing two things out of the store you know when things always take longer. I still think it's terribly irresponsible but I can understand a little bit better how it would have happened. I don't think they probably did it on purpose but still it's, I don't think it's acceptable at any point to do that.

Another parent, NM, described that she sympathizes with the parents who may be struggling. She expressed that she understands how parents unintentionally leave their child in the car because of her personal experience with forgetting her baby in the car for a few seconds. NM discussed how parents who maliciously leave their children in cars, may be crying out for help and have struggles with parenting.

NM described: I don't like to excuse parents' behavior. So, I sympathize with them, because if they got to that point where, let's say, they did it maliciously. If they got to that point where they had to kill their baby like that, that's really sad that human being had to get to that level to get help, or to find they must have been struggling as a parent if they had to go to that extreme to get rid. It's just that's really sad…

BD expressed a view similar to NM with regard to thinking that the parent is dealing with some mental stressor. BD expressed his thoughts:

My thoughts and feelings are it's unfortunate you know that this happens, and like I said and if the kid dies. I think why has it come to this you know you know

because I'm sure there is something going on you know there's some type of trauma or distraction that's caused you to neglect or not care for your child, you know, or to not have them on your forward thought. You know something must be overwhelming where the magnitude of a child is not even on your radar.

Both NM and BD discussed how a parent's mental state may have an impact on the child being left unattended in a car. NM expressed that some parents may be struggling with all the demands of caring for children. NM discussed that if a parent intentionally left their child in a car, they may have been desperate and crying out for help. BD shared a similar perspective to NM with regard to the parents being overwhelmed and unable to safely care for their children. They also discussed that other distractions may contribute to parents leaving children unattended in cars which is consistent with current research literature that described how changes in parents sleep schedules, work schedules, and daycare pick-up/drop-off routines are stressors that may cause parents to forget their children in a vehicle.

Specific Aim 2: Adult parents or other caregivers' knowledge about adverse environmental heat exposure and risks to health of children aged newborn to four-years

Adult parents or other caregivers' knowledge about environmental heat exposure and risks to young children's health were elicited with the use of a semi-structured interview guide. The parents and other caregivers of children were asked open-ended questions to facilitate sharing of their knowledge about PVH, environmental heat exposure, preventative education, climate change and children's health. Parents and other caregivers of children's knowledge was derived from categories that emerged

after the open coding and abstraction process of inductive content analysis. There were seven main categories that emerged from the interview data.

General knowledge about the effects of climate change

Parents and caregivers of children discussed having knowledge about climate change affecting children's lungs, mental health, learning, immune system, body temperature, and risk of cancer. They also described climate temperatures ranging between 60 degrees to 100 degrees Fahrenheit as harmful for young children. SM, mother of three children, described how climate change affects children's health as well as adults. She named two health conditions that climate change has affected. SM described: " So, I guess climate change is affecting our youth a lot their getting asthma at a higher rate, cancer at a higher rate. It's really affecting us and our youth." OM shared her knowledge about the effects of climate change on children's immune system, mental health and breathing. She also discussed how the air quality can affect children's health. OM shared:

> So, I feel like when the climate change happens too often. I don't think it's good for their health…so I feel like it's just kind of hard for their immune system and you kind of have to be careful, because yeah, they're just not they're like new to the world so then their immune system isn't as strong and not as used to it, like the way we are… I don't know, and I feel like it also, like climate changes can have a lot to do with like their mental health later on as well…Yeah air quality has a lot to do with like their health in general and their breathing.

CC discussed the effects of climate change on children with chronic health conditions like asthma. She also discussed that she would keep children inside depending on the weather. CC shared:

> If they're, if they have underlying illness. Like I did have kids that were asthmatic for instance, I had kids that couldn't be in the sun too long and you know things like that. So, the climate change and not knowing what it's gonna be like that played a part to and making sure that you know we adjusted you know the children to what's going on. I mean sometimes we had to keep certain kids inside and stuff because of the weather.

The parents and CC described similar effects of climate change on children's health. They discussed that climate change impacts air quality which affects breathing and asthma in young children. CC shared that she modifies the children's outdoor activities dependent upon the climate/weather to help prevent asthma flare ups. Parents also described that climate change can affect children's immune systems and mental health. There were two parents who discussed the effects of the cold climate on their children's health. They described the cold temperatures as being more harmful for children than environmental heat. EM described that children get sick more often when the weather is cold.

> EM described the effects of the cold climate: I feel that climate change is very crucial now. I see it now, because my oldest she's three and she's in school, and from the summer to now is starting to get cold and all the kids, including her are getting sick… Under 62 under 60 degrees, I think, is harmful…

The other parent, BD, shared a similar perspective as EM regarding the cold climate being more harmful for children than environmental heat. BD discussed children being in the sun for an hour versus being in the snow for an hour. He shared that exposure to cold is more dangerous for a child if they get buried in the snow.

> BD described: I do believe the extreme cold might be a little bit more harmful only because of snow and you know it's more, a little bit more immediate, you know. You can get sunburned, you know from being out in the sun all day and get a headache, you know… you spend an hour in snow versus the hour at the beach…I would say snow might be a little bit dangerous. If you look you don't want to go looking outside for your child in the snow and find him buried.

A child caregiver and some parents discussed having limited knowledge about climate change and children's health. They also discussed having a lack of knowledge about the signs of overheating in children. CG shared that she had limited knowledge about climate change, however she discussed that it may affect children's ability to learn.

> CG shared: Well, I mean in the climate change I think maybe it could affect them. How should I say this? Um I'm trying to say something about their learning that it could possibly enable or be effective to you know how they learn, or their education…I don't know a lot about climate change…

A parent, JM, also shared that she had limited knowledge about climate change and children's health. She described that climate change is increasing toxins in the air that may affect children's breathing. JM shared: "So, I don't know much about it on

young kids health. I mean I would assume that climate change is releasing toxins into the air that's making children unsafe to breathe in, you know, normal unpolluted air…" QM shared: "I don't know anything about it specific to children's health, you know, just at a high level I've heard about climate change and just things that are happening around the world. As far as you know, it's hotter temperatures, I believe there's more like tornadoes, hurricanes…" Although the caregiver and parents shared that they had limited knowledge about the effects of climate change on children's health, they were able to discuss some changes in the climate. They discussed changes in the temperature, air pollution and occurrence of tornadoes.

Another parent discussed her perspective regarding parents' lack of knowledge about signs of overheating in children. TM described seeing children playing at the park who were red in the face and the parents did not notice that the children were close to overheating.

> TM shared: Yeah, just as the climate, I mean, with climate change getting warmer. It's gonna have more of an effect on everybody like kids, especially because they haven't quite been able to regulate body temperatures yet. So, I think it's just gonna be a continual thing that we're gonna have to be paying attention to making sure that our kids are, you know, just like taking care of our kids appropriately like there's been plenty of times out at the park, where you see kids that are completely red in the face super-hot, not sweating, and they're just miserable...And just there's so many parents who just don't know you know those kinds of signs to be looking out for.

Although, the parents and caregivers expressed having limited knowledge about the effects of climate change on children's health, they were able to identify a few health issues that may be intensified by environmental heat. The health issues that the parents and caregivers discussed were described in current research literature about the impact of climate change on children's health. With the exception of EM and BD, who described the cold as more harmful for children's health, the other parents and caregivers identified that environmental heat exposure can be dangerous for young children. A caregiver and one parent acknowledged the importance of monitoring children for signs of overheating and watching their activity levels during warm weather.

Receiving information about PVH

Parents and caregivers of children identified that their primary sources of information about PVH are: news stories, social media, stories from friends or relatives, pediatric health care providers, and childcare provider meetings. They also reported seeing more news stories about PVH during the summer. There were two parents, Ms. A and SG who shared that they were not familiar with the term PVH and that they had not received any information about it. There were two parents who identified that in addition to hearing about PVH on the news, they received information about child safety in cars from their pediatric health care providers. SM shared: "My kids go to Kaiser and they give out pamphlets sometimes about heatstroke, and this is only in the summer time, too…a pamphlet, or something, saying, don't leave your kids in a car heatstroke and things like that." The other parent, NM, recalled that she was asked to complete a screening tool that asked about children being left in the car.

NM described: I think now, this last time you know how we do the 6 months checkup, you know what it was the 8 month. I think this time there's a, you know they give us a screening tool every time, and this time they put it in there like, do you leave your child in the vehicle when it's running…without supervision and the windows down? …

CC identified that in addition to hearing information about PVH on the news or internet resources, she also received information from her childcare provider meetings. CC shared: “Other than when we go to our meetings. We can go online. You can Google and it'll say you know, the number of children that have you know died due to heat, exhaustion in the car, you know whatever”… In addition to parents and caregivers identifying their sources of information for PVH, they shared what they have heard about PVH.

TM discussed information she heard about PVH:

I mean I hear that it happens I mean it's like never really intentional. It's always unintentional that you like just forgot your kid. You forgot that you had them you'd probably just you know mentally gone on autopilot, just weren't thinking about it we're maybe having to do something that's outside of your normal routine. And then you just space it. I don't think people really intentionally, I hope people don't intentionally leave their kids shut in the car with the car turned off…

CC shared:

Now one thing I've heard about, with the kids being in the car is first of all. Sometimes, the kids are over overdressed, for one thing, so that on top of the

fact that if they're left in that car you know, just like a double whammy… and then what we have been told to do is, you know prevent a kid from being left in that car in the backseat is do something to remind yourself… it sounds kind of like work how come you got to you know do something to remind you…but you know again, we're human, you know people are human.

Both TM and CC shared similar information about parents forgetting a child in the car. TM expressed that she does not think and that she hopes people do not intentionally leave their children in the car. TM discussed that the parents may be spaced out and functioning on autopilot when they forget their child in the car. CC explained that parents could use something to remind themselves that a child is on the backseat and this may help prevent the child from being left. They both identified the role that human error plays with respect to PVH. Other parents described the physical symptoms of PVH that have been talked about in the news, on social media or stories shared by friends or relatives. PM shared : " All I know when I hear that term is that it's a child left in a car. And the child is now basically like lethargic and you know they're gonna need some type of you know EMT medical assistance during that time." CM described her knowledge of PVH: "Wow! Well, it could be fatal. I know that for sure it could be fatal I don't know maybe it could, cause maybe some like brain damage to the baby you know if the baby is, you know, if they don't get the baby on time, I would think maybe it causes something because you're trying to breathe in this hot air…" Another parent provided a similar description as CM's when she described breathing issues associated with the hot temperature in the car. JM shared that she was unclear about how the child passes away, however she knows that the heat makes it hard for the child

to breathe. She described: “So, I mean the only thing I know like I said so when I was growing up, I didn't realize that leaving the kid in the car posed a greater risk because it's hotter within the car than on the outside. So, you're heating them up ...It's unclear to me how the child actually you know, passes away. Is it asphyxiation or what have you…”

Parents described similar physical symptoms of PVH related to difficulty breathing and losing consciousness. They also described that PVH may lead to death. Overall, parents and caregivers shared knowledge of how PVH is often a result of children left unintentionally in a car. They shared that they primarily received information about PVH from the news or social media. There were two parents out of the 16 participants who expressed that they were not knowledgeable about PVH or its symptoms .

Parents questioning and judging other parents

Parents shared their knowledge of comments that have been made about parents who have left children unattended in cars. The parents described that the conversations about children left unattended in cars usually start off with questions about the actions or behaviors that caused the situation. They also shared that judgmental comments often follow the initial questions about the parent’s behavior. FM shared: “At least the people that I know like. They agree with me, you know, as far as like, you know how could you know a parent do this and you know why? Why would someone be so irresponsible?” PM described hearing parents talk about a child being left in the car unattended:

> The only thing I always hear from parents is like I can't believe they did that. I can't believe they left their kid in there, Oh, my gosh! That's terrible and it's like one yes, it's terrible… I could see if they purposely left the child in there but there has been sometimes that you know that the kid was not. They did not even know the kid was in the car. They forgot they were running late. They thought, you know the other parent took the kid, and it ended up being, you know the child died…But you never know when that could be you…It's sad, because parents… always like that would never be me what if it can be you it can be you and that's what is sad when I hear that and when I hear people like oh, you know just judging…

PM discussed that she has heard parents make judgmental statements without knowing if the child was accidentally left in the car or if it was intentional. PM expressed that the parents feel that they would never leave their child in a car however, she wants them to recognize that it could happen to any parent. CC shares a similar perspective as PM. CC recognizes that any parent can forget their child in a car under certain circumstances. CC described situations that some parents have experienced:

> They have sometimes they are in a rush. I mean, you know, sometimes I'll hear a parent tell me that they forgot and left the diaper bag on top of the car, drove off, but so you know, leaving them in that car is mainly because people are rushing you know they'd be rushing or maybe it's not the normal thing, that you know they do all the time. You know, it is not routine so, you know they forget, and they'll leave that baby back there…

CC discussed how changes to the normal daily childcare routine or work schedule may affect a parents ability to remember their child is in the car. She also discussed that when parents are in a rush, they may forget their child in a car. Another parent shared that parents who have left children unattended in a car, are often blamed before the facts about the situation have been disclosed.

> SG described**:** I feel like the first thing is to blame the parent that left the child. Yeah, I think that's like the first like who's the parent? Why would you leave your child? But then, like yeah I know that's the first question to ask but like, you know, I don't know the parents or the child who might be going through stuff. I mean I'm not justifying the fact that the child was left but like even for parents maybe mental awareness…if you're not okay, you can't possibly give the best care to your child, and like your, you have a 101 things you want to do, you're rushing and then it's easy to forget...So instead of firsthand blaming, you know, doing blames, we should also like talk to parents.

SG expressed that it is more important to find out about the parent's mental state and ability to take care of their child than to judge or blame them. She discussed the importance of talking to the parents to find out if they are going through something. SG and PM shared a similar perspective that it is important to gather knowledge about the situation first rather than judge or blame the parent right away. SG, PM and CC shared a similar perspective that anyone can unintentionally leave their child in a car if they are rushing, experiencing mental stressors or changes in their normal routines. Their perspectives are consistent with current research literature that discussed scenarios in which a parent had a momentary lapse in memory and forgot to drop their child off at

daycare because of a change in their normal daily routine.

Other parents shared their knowledge about parents excuses for leaving a child unattended in a car. OM shared a conversation she had with her mother:

> So, when my mom was telling me about it, she basically mentioned that, like some parents, just think that it's okay because they have their own excuse like they have their own, I guess like view of it…Um which is why I think like educating mothers, and like certain type of classes would be a great idea because I feel like some people just don't have that education to know better or to think better they think like it's okay, and every time I've seen it like on social media…They've always had an excuse for it and they've always had like a story behind it, saying well, I had to do this, and we'll this and that…

OM expressed that she does not know if the parents who have excuses for leaving their child unattended in a car lack the education to know better or if they are being stubborn and think it is okay to leave them. OM suggested that providing education about the risks associated with leaving children unattended in a car may help address a possible knowledge deficit for these parents. Another parent, SM, shared her knowledge about parents having excuses for leaving a child in the car. SM also shared her knowledge about excuses she hears during conversations with African American parents about environmental heat exposure and sunscreen.

> SM shared: I think I don't know I feel like the parents that do it probably do it for a reason. So maybe their kid is sleep, or they think they're doing it for a short period of time, or there's always an excuse. I think I don't know. I don't know anyone specifically that will leave their child in the hot car. I know people that are

> black and think that the heat doesn't really affect black people when it does, we have all the melanin. So, I think the number one excuse I know that comes from people around me in my circle is that we're black we already have melanin, we don't need sunscreen…

SM shared that the parents in her social circle feel that environmental heat does not affect them because of their darker skin complexion. According to SM's perspective, these parents use this as an excuse for not taking precautions such as using sunscreen or hats to protect their children's skin from sun exposure. SM discussed a cultural perspective that may influence some parents' choices related to protection from environmental heat. This cultural perspective about some parents thinking that children with darker skin do not need sunscreen was not discussed in current research literature. SM described that some of the parents in her social circle make excuses for not protecting their children from the sun with proper clothing or sunscreen because they believe that the melanin in dark skin has protective properties.

Parental accountability

Specific aspects of parental accountability were identified by parents and caregivers of children. The following measures were identified to help promote parental accountability: mandate similar to child abuse, tickets or jail time, meetings to find solutions and accepting responsibility for protecting children. CC described having a mandate created that widely disseminates information about children left unattended in a car and enforces reporting of these incidents. She described the mandate as being similar to the current child abuse mandate. CC shared: " I think the department of children and social services should definitely, you know, play a part. I think the

pediatricians…anyone that takes care of children. Just like we're, you know mandated for child abuse reporting, so I think that should be kind of a mandate also in that same fashion."

Other parents discussed tickets and jail time for parents who leave their children unattended in cars. SM described: "Something that consistently reminds them, and then also something that reinforces that behavior. So, if they were ticketed, maybe even put in jail, maybe they would stop doing it." BD shared similar thoughts as SM. He discussed whether parents who have left their children in cars are given penalties if the child dies. BD discussed: " I do have some thoughts on like I don't know if we talked about accountability and the penalty for these parents who have left the kids in the car you know, and they have died, the children have died… " Both SM and BD expressed that enforcing tickets, penalties, and jail sentencing for parents who leave their children in cars are actions that could be instituted to hold them accountable. SM also expressed that the enforcement of tickets and jail sentences may function as reminders for parents to not leave their children unattended in a car. BD identified the need to assess if the parents have other children that may be at risk of being left unattended in a car after a child dies as a result of PVH.

In addition to using tickets and jail sentences to reinforce parental accountability for children left unattended in cars, parents discussed holding meetings. They suggested meetings could be held to discuss finding solutions to prevent children from being left in cars and to remind parents not to leave their children. BD discussed: "You know this does happen and you know I think we could do more about it…we even have in the meetings conversations to provide a solution, and then who's going to implement

it? Just getting the solution, implementing it and making it a priority." QM shared: "I think what is at my job we actually have safety discussions before meetings. So those are kind of topics that an employee can bring up to remind colleagues, so that could happen at anyone's job." QM suggested that any worksite could have a safety discussion or meeting with employees to talk about the risks associated with leaving children unattended in cars.

Another measure parents identified that could help promote accountability is parents accepting their responsibility to protect children. ND expressed that a child needs to be a parent's priority and needs to be protected. He shared: "Regardless of whatever you're dealing with whether it be challenges with your husband, wife, boyfriend, girlfriend, whatever you have, and you've got to make sure that you put that kid first because that's our responsibility you know we gotta protect them no matter what." JM shared a similar perspective as ND with regard to parents taking action to protect their children. JM expressed that parents need to learn about the dangers of leaving children in cars for any amount of time and act responsibly by not leaving their children in cars. JM shared: I don't know how to disseminate materials or attention to parents who think that it's okay to leave kids in the car even for a minute amount of time. I think it's important for parents to be educated on what truly is happening within the car to make it unsafe for a child to stay in a car by themselves…" Parents and caregivers shared that mandates, jail time, and tickets/fines may serve as reminders and help prevent parents from leaving children unattended in cars. They expressed that parents are ultimately responsible for protecting their children and that measures such as mandates or penalties may help promote accountability.

Environmental concerns

Parents shared their knowledge about environmental factors within their communities that could be addressed to help minimize environmental heat exposure in young children. They identified that limited green spaces, lack of shade covering in public spaces, and lack of sunscreen use among a specific ethnic group are factors that need improvement. NM described her neighborhood's lack of green spaces as similar to an injustice due to limited economic resources. NM shared that she has observed more trees and green spaces in neighborhoods where money is invested.

> NM shared: You know like I really feel that all has to do with money. A different neighborhood will have like more like trees or even like lighting at night, so that your system could know it's time to sleep. So, I noticed that a lot of the times like I just feel I mean, I don't wanna say that it's an injustice, but I just feel how money just changes everything…like, I said, just like with the climate change. I feel that there are a lot of like I said we don't have trees, or this money invested in that where you know they'll be cleaner air for our lungs, or for us to have like parks, or, you know, safe places where we're able to walk. Not take the car…So, I feel like we don't have safe places like that it's green for the children…

Parents EM and SM described the need for more shading on playgrounds, schools, parks, and beaches. EM shared that she noticed a school in her community placed shade covering on different areas of the school, however more shading is needed on the playground. EM shared: "…I think we should, they should put more covers in different spots like on the playground so kids are able to go under there, and maybe they should have like water spouts where you can fill up the water bottle…" SM

discussed the need for more shade covering at parks and beaches. She suggested beaches could provide tents for people who do not have their own. SM described: “Maybe outside should have more public shading, especially at parks, especially maybe at beaches they can have I don't know tents for people who didn't bring one…”

Other parents shared their knowledge about a culturally sensitive topic regarding a belief among some African American parents that their children do not need sunscreen. JM and SM shared that some African American people believe that the heat and sun do not affect them because of the melanin in their dark skin. Both JM and SM are African American mothers who shared that they apply sunscreen to their children’s skin because they know that exposure to heat and sun is harmful for children regardless of the color of their skin.

> JM shared: When we knew that we were doing walks, and the sun was beating down um covering them up. I know for us some people think, black people think oh we don't need it but we're sunscreening our kids. So, I think there's a bigger conversation about what brand of sunscreen, what type of sunscreen needs to go on maybe melanated skin, because we do need sunscreen and our children need it and I don't think enough of us are putting that on our children once we take them outside…Sunscreen, visors, hats, whatever you can do to keep them not being exposed as much.

SM shared: “I know people that are black and think that the heat doesn't really affect black people when it does, we have all the melanin...” JM and SM discussed that conversations are necessary among African American parents to provide information about protecting their children’s skin from sun exposure with sunscreen and proper

clothing. JM described a need to talk to these parents about specific sunscreen for children with melanated skin in order to help them become more comfortable with using it. Overall, the parents discussed the need for more resources in their communities to increase public shading, green spaces, and education about sunscreen use specifically for African American families.

Social support for parents

Parents and caregivers discussed the importance of having emotional, physical, and educational support to help prevent young children from being left unattended in cars or unshaded areas. They identified that the sources of support could be family, parent groups, parenting classes, medical providers, and safety training. CC shared her knowledge about why some parents leave children unattended in cars.

> CC shared: Well, I guess it depends on why it is happening in the first place, other than, say, the person is going to work and forgets. You know that the child is in the back. The other thing is, when sometime, believe it or not, parents don't have help, you know. So, they think a little quick trip to the store, or you know whatever you know can lead to, you know I can leave the kids in the car while I run in and stuff like that so sometimes, they don't have help. You know that makes a difference if they have somebody that they can get to watch their child while they go and do you know, errands…"

A parent, NM, also shared similar information as CC regarding the importance of having help with daily parenting activities in order to help reduce the stress that parents experience. NM shared her knowledge that stress and lack of support may lead to children being left unattended in cars. NM shared: "You know, it really comes down to

social help and you know, I think parents really should have social support and that's what really just makes or breaks like the daily activities if you have that social support…" Other parents and caregivers identified that parenting and safety classes could provide educational support. They described that the classes could provide information about heat exposure in young children and be held at various locations such as medical offices/health clinics, schools, gyms, and fire stations. CG described that counselors, medical professionals, paramedics, and fire departments would provide useful information to parents and caregivers about heat exposure in young children.

> CG shared: I mean people that are in the field of counseling would probably be able to give some good advice or anybody in that field, therapist, counselor you know… people that are medical in the medical profession, say like the fire department…You know somebody that is actively working with this may be involved in this type of situation or incident. So that's why, I say the fire department, sheriffs, paramedics.

FM, described that parenting/safety classes could be held at health clinics and gyms to provide information about heat exposure in young children. He described gyms might be a good place to have classes because new mothers may be working out there and gyms already have some nutrition/fitness classes in place. FM shared that gyms could incorporate classes for parents about safety and heat exposure in young children.

> FM described: "Oh, maybe their doctor, I guess the doctor maybe like even one of those like health clinics you know. Maybe even maybe even at the like sometimes the gyms have like, you know, these health-conscious courses you could take…So, maybe they could even have like a little parenting, you know

topic, for moms that you know that are trying to recover from like the pregnancy they're trying to get in shape..."

Parents also shared their knowledge about a need for more classes in their communities that teach parents about child safety at each stage of development. They described that classes to teach parents about car seat safety, heat exposure, and general childhood safety would provide support for new parents. OM shared her knowledge about a few classes being offered during pregnancy and that was the extent of the information.

> OM shared: I feel like parents need. They need to have more classes for parents like new parents. Some people just are not in the best position to be parents in the moment, and I feel like you could always learn like there's always something that that can be taught or presented to you…like throughout motherhood like throughout, you know the stages like baby, toddler, kid, teenager. Like there should always be something like a class that you're constantly learning like how to grow with your kids.

BD echoed what CM shared about the need for parenting and safety classes for each developmental stage. He also described that parents are not receiving training or education about car seat safety or general child safety. BD shared that he did not receive any training and learned some things about parenting from his aunts and grandmother. He shared his cultural knowledge about the absence of African American men in the home to set examples of how to be a father. BD shared that his father was not present in his life while growing up therefore, he did not learn about fatherhood from him.

BD shared: I think another part of that, you know, institutionally is that we have so many kids out here that no one's getting like child training on how to put a child in car seat, how to take care of them you know, it's like you kinda get some stuff while they're babies but you know we should, you know as a parent. I didn't get help you know like maybe I learned stuff from aunts and grandma but there's no like hey you're having a baby let's do training, you know, like this is what they do at 1, 2, 3, 4, 5, 6. This is how to be a great parent. Do that to be a great father…you know we don't have that, especially in our community. Maybe other communities, might but you know I really didn't have that, especially with our father's not even being there, you know…

In addition to parenting and safety classes, BD also described a need for sensitivity training for all parents. He compared the training to receiving a license and he described that parents would see a physician, child specialist, and psychologist at different appointments throughout the pregnancy. BD shared that the sensitivity training would help educate parents about car safety and heat exposure in young children.

BD described: I think you know there should be some type of sensitivity training for all parents who are having birth you know in terms of car seat, just like we get a license…so just like, for example, during your whole pregnancy, we might have about 9 appointments 9 months, you know. So maybe, instead of 9, we'll have about 15 and those different appointments that you're not seeing the doctor, you're seeing a child specialist, a psychologist you know someone that does education…so that your whole pregnancy would be an educational journey, so

> that you don't make mistakes of leaving your child in the car seat, because you just don't know better, you didn't have no type of training.

PM described an additional form of support that pediatricians could provide for parents of young children. She described that pediatric offices could offer safety classes and send out text message reminders on hot days to parents. PM discussed that most people may not want to take a class therefore, the text message reminders could be sent out to all parents regardless of if they take a class.

> PM described: Hey let's offer a class how many people are going to say, hey, I'll take this class. I have time to take this class. Most people would be like no I don't want to take the class. I don't have time whatever I'm not gonna leave my kids in the car, you know…it would be good if you would be like, okay, it's 90 degrees you know a text gets sent out to people and say, hey, it's 90 degrees please ensure that you stay shaded, or you take your kids out of the car.…if it was up to me, I would hope that somebody would host a class like at the schools, you know, even at the doctor's office…Have more pamphlets out….Even if you can't do a class you know have the pediatrician say hey it's gonna be hot, you know send out a reminder a text just like they send out a text for reminder of appointments…

A form of emotional support for parents and caregivers was discussed by CG. She described parent groups or care groups where people can share their experiences and opinions related to child safety and parenting.

> CG described: I would probably talk to my doctor first to see if there's any other resources or other programs that offer information that would address these type of concerns or these situations, to see if there are other training or other seminars. Maybe have other parents that have work groups or study groups, or some kind of groups where people just get together, and just talk about their opinion or other experiences that they have with their kid. You know, talking to other parents or care groups…

Parents and caregivers identified that family members, friends, and parent groups could provide emotional or physical support for parents. They shared that the physical support of assisting with childcare, running errands or household chores could help minimize daily stressors that contribute to children being left unattended in cars. Physical support could enable parents to complete errands and other tasks without having to multi-task while caring for a child. Parents and caregivers also identified that educational support such as safety/parenting classes, sensitivity training, and text reminders from medical providers could help increase knowledge about heat exposure in young children. They also identified a need for pediatric clinicians to provide more educational resources about environmental heat safety and young children.

Community partnering to increase awareness

Through partnering with community centers, churches, health clinics, parks, and schools, information about environmental heat exposure in young children could be disseminated to people who provide care for children. Parents and caregivers identified that these community agencies could be used to help increase awareness about environmental heat exposure in young children. Parents described the role that

churches, schools, and community leaders could play in providing educational reminders for parents.

> QM described: Preventative of education, I mean I haven't heard of many things related to just the kids being outside. So, there's more discussion about what to look out for, what to avoid. Still just reminders about the dangers of leaving kids in the car…churches can do reminders for people that go to church, schools, child care centers can do education about it. Written communication in any form can go out whether there's like emails, text messages, just reminders….

In addition to discussing partnering with churches and community centers, ND included daycare centers. ND discussed the role of these community agencies related to increasing awareness and education about environmental heat exposure in young children.

> ND discussed: Specifically, oh I don't know I just think that individual communities maybe could do some preventative educational talks…a community center or church or you know places like that where people gather, and you know, even daycare centers, you know maybe they could, you know, give some paperwork or pamphlets…you know, make sure that you know parents aren't really doing that…

Another parent, FM, discussed involving different community leaders and community members to educate the public about environmental heat exposure in young children. FM discussed: " I think. Well, it starts with, I guess community leaders, you know….starts like lower level, like, you know maybe pastors, you know, might be, you

know, teachers, you know city councilman, you know members…" Other parents discussed that park attendants, law enforcement, court, child protection services, counselors, grandparents, and anyone working with children should be involved with increasing awareness or education about environmental heat exposure.

> SM discussed: "I guess anyone who deals with kids… so we should be telling people that, DCFS if they need to be involved. A court system if you're getting some type of custody arrangement or child support. Maybe they should give information out at schools, doctor's offices should give information out, police."

Both parents ND and EM discussed grandparents and others that provide care for children should be involved with education about environmental heat exposure in children. ND shared: "…parents, grandparents. Obviously, grandparents are always a great resource in child rearing. Yeah, I mean just the family, I guess family." EM shared: "parents, the teachers, the child givers, the park attendants, anyone who's in charge of the care of the children should be involved. Grandma, grandpa, everyone." JM discussed partnering with pediatricians, nurses, community radio stations, and community events to help increase awareness of environmental heat exposure in young children.

> JM discussed: I would say pediatricians probably should maybe spearhead. Pediatric nurses, people who have some sort of maybe clinical aspect, as well as parents who have maybe just their own experience with them protecting the child. So, I think both sides should be involved into disseminating information or creating a space in which we can learn about the environment's impacts on children…I think something like partnering with maybe I don't know community

> centers, radio stations to have some kind of picnics or festivals or get togethers, and which you know we're disseminating information about how we should be protecting our children from the sun…that could mean by leaving children in the heat too long in a car too long. And what preventative measures you could take, such as clothing, sunscreens…

In addition to discussing partnering with various community agencies, medical providers, families, and schools, parents described different forms of media that could be used to increase awareness about environmental heat exposure in young children. They described television commercials, social media, billboards, Public Service Announcements, Amber Alerts, and technology in cars as media to disseminate information. CM described the need for reminders for parents and caregivers to not leave their child in the car, especially during the summer. She also described that billboards or something that will grab their attention should be used to disseminate the reminders.

> CM described: I think maybe like once summer comes or the heat is coming in, or just like yearly I think there should be a freaking like big reminder, you know, like for the parents or the caregivers in regard to leaving their kids in the car, cause I know a lot of people, do it. I know people do it to like get out the store, get a few things…make an announcement on the news and when they have their pediatric visit, I feel like it should be something that's reminded. Don't leave the baby in the car you know to like heat exposure. Maybe even getting something in the mail, just something that can be seen and known, a billboard. You get me,

like something that is in your face…to call the attention to, a call the attention to what we're trying to prevent.

Another parent, Ms. A, discussed how commercials about PVH on social media and television impacted her. She recalled noticing the commercials more after having children and described them as being informative. Ms. A also discussed hearing PSA's that were helpful in educating her about PVH. Ms. A described PSA's and commercials on social media or television as a medium that could be used to increase awareness about environmental heat exposure in young children.

Ms. A described: Well, yeah, you know what I had never really thought about it much until I had children. But I don't know, I guess after I had children, I started seeing the things pop up on Facebook or different news outlets where it caught my eye more where it's like oh, yeah like that's really scary…Just public announcements, or whatever you call them…

SG discussed a need for increased awareness about the risks of leaving children in cars before something happens. She described hearing more information about it on the news after something bad happened to a child. SG discussed the importance of getting the information out to parents and caregivers before anything bad happens because it may help to prevent a child from being left in a car. She described the need for the information to be posted frequently on different media platforms so that parents and caregivers will see it everywhere.

SG discussed: I think maybe more awareness. You know because honestly the only time I've heard about things like this is when there's a bad situation and like

> it's in the news… Everyone is in a hurry, but like, you know, it could. The end result is not always good, so we don't wanna wait till there's something bad before we like talk about it, so like, you know, just getting people more informed. So, they're aware, and you know they don't end up leaving their kids in the car like and wait till something terrible happens. I think that'll be helpful at least if it's constantly in your ear like you see it everywhere…

FM shared similar information as SG with regard to discussing the need for more commercials to educate people about the risks of leaving children unattended in cars. FM also discussed different methods to increase awareness about environmental heat exposure in young children. He discussed having celebrities speak about it and holding parenting workshops. Although FM described the need for more education and awareness for parents, he shared that he honestly does not know because some parents leave kids in the car due to being lazy and irresponsible. He appeared to have some doubt about whether increased awareness and education would help these parents.

> FM discussed: I think. just educating people. Honestly, you know, might have to have more commercials. Might have to have, you know you know more celebrity speaking on it. Just getting the awareness out there. Maybe even have, like some workshops, you know, parenting workshops. But I don't know honestly. I think it's just. I think it's just laziness, you know. I think some parents get lazy…it's mainly being just irresponsible...

Both EM and BD described the use of technology to increase awareness about environmental heat exposure in young children. EM described having technology such

as a meter on cars that indicates a child has been left unattended. She also described having something similar to an Amber Alert that would send out a notification when children are left unattended in cars.

> EM described: Well, I feel like, because technology is getting better. Maybe one day they can put something in the car to let us know if well, like a warning to let you know if you're leaving someone in the car, especially a baby…we should have some kind of meter on our car that tells you if a car, I mean a child is left in there unsupervised, or maybe we should have like a I don't know…I think we should have like a whole you know, how like we do the Amber Alert?...

BD described technology such as the Apple ear tag button that could be placed on a child's car seat to alert parents if they get separated from their child. He also described that car seat manufacturers could place cameras in the car seats similar to the cameras people have for their homes.

> BD described: Apple ear tag. Alright the air tag is like a little button, and you can put the button anywhere you'd like. Put the button on the car seats and the kids. Then you will know if you get separated from them or distanced from them…Are we holding them accountable…Where is the camera in the car seat? There are cameras in our houses, on our doors everywhere. It can at least be in the car seat you know …"

BD also discussed partnering with car seat manufacturers to set up displays at stores to provide education about car seat installation and the importance of not leaving children in cars alone. He described that this training would help to increase awareness and

disseminate information to parents. BD described: “I think some of the preventative education should also, you know, like I said earlier, come from the doctor's office, but it can also come from the store. The manufacturers that are selling the car seats, you know, have displays at meetings, you know…and have trainings and different things like that…but also instructing you know how to put it on and how to remember…”

Other parents and caregivers described some of the current resources for information about environmental heat exposure in young children. They described online, health departments, hospitals, the CDC, and the public as possible places where parents and caregivers can receive information. Parents and caregivers also discussed the need to increase awareness and the dissemination of information about environmental heat exposure in young children. Both SM and CM described that parents could get information about environmental heat exposure from clinics, hospitals, pediatricians, and the CDC. SM described, “CDC, I don't know the clinics and hospitals in doctor's office. If they visit, maybe they should have some type of pamphlet, or something, or billboard poster for them to read.”

> CM described: I believe you can get information like that from like, I had this paperwork when I left the hospital. I believe with CHP. You call a certain number they could give you information, also pediatric doctor can give you that information I’m pretty sure. Also, online. What I think like the CDC I don't know if it's CDC but it's like some health page can also give you information in regard to leaving children in a hot vehicle….I would say school...

CG described similar resources of information as SM. CG shared that she would speak with the doctor and search online to find current information. JM discussed searching

online and advertising at community events to increase awareness and provide education for parents. JM discussed: “...this is so unique and new that I didn't even know it was the thing I mean I think the best way is probably online. Social media is probably gonna be a big factor for parents seeking out that information ...Maybe a community event and having a fair..” CC described using pamphlets and bulletin boards to increase awareness and disseminate information. She also described making cards for parents’ dashboards that could help remind parents to check the backseat.

> CC described: I think pamphlets and bulletin boards are similar to what we you know. I'm not sure if you have ever seen those bulletins? But it's like the ones they use for like the CPR. And it shows you the steps…diagrams of a kid in the backseat…I think the more they see things that helps them to remember. So, I would like to see like little cards, or something like that the parents could have. That you know that they take and put on the dashboard… more posters and stuff…so, I think you know things like that… when you're seeing something all the time. It kind of starts sticking so that sounds kinda good. Look back! Look back. You know or check back, you know…

Although parents and caregivers described various mediums and resources that could be used to educate more people about environmental heat exposure in young children, they identified a need for increased awareness. Parents and caregivers acknowledged that community partnering is vital for securing more resources to ensure that preventative information about environmental heat exposure in children is widely available.

Summary

This chapter addressed the specific aims of the research study. Adult parents and other caregivers' perceptions regarding behaviors leading to children being exposed to adverse environmental heat were elicited with the use of a semi-structured interview guide. Parental and caregiver perceptions were expressed through five main categories that emerged from the narrative interview data: (1) general child safety concerns; (2) physical location and scenarios for environmental heat exposure; (3) parental behaviors and observations; (4) parental experiences and anticipatory fears; and (5) feelings and thoughts about other parents or caregivers.

Adult parents and other caregivers' knowledge about environmental heat exposure and risks to young children's health were identified through seven main categories that emerged from the narrative interview data: (1) General knowledge; (2) Receiving information specifically about PVH; (3) Parents questioning and judging other parents; (4) Parental accountability; (5) Environmental concerns; (6) Social support for parents; and (7) Community partnering to increase awareness.

Chapter 6

Discussion

Increased global temperatures related to climate change have intensified an urgent need to address environmental heat exposures that children may encounter (Vamos, 2014). Young children are at increased risk because of the inability to quickly thermoregulate in extreme heat, and lack of ability to control or remove themselves from hazardous heat environments (Smith, 2019). Parents and other caregivers are in a position to protect their children from dangerous heat however, little is known about parent and caregiver knowledge related to heat microenvironments or their perceptions of their role in protecting young children from these adverse exposures. To address the need for information to guide best approaches to protect young children from adverse heat exposures, this study used qualitative inductive content analysis methodology to gather foundational data from 14 parents and two non-parent caregivers. A public health model applied to prevent child maltreatment along with Haddon's Matrix were used as a theoretical framework. To our knowledge, this is the first study that directly interviewed parents and other caregivers about their perceptions of climate change and hot weather in relationship to dangerous heat microenvironments, and to explore perceptions of their caretaker role in relationship to protecting young children from adverse heat exposures.

Findings showed that parents and other caregivers did not spontaneously include weather related heat environments when discussing their role of providing safe environments for young children. They routinely identified physical and emotional safety for young children in terms of car seats, keeping unsafe objects out of reach, keeping a close eye on young children around animals/pets, swimming pools, strangers, and

dangers in a kitchen. This suggests that it would be beneficial to move the topic of hot weather and dangers of heat microenvironments into the existing framework of general safety concerns that parents endorse as important to their role in keeping young children safe. For example, information on hot weather and adverse heat microenvironments would be routinely included with information on childproofing homes, car seats, swimming pools and playgrounds, rather than being a separate, stand-alone safety concern. This would fit within the overall view expressed by parents and other caregivers that child safety is an interconnection between home, public and emotional spaces.

Several parents described taking an active role of continuous monitoring their children while playing or watching sports outdoors which is consistent with the American Academy of Pediatrics (AAP) recommendations to help prevent heat stress in children. AAP recommendations for children when climate temperatures are elevated include: reduced exercise intensity, adequate hydration, frequent rest periods, and education on heat illness and hydration to help raise awareness of prevention (Smith, 2019). Only several parents reported this behavior which points to a need for more research as to why some caregivers of young children do and others do not embrace these recommended protective behaviors during hot weather.

Overall, parents' perceptions, behaviors or experiences surrounding accountability for children exposed to adverse heat environments ranged from minimizing risks, understanding other parents, and advocating for young children. Participants primarily spoke about holding parents and caregivers accountable for leaving children in hot cars. However, one parent whose child suffered heat illness

playing on an unshaded school playground on a hot day described taking an active role to hold the school accountable and was successful in advocating for her child. This is an area for potential intervention, how to encourage and teach parents and other caregivers to advocate for their young children. Societal and cultural forces were also identified as being accountable for exposures of young children to environmental heat. For example, it was noted that green spaces and shade coverings in public spaces varied by neighborhoods based upon economic resources. An African American father shared his perception of a racial disparity between bystanders' responses to children left unattended in cars based on their ethnicity. The racial disparity between bystanders' responses to children left alone in cars has not been discussed in previous qualitative research studies and is a concern that warrants further exploration. The public health framework, Haddon's Matrix, could be used to analyze the bystanders' actions during the event stage where the children were left unattended in cars. Haddon's Matrix framework could be used to identify how, when, and where interventions effectively prevent or reduce an injury (Scott et al., 2016). The bystanders' willingness to quickly intervene without racial biases could help prevent or minimize injuries for the children that were left unattended in the cars. This points to another area for future work that motivates parental and other caregiver advocacy for equity and inclusion for all children.

Participants identified the need for more social support, awareness, and education for parents and others caring for young children. Participants described the need to increase: accessibility to parenting classes about safety; involvement of pediatricians, teachers, nurses; and establishment of parent/caregiver support groups. It was also acknowledged that community partnering would be vital for securing more

resources to ensure that preventative information about environmental heat exposure in children is widely available.

The general shared perception among the parents and caregivers was that parenting can be overwhelming, stressful and full of distractions that may contribute to parents unintentionally leaving a child in a car. Although parents and caregivers acknowledged that parenting can be overwhelming, they expressed that the behavior of leaving a child was not acceptable. The empathy and understanding that the parents and caregivers expressed during the interviews for this dissertation study, differed from the perceptions of parents, caregivers, and experts who participated in a comparative analysis study in Athens-Clarke County, Georgia. Most of the participants denied they could forget their child in a hot vehicle and acknowledged the perception that unfit parents or lifestyle factors increase a parent's risk of forgetting a child (Williams & Grundstein, 2018). The participants in the study did not express empathy for parents who forgot their children in a car and they shared the perception that it could not happen to them.

Parents also discussed their knowledge about the effects of climate change and hot weather on young children's health. Their discussions mainly centered around information that they had received about PVH. They endorsed the need for more social support among parents who multitask while driving with young children and the need for more awareness about the risks of environmental heat exposure in young children. Parents and caregivers discussed the need for partnering with health care providers, churches, schools, and other community agencies to help provide education for parents about adverse environmental heat and risks to young children's health. Parents and

caregivers identified a lack of knowledge and provided ideas about community resources that could be used to address the deficit. This approach was applicable to the pre-event stage of Haddon's Matrix framework that focuses on preventative actions or education to reduce harm or injury.

Overall, parents discussed that more education is needed about the risks of leaving children unattended in cars, outdoors in unshaded play areas, and the use of sunscreen, especially for parents that make excuses. Parents and caregivers identified sources of emotional and educational support for parents could be: parent groups where they can share their experiences related to child safety; child safety classes at each stage of development; car seat safety education/training; sensitivity training for all parents with a license issued after course completion; and text message reminders from pediatric providers to parents on hot days. They described that parenting and safety education classes could be held at medical offices/clinics, hospitals, gyms, schools, and fire stations. Parents and caregivers identified that the most meaningful sources of support could be family, parent groups, parenting classes, medical providers, and child safety trainings/classes.

Parents and caregivers identified that partnerships with churches, health clinics, community centers, parks, and schools could be used to help increase awareness about environmental heat exposure in children. Parents also described the role that churches, schools, and community leaders could play in disseminating information about environmental heat exposure to people who provide care for children. In addition to describing the role of these community agencies and leaders, parents discussed who should be involved with increasing awareness about environmental heat exposure.

They identified park attendants, law enforcement, court, child protection services, counselors, teachers, grandparents, pediatricians, nurses, and anyone working with children should be involved with increasing awareness or education.

Parents described different forms of media that could be used to increase awareness about environmental heat exposure in young children. They described television commercials, social media, billboards, Public Service Announcements, amber alerts, and technology in cars as media to disseminate information. A new father described using celebrities to speak about environmental heat exposure in young children to help spread awareness.

Parents and caregivers also discussed using pamphlets, bulletin boards and cards for parents' dashboards to increase awareness. They shared that attention grabbing reminders about not leaving children unattended in cars could be sent out via text messages, flyers in the mail, or news announcements, especially during the summer months.

Literature gap addressed

Limited research has focused on public health messaging and public health education involving health care providers discussing adverse heat environments and PVH with parents of young children (Williams & Grundstein, 2018). Current research focuses primarily on PVH, preventative technology devices, and physiological changes associated with heatstroke. Many of the research studies involving adverse environmental heat exposure in children use quantitative or mixed methods. This dissertation research study addressed the literature gap through the use of qualitative inductive content analysis methodology to explore parental and caregiver perceptions

and knowledge about the broader scope of potential weather-related environmental heat exposures in young children. This qualitative study also explored parent and caregiver perceptions of modifiable parental behaviors that influence their decision to leave young children unattended in vehicles or in unshaded play areas. The exploration of these parental perceptions can be a first step to guide future research to identify modifiable risk factors that contribute to leaving young children in microclimates that expose them to adverse environmental heat.

Study Implications

Implications for Research

Findings from this qualitative study provide a guide for future research efforts to develop public health and/or behavioral interventions that may help prevent severe injuries and death of young children associated with adverse environmental heat exposure. Using qualitative methods, findings identified parent and other caregiver perceptions about behaviors that may lead to children being exposed to adverse environmental heat.

Parents and caregivers shared their knowledge that many parents do not have assistance with their children when they run errands and that this lack of support contributes to behaviors that may lead to children being left unattended in cars. Parents and caregivers described that daily multi-tasking behaviors while caring for young children can lead to parents rushing, feeling overwhelmed and forgetting a child in the car. Parents also identified the behavior where children are left in locked cars with the air conditioning running while the parent makes a quick stop or runs into the home to retrieve an item. Some parents perceived this behavior as less of a risk because the

child is sitting in cool air. Parents and caregivers expressed the need for increasing awareness and education about environmental heat exposure in young children through partnering with pediatricians, pediatric nurses, community leaders, community events/fairs, and radio stations.

Future research is needed to develop and explore interventions that will help provide support for parents and caregivers. Public health interventions are needed to educate parents and caregivers about the risks to young children during hot weather. Collaboration with health care providers, community agencies, and other agencies at the regional and national level are needed. Parents and caregivers identified that parent/caregiver workshops, classes held in clinic or community settings, PSA's, billboards, pamphlets, celebrity sponsored events and text message from health care professionals may be effective public health strategies to increase awareness about the risks of adverse environmental heat exposure.

Implications for Practice

Efforts to involve nurses and other healthcare professionals with educating and increasing awareness about the effects of environmental heat exposure on children's health are needed because some parents and caregivers expressed having limited knowledge regarding the effects. A knowledge deficit for parents and caregivers related to preventative education about environmental heat exposures in young children has been identified. There is a need for parents and caregivers to receive valid research-based information. Parents and caregivers identified the need to increase awareness and education about environmental heat exposure in young children through collaboration between numerous community agencies and community members such

as: park attendants, law enforcement, court, child protection services, counselors, teachers, grandparents, pediatricians, nurses and anyone working with children.

Strengths and Limitations

Strengths

Strengths of this research study include the diverse range of the participants' educational levels and occupations. The education levels of the participants included: seven participants with bachelor's degrees, four participants with master's degrees, four participants with some college credit, no degree and one participant with a high school diploma. The variation in the educational levels contributed to the diverse perspectives presented by the participants during the semi-structured interviews.

Occupations of the participants included: teachers, a school aid, licensed child care provider, registered nurse, social worker, managers, a foster care provider, analyst, coordinators, and real estate agent. The broad range of occupations among the participants enabled them to share some personal experiences or knowledge about young children's exposure to environmental heat that were encountered through their work surroundings. An additional strength of the research study is over half of the participants identified as Black or African American, which is an infrequent occurrence, as this minority ethnic group has been historically underrepresented in research studies. Through their participation in this research study, some African American parents were able to discuss culturally sensitive experiences related to environmental heat exposure in young children that have not been described in other qualitative research studies.

Limitations

Study limitations include a sample consisting largely of female participants. The

study also lacks geographic diversity. Recruitment approaches limited participant residents to the cities of Inglewood, Los Angeles and nearby surrounding areas. Another factor that may have limited geographic diversity was the recruitment protocol restriction to those who spoke English. Recruitment of caregivers of children was challenging because many expressed that their hectic schedules made it difficult to set aside time to participate in the interview over zoom, despite being offered flexible scheduling options. Most of the caregivers were also mature in age and expressed being unfamiliar with zoom technology. The reliance on computer technology to recruit and conduct interviews may have unintentionally excluded potential participants who lacked access to computers or were unfamiliar with using technology.

Conclusion

Parents and other caregivers of children shared their perceptions, knowledge, and experiences surrounding adverse environmental heat exposures in young children. They revealed that it is important for parents to receive emotional, physical and educational support in order to help prevent young children from being left unattended in cars or other dangerous heat microenvironments. Parents and caregivers discussed that the lack of support in any one of these areas can contribute to behaviors such as multi-tasking, rushing or feeling overwhelmed while running errands or caring for young children. They perceive that these behaviors may lead to children being left in hot unshaded play areas or forgotten in cars. Some African American parents believe that the sun will not harm their children's skin because of the melanin in their dark skin. Some participants in this dissertation study suggested that more education about the use of sunscreen on dark skin is needed for African American parents. Overall, parents

and caregivers expressed the need for increasing awareness and education about environmental heat exposure in young children through partnering with pediatricians, pediatric nurses, community leaders, community events/fairs, and radio stations. They identified the need for more resources in their communities to improve public shading and green spaces that will help minimize environmental heat exposure in young children. Findings from this study highlight the need to increase awareness and education about environmental heat exposure in young children through collaboration with health care providers and community agencies. Parents and caregivers shared experiences and knowledge that can provide new insights for developing public health strategies that are effective in addressing parental behaviors that contribute to adverse environmental heat exposure in young children.

Table 3: Summary of Categories

Specific Aim 1: Explore the perceptions of adult parents or other caregivers regarding behaviors leading to children being exposed to adverse environmental heat.

Main Categories

1) General child safety concerns:

Home environment
Child safety in public places
Emotional safety

2) Physical location/scenarios where children are exposed to environmental heat:

Outdoor playgrounds and school yards without covering,
Attending sports events/sports practices in summer
Cars
Homes/apartments without AC
Backyards, gardens, lakes, pools
Vacation locations
Amusement parks in warm weather

3) Parental behaviors and observations:

Monitoring/protecting children in hot weather
No observations of children left in cars
Observing children unattended in cars at stores
Observing unattended children playing in the heat outside
Bystander reactions to African-American children vs. Caucasian children left in cars
Advocacy to protect children

4) Parental experiences and fears:

Related to children overheating or left in car
Past childhood experiences with being left in a car

5) Feelings and thoughts about other parents or caregivers who have left children unattended:

Hearing about children and animals left in hot cars
Sadness, anger, confusion and irritation with parents
Sympathy
Feelings about older kids left in cars
Feelings of sadness for children left in cars

Specific Aim 2: Identify adult parents or other caregivers' knowledge about adverse environmental heat exposure and risks to health of children ages newborn to four-years.

Main categories:

1) General knowledge:

Effects of climate change on children's health/mental health
Limited parental knowledge about climate change and children's health
Lack of knowledge about signs of overheating in children

2) Receiving information about PVH:

Physical symptoms of PVH
Sources of information- news stories, social media, hearing stories, pediatrician, care provider meetings
Lack of hearing information about PVH

3) Parents questioning and judging other parents:

Rushing and forgetting child
Parental guilt associated with children dying in cars
Judging and blaming parents
Questioning parent's mental awareness
Parents having excuses
Parents not talking about kids left in cars

4) Parental accountability:

Tickets and jail time for parents who leave kids in cars
Need a mandate similar to child abuse and license similar to a driver's license
Parents responsibility to protect kids
Meetings to find solutions

5) Environmental concerns:

Limited safe green spaces in neighborhoods without economic resources
Need for more shade covering at schools, parks, beaches and playgrounds
Some African-American parents' excuses for not using sunscreen

6) Social support for parents:

Parent groups for sharing experiences and sensitivity training
Parenting/car safety classes for each stage of childhood
Classes provided at medical offices, schools, fire departments and gyms to teach parents about heat exposure in children

Text message reminders on hot days

7) Community partnering to increase awareness:

Jobs and churches to discuss child protection from heat exposure
Involving: community centers, park attendants, law enforcement, courts, child protection services, counselors, grandparents, anyone working with kids
Increasing awareness: commercials, billboards, PSA's to increase awareness before something bad happens
Technology in cars, involving car seat manufacturers, amber alerts
Resources for parents about environmental heat exposure: online, health department, CDC, public, caregivers, hospitals, health department/county

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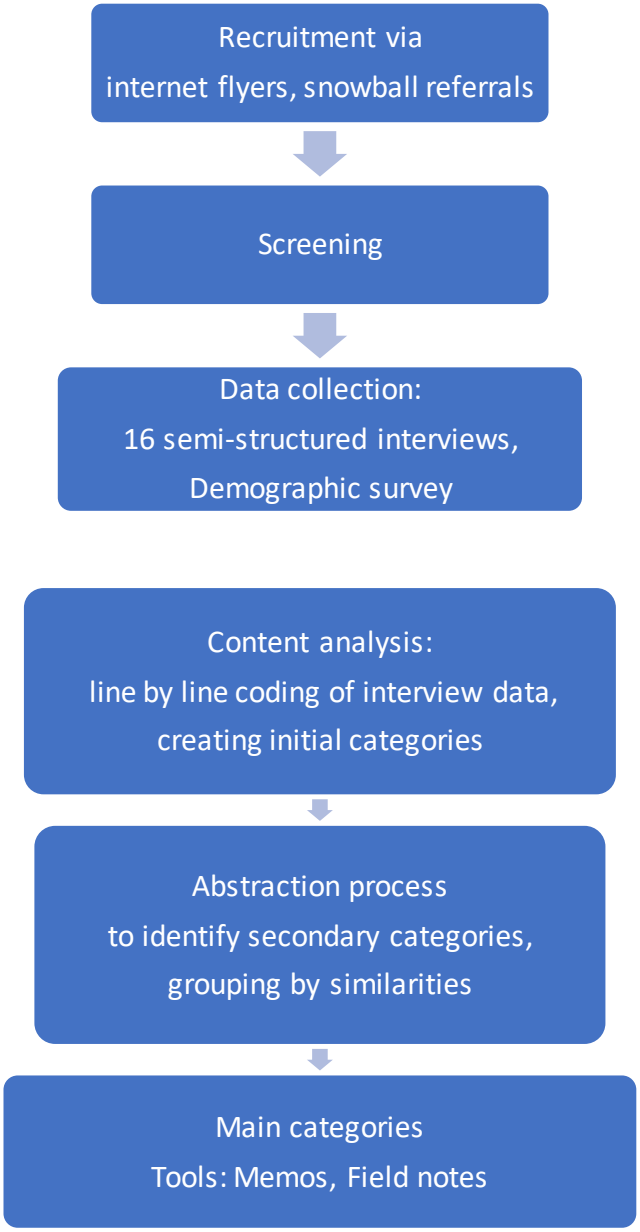
Appendix A

Research Design



Appendix B

UNIVERSITY OF CALIFORNIA, LOS ANGELES
SCREENING CONSENT SCRIPT

Qualitative Study of Knowledge and Perceptions of Parents or Other Caregivers about Environmental Heat Exposure and Children's Health

Thank you for calling Virgin Watters, RN, MSN, PhD doctoral student regarding the study of knowledge and perceptions of parents about environmental heat exposure and children's health. I would like to ask you a few questions in order to determine whether you may be eligible for the research. Before I begin the screening, I would like to tell you a little bit about the research. The purpose of this research study is to explore knowledge and perceptions among parents or other caregivers of young children about environmental heat and children's health. This study uses interviews with parents and other caregivers as a way to collect their thoughts.

Would you like to continue with the screening? The screening will take about five minutes. I will ask you about information such as age, gender, language spoken, etc. You do not have to answer any questions you do not wish to answer or are uncomfortable answering, and you may stop at any time. Your participation in the screening is voluntary.

Your answers will be confidential. No one will know your answers except for the research team. Your answers will be destroyed if you do not qualify for the study. If you qualify for the study and decide to participate, your answers will be kept with the research record without your name or any other identifying information.

Would you like to continue with the screening? [*If no, thank the person and hang-up*]

Screening Questions

1) Are you the parent or caregiver of a child under the age of four years?

2) Are you 18 years of age or older?

3) What is your city of residence?

4) Do you speak, read and write English?

5) What is your gender?

Thank you for answering the screening questions. According to the responses provided for the screening questions, you are eligible to participate in this study.

Not eligible: According to the responses provided for the screening questions, you are not eligible to participate in this study because you do not meet one or more of the following study requirements: age, city, language or age of child.

Do you have any questions about the screening or the research? I am going to give you a couple of telephone numbers to call if you have any questions later. Do you have a pen? If you have questions about the research screening, you may call Virgin Watters, RN, MSN, PhD doctoral student at (310) 825-9559 and she will answer your questions.

If you have questions about your rights as a research subject or if you wish to voice any problems or concerns you may have about the study to someone other than the researchers, please call the UCLA Office of the Human Research Protection Program at (310) 206-2040.

Thank you again for your willingness to answer our questions.

Appendix C

UNIVERSITY OF CALIFORNIA, LOS ANGELES

CONSENT TO PARTICIPATE IN RESEARCH

Qualitative Study of Knowledge and Perceptions of Parents and Other Caregivers about Environmental Heat Exposure and Children's Health

You are invited to join this research study led by Virgin Watters, RN, MSN, PhD doctoral student at the University of California, Los Angeles, School of Nursing. You are invited to join this study because you are a parent or caregiver of a child younger than 4 years old, you live in Southern California, and you are 18 years of age or older. Your participation in this study is voluntary. Please read the information below and ask questions about anything you don't understand before deciding to be in the study.

The purpose of this research study is to explore knowledge and perceptions among parents or other caregivers of young children about environmental heat and children's health. This study uses interviews with parents and other caregivers as a way to collect their thoughts.

If you agree to participate in this research study:

You will complete a short demographic questionnaire regarding your age, gender, city of residence, ethnicity, number of children, education and occupation.

You will participate in an interview lasting 40-60 minutes where I will ask you questions about your knowledge and experiences related to children's exposure to environmental heat.

The interview will be held over zoom and you can choose to use video with audio or audio only. The interview will be recorded. You will be able to review, edit, and erase the recording of your interview. You may ask at any time to stop the recording. The recording will be transcribed and you will have a chance to review the transcript if you choose to do so.

There are minimal risks involved with participating in the research study, although it is possible that increased awareness of feelings and emotions may arise during the interview process. You can request to stop the interview at any time.

There may be no direct benefits to you for participating in this research study. However, the results of the research are expected to help public health professionals, community-based organizations, and health care providers work together with parents and caregivers of young children to optimize the health of children during hot weather.

You will receive a $25.00 e-gift card for participation.

Will information about me and my participation be kept confidential?

Any information that is obtained in connection with this research study and that can identify you will remain confidential. It will be disclosed only with your permission or as required by law. Confidentiality will be maintained by means of changing your name and any identifying information you state during your interview to protect your identity. Your data, including de-identified data may be kept for use in future research. All zoom recordings will be deleted after transcription. Only the principal investigator will have access to the recording of the interview.

As a mandated reporter, the principal investigator may not be able to keep confidential any disclosure or endorsement of thoughts to harm yourself or others. Depending on how intense your thoughts are or how much you feel like hurting yourself, the researcher may provide you with referrals for treatment, work with you to contact your personal physician, trusted family member, or therapist to discuss your thoughts of harming yourself; or work with you on a plan that may include getting you to a hospital for safety. Information disclosed during the interview regarding harm to a child will be reported to child protection services.

If you have any questions, comments, or concerns about the research, you can talk to one of the researchers. Please contact: Virgin Watters, MSN, RN, PhD, doctoral student by phone: 310-825-9559 or email: vwatters@g.ucla.edu or Faculty Sponsor: Wendie Robbins, PhD, RN, FAAN, FAAOHN, by phone: 310-825-8999 or email: wrobbins@sonnet.ucla.edu

UCLA Office of the Human Research Protection Program (OHRPP):

If you have questions about your rights as a research subject, or you have concerns or suggestions and you want to talk to someone other than the researchers, you may contact the UCLA OHRPP by phone: (310) 206-2040; by email: participants@research.ucla.edu or by mail: Box 951406, Los Angeles, CA 90095-1406.

WHAT ARE MY RIGHTS IF I TAKE PART IN THIS STUDY?

You can choose whether or not you want to be in this study, and you may withdraw your consent and discontinue participation at any time.

Whatever decision you make, there will be no penalty to you, and no loss of benefits to which you were otherwise entitled.

You may refuse to answer any questions that you do not want to answer and still remain in the study.

You will be given a copy of this information to keep for your records.

Appendix D

Semi Structured Interview Guide Questions

(The PI will have reviewed the consent form with the participant and have obtained consent prior to the interview).

Introduction: Good afternoon and thank you for agreeing to have a conversation with me about children and adverse environmental heat. Your name and other identifiers will be kept confidential and will not be recorded. We are happy to have you participate and want to let you know that you do not have to answer any questions that you do not want to, or that make you feel uncomfortable. Do you have any questions before we start the interview ? The recording will start now and please let me know anytime you wou ld want to turn off the recorder.

Grand tour question: How do you view safety with children and can you share what issues are important to you?

1. What do you know about young children and heat exposure?

   Follow-up question: Can you tell us where young children may be exposed to environmental heat?

2. Can you tell us what you know about the effects of climate change on young children's health?

   Follow-up question: What climate temperature do you feel is harmful for a young child?

3. What scenarios can you think of where children might be exposed to environmental heat?

   Follow-up question: How might this scenario occur?

4. Have you seen, heard or experienced a situation where a young child was left unattended in a car or unshaded area?

   Follow-up questions: What happened? How long ago did this happen? Do you know the events that led up to the child being left unattended in the car or unshaded area?

   What was the outcome for the child? What was the parent or other caregiver of children's reaction?

5. How often have you seen young children left unattended in a car or unshaded area?

   Follow-up: Can you share your thoughts or feelings about parents or other caregivers of children who have left a young child unattended in a car or unshaded area?

6. What have you heard about Pediatric Vehicular Heatstroke (children dying in hot cars)?

   Follow-up questions: Where have you received information about children dying in hot cars? How often have you heard information about young children left unattended in cars?

7. What do you think are some steps to help prevent young children from being left unattended in unshaded areas or cars?

   Follow-up questions: What else is needed? What preventative education do you think parents or other caregivers of children will find helpful?

8. What do you hear parents say about preventing children from being left unattended in hot cars or unshaded areas?

Follow-up questions: Where do parents or other caregivers of children seek out information about children's health and environmental heat exposure? Who should be involved with providing information about children's health and environmental heat?

Closing question: Would you like to talk about any information that was not previously brought up during our interview?

Thank you for taking the time to participate in the interview and the recording will stop now.

Appendix E

Participants and the number of children	Transcript	Main Categories
Ms. A: mom of three	"So, I've definitely learned more with children and you know if I leave them in the car. It's just I'm right there and the car is always running. I would like if I have to run home and grab something."	Physical location/scenarios where children are exposed to environmental heat
TM: mom of four	"Going to the beach, going to the mountains with the higher altitude. I mean it's just; I don't know just any time that they're outside, and for I mean just if you're outside for a long amount of time."	Physical location/scenarios where children are exposed to environmental heat
PM: mom of three	"…she was hospitalized. So, the heat exhaustion, and just heat in general with kids is like it, it was very scary and for me it's like no I am petrified. So even now, with that we started the new year at school, I did have to talk to a lot of the teachers and say, hey, my kid has experienced heat exhaustion."	Parental experiences and fears
FM: father of one	"I haven't seen it lately, but I know like growing up you know parents would do that a lot, you know. I was probably, it even happened to me as a kid. You know my mom might, you know she may run to the store or something like that, for you know, a couple of minutes…but I it was nothing like a long time, though."	Parental experiences and fears
CG: foster mom of one	"I don't know anybody personally that has done it, and everything that I've heard has been over the news, so they forgot or they possibly went to the store real quick for a minute to do something or left them in the car, but that's only through media…"	Receiving information about PVH
SM: mom of three	"I guess just what they report on the news. They only really give it attention when it's in the summer, and when you know, if a kid has died…My kids go to Kaiser and they give out pamphlets sometimes about heatstroke, and this is only in the summer time, too."	Receiving information about PVH

SG: mom of one	“I mean I'm not justifying the fact that the child was left but like even for parents maybe mental awareness, like make sure you're okay, you know making sure you're okay because if you're not okay, you can't possibly give the best care to your child, and like your, you have a 101 things you want to do, you're rushing and then it's easy to forget, it's easy it's really easy to forget.”	Feelings and thoughts about other parents or caregivers
CM: mom of one	“I don't know how people in their mind do things like that. Personally, I don't because I don't see myself again, like maybe because I wasn't brought up like that but my mom was like, don't leave the baby alone this and that you know so I don't know I find that so crazy.”	Feelings and thoughts about other parents or caregivers
ND: father of one	“Oh, yeah, in my early twenties. I used to work at a grocery store, and it wasn't common but you did see it sometimes, where you know, you would see people run in and get things and depending on who it was, you would see that you know the outrage. For example, if it was someone that looked like me no one would say anything you know what I mean. But if it was a kid that maybe had a lighter hue to them. Then, you know, there would be a little more uh, people will be, their arms would be in the air…”	Parental behaviors and observations
NM: mom of five	“She was probably like a month old, and then my toddler was with my mom, so I was trying to get back to them, and I left her in the car. I left her and I had already gotten home. I parked, and I left her in the car with say you know, like maybe 10 seconds from when I walk to my car to my door at the door, and I tell myself, oh, my gosh, I’m forgetting something and that split second to myself. Now I know how certain parents do that and not intentionally okay…I just I knew I have a lot going, but I’m missing something, but I’m like I don't know oh, my gosh! I had already shut the door, and I’m like Oh, my gosh! I left her in the car. I	Parental behaviors and observations

	realized that just a second No, but I did. I felt horrible."	
JM: mom of two	"So, I don't know much about it on young kids health. I mean I would assume that climate change is releasing toxins into the air that's making children unsafe to breathe in, you know, normal unpolluted air…"	General knowledge about climate change
EM: mom of two	"I feel that climate change is very crucial now. I see it now, because my oldest she's three and she's in school, and from the summer to now is starting to get cold and all the kids, including her are getting sick… Under 62 under 60 degrees, I think, is harmful…"	General knowledge about climate change
BD: father of two	"I think you know there should be some type of sensitivity training for all parents who are having birth you know in terms of car seat, just like we get a license, just like we open a business, you know. It's hard to kind of regulate our job process, but you do go to the doctor. We do have appointments with the doctor. So just like, for example, during your whole pregnancy, we might have about 9 appointments 9 months, you know. So maybe, instead of 9, we'll have about 15 and those different appointments that you're not seeing the doctor, you're seeing a child specialist, a psychologist you know someone that does education, someone that that gives shots and then so that your whole pregnancy would be an educational journey, so that you don't make mistakes of leaving your child in the car seat, because you just don't know better, you didn't have no type of training."	Social Support for parents
OM: mom of one	"I feel like parents need. They need to have more classes for parents like new parents. Some people just are not in the best position to be parents in the moment, and I feel like you could always learn like there's always something that that can be taught or	Social Support for parents

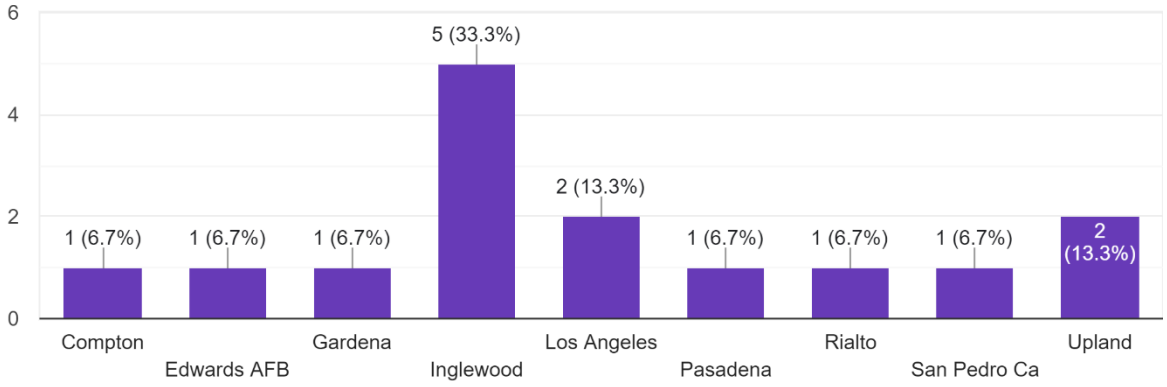
	presented to you…And then I feel like there should be more of that like throughout motherhood like throughout, you know the stages like baby, toddler, kid, teenager. Like there should always be something like a class that you're constantly learning like how to grow with your kids."	
CC: paid child care provider	"I think pamphlets and bulletin boards are similar to what we you know. I'm not sure if you have ever seen those bulletins? But it's like the ones they use for like the CPR. And it shows you the steps. So, if they design, or they may have them but if they did something like that you know, check back or check back something saying that, and then diagrams of a kid in the backseat. So, I think all those things are helpful I think the more they see things that helps them to remember. So, I would like to see like little cards, or something like that the parents could have. That you know that they take and put on the dashboard …"	Community partnering to increase awareness
QM: mom of one	"Preventative of education, I mean I haven't heard of many things related to just the kids being outside. So, there's more discussion about what to look out for, what to avoid. Still just reminders about the dangers of leaving kids in the car…churches can do reminders for people that go to church, schools, child care centers can do education about it. Written communication in any form can go out whether there's like emails, text messages, just reminders… I know at community events a lot of times local enforcement agencies would be there giving information as well."	Community partnering to increase awareness

Appendix F

Parent and Caregivers Characteristics

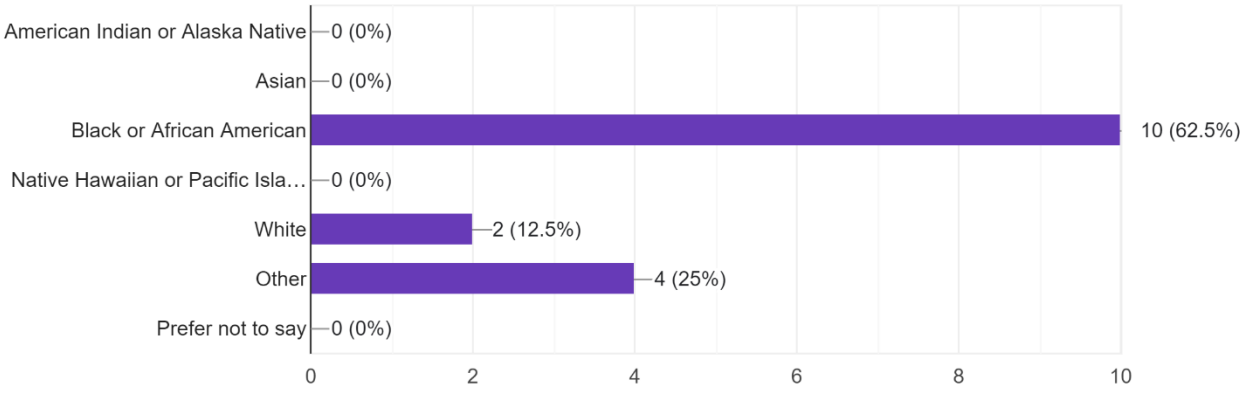
What is your city of residence?

15 responses



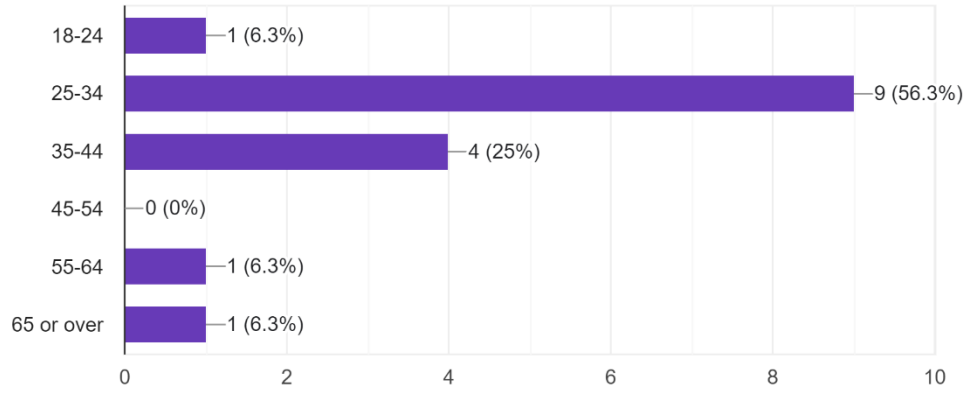
How would you best describe yourself?

16 responses



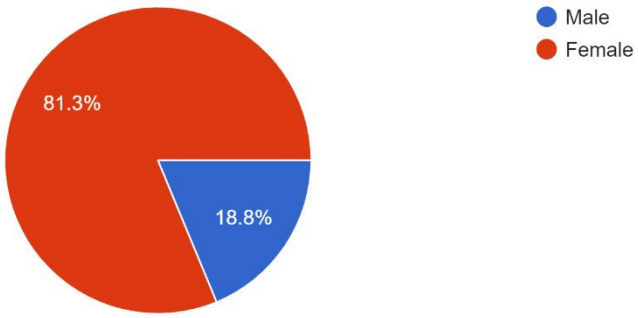
What is your age group?

16 responses



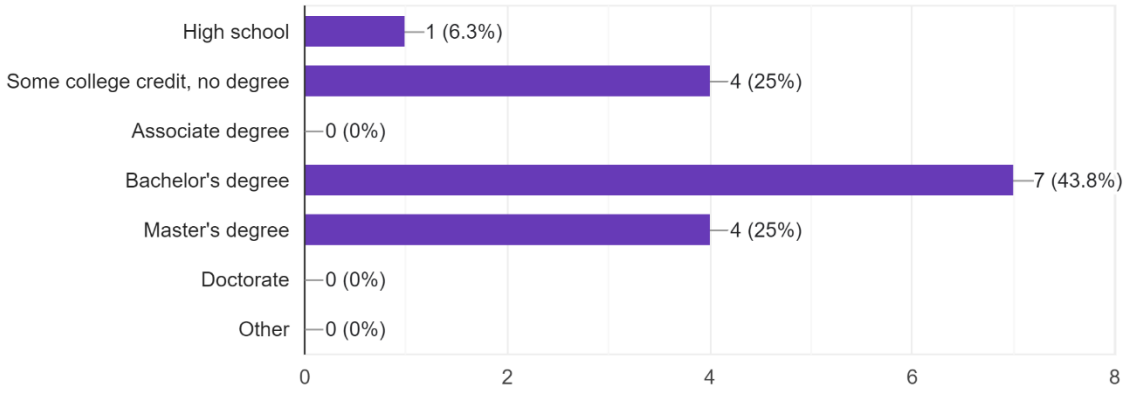
Gender?

16 responses



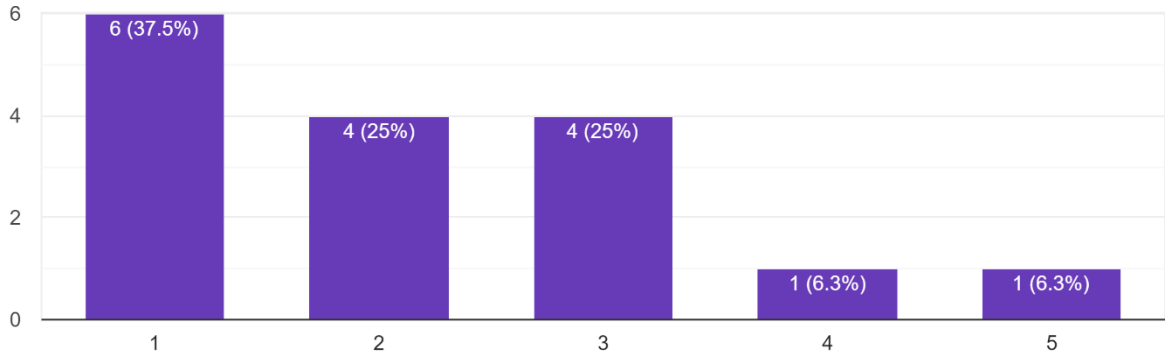
What is the highest level of school you have completed?

16 responses



How many children do you have?

16 responses



Appendix G

Demographic Survey for parents or other caregivers of children

Google Forms

What is your city of residence?

How would you best describe yourself?

- [ ] American Indian or Alaska Native
- [ ] Asian
- [ ] Black or African American
- [ ] Native Hawaiian or Pacific Islander
- [ ] White
- [ ] Other
- [ ] Prefer not to say

What is your age group?

- [ ] 18-24
- [ ] 25-34
- [ ] 35-44
- [ ] 45-54
- [ ] 55-64
- [ ] 65 or over

Gender?

- ( ) Male
- ( ) Female
- ( ) Other:

What is your Occupation?

What is the highest level of school you have completed?

- [ ] High school
- [ ] Some college credit, no degree
- [ ] Associate degree
- [ ] Bachelor's degree
- [ ] Master's degree
- [ ] Doctorate
- [ ] Other

How many children do you have?

Appendix H

Research Initial categories

Grand tour question: How do you view safety with children and can you share what issues are important to you?

Initial categories	Secondary categories
Car seat safety	Car seat safety
Child safety in home environment	Child safety in home environment (includes water/animal safety, choking hazards)

Closely monitoring children outside	**Child safety in public (includes street/parking lot, school/daycare, outside and proper clothing for weather)**
Protecting children from harm	**Emotional safety and children**
Public safety and children	
Emotional safety and children	
Nutrition and choking hazards for children	
Water safety for children (pool and bathtub)	
Animal safety for children	
School and daycare safety	
Proper clothing for weather	
Street and parking lot safety	
Child proofing the environment	
Hands on approach vs. being overprotective	

What do you know about young children and heat exposure?

Follow-up question: Can you tell us where young children may be exposed to environmental heat?

Initial categories	Secondary categories
Locations where children are exposed to environmental heat	**Locations where children are exposed to environmental heat**
Children and dogs in hot cars	**Limited parental knowledge about climate change and children's health**
Monitoring kids for signs of overheating	**Parental experiences and fears related to children overheating or left in cars**
Hearing about children left in hot cars	**Monitoring/protecting children in hot weather (includes signs of overheating, hydration, proper clothing)**
Personal experiences with leaving a child in the car	**Hearing about children left in hot cars**
Parental fear related to experience with child overheating	
Limited parental knowledge about climate change and children's health	
Proper hydration for hot weather	
Limiting children's sun exposure	
Differences between children and adult body temperature regulation	
Proper clothing for children in hot weather	

Can you tell us what you know about the effects of climate change on young children's health?

Follow-up question: What climate temperature do you feel is harmful for a young child?

Initial categories	Secondary categories
Closely monitoring children's activity level during warm weather	Effects of climate change on children's health/mental health
Proper clothing for children in hot weather	Close monitoring and protecting children in warm/hot weather (includes sunscreen, proper clothing and hydration)
Health conditions affected by climate change	Lack of parental knowledge about signs of overheating in children
Climate change effect on children's mental health	Limited safe green spaces in neighborhoods without economic resources
Parents lack of knowledge about signs of overheating in children	
Effects of climate change on children's immune system	
Identifying unsafe environmental temperatures for children	
Limitation of safe green spaces in some neighborhoods	
Economic impact of climate change	
Proper hydration and sunscreen when kids are in the heat	
Teaching kids to pay attention to weather changes	
Children's inability to regulate body temperature	
Need to continuously monitor kids in heat	

What scenarios can you think of where children might be exposed to environmental heat?

Follow-up question: How might this scenario occur?

Initial categories	Secondary categories
Outdoor playgrounds without covering	Outdoor playgrounds and school yards without covering
Attending sport events in summer	Cars
Outdoor pools and lakes	Attending sports events/sports practices in summer

Vacation locations with warm weather	**Homes/apartments without AC**
Cars	**Backyards and gardens**
Homes and apartments without AC	**Lakes and outdoor pools**
Hot playground equipment	**Vacation locations and amusement parks in warm weather**
Playing on school yards without shade	
Backyards and gardens	
Amusement parks	
Desert locations such as Las Vegas	
Sidewalks and streets	
Kids outside without shirts	
Kids soccer practice	

Have you seen, heard or experienced a situation where a young child was left unattended in a car or unshaded area?

Follow-up questions: What happened? How long ago did this happen? Do you know the events that led up to the child being left unattended in the car or unshaded area? What was the outcome for the child? What was the parent or other caregivers of children's reaction?

Initial categories	Secondary categories
Past childhood experiences with being left unattended in cars	**Past childhood experiences with being left unattended in cars**
Personal experiences with leaving a child in the car	**Personal experiences with leaving a child in the car**
Hearing stories about children left in cars	**Hearing stories about children and animals left in cars**
People observing African-American children unattended in cars	**No observations of children unattended in cars or outside**
Fear of leaving child in a car	**Observing children unattended in cars at stores**
No observations of children unattended in cars or outside	**Expressed fear of leaving a child in a car**
Observing children unattended in cars at stores	**Bystander reactions to African-American children vs. Caucasian children left unattended in cars**
Hearing about animals left in hot cars	**Advocacy to protect children from being left in cars**
Advocacy to protect children from being left in cars	
Observing kids playing in the heat	
First responders	
Angry bystanders of children left unattended in cars	

How often have you seen young children left unattended in a car or unshaded area?

Follow-up: Can you share your thoughts or feelings about parents or other caregivers of children who have left a young child unattended in a car or unshaded area?

Initial categories	Secondary categories
No personal experience seeing a child unattended in a car	Feelings of anger, confusion and irritation with parents
Observing unattended children playing in the heat outside	Sympathy and understanding for parents without excusing the behavior
Hearing stories about children left in cars	Identifying parents are overwhelmed, distracted and lack family support
Identifying parents are overwhelmed and distracted	Feelings of sadness for children who are left in cars
Feelings of anger, confusion and irritation with parents	No personal experience seeing a child unattended in a car
Lack of family support	Observing unattended children playing in the heat outside
Feelings of sadness for the children who are left in cars	Hearing stories about children left in cars
Desire to protect children from being left in cars	Need for parent training related to car seats
Sympathy and understanding for parents without excusing the behavior	Desire to protect children from being left in cars and available car safety resources
Car safety resources available for parents	Personal experience with leaving/forgetting a child in the car
Thoughts about parent's mindset	Past childhood experiences with being left in a car
Need for parent training related to car seats and caring for children	Personal experience with seeing children left in cars
Personal experience with leaving/forgetting a child in the car	Past observed responses from bystanders based on the ethnicity of children left in cars
Past childhood experiences with being left in a car	
Past experiences with observing children left in cars	
Personal experience with seeing children left in cars	
Past observed responses from bystanders based on the ethnicity of children left in cars	

What have you heard about Pediatric Vehicular Heatstroke (children dying in hot cars)?

Follow-up questions: Where have you received information about children dying in hot cars? How often have you heard information about young children left unattended in cars?

Initial categories	Secondary categories
News stories about children dying in cars	Receiving information about PVH from news stories and pediatrician

Sources of information about PVH	Parental actions that contribute to children being left in cars
Parental actions that contribute to children being left in cars	Parents' responsibility to protect kids and reminders for parents
Hearing about pets and kids left in cars	Parental guilt associated with children dying in cars
Reminders for parents	Lack of hearing information about PVH
Feeling parents need to do more	Physical symptoms of PVH
Lack of hearing information about PVH	Legal actions and PVH (includes meetings to find solutions)
Hearing about PVH annually	Hearing about pets and kids left in cars
Physical symptoms of PVH	Receiving information about children left in cars at care provider meetings
Receiving information about heatstroke from pediatrician	Feelings about older kids left unattended in cars
Receiving information about children left in cars at care provider meetings	
Feelings about older kids left unattended in cars	
Legal actions and PVH	
Having meetings and conversations to find solutions	
Parents' responsibility to protect kids	
Parental guilt associated with children dying in cars	
Hoping kids are not left in cars as often	

What do you think are some steps to help prevent young children from being left unattended in unshaded areas or cars?

Follow-up questions: What else is needed? What preventative education do you think parents or other caregivers of children will find helpful?

Initial categories	Secondary categories
Classes for parents about signs of heat exposure in children	Classes for parents about signs/effects of heat exposure in children and protection (held at schools and medical offices)
Discussions about protection of children from heat exposure	Parenting/car safety classes for each stage of childhood and educational materials
Classes about car safety and children	Technology in cars to alert parents a child is left behind and Amber Alerts
Text message reminders on hot days	Commercials, billboards and PSA's to increase awareness before something bad happens
Classes at schools and doctor's office about how direct sunlight affects kids	Text message reminders on hot days

Educational materials for parents	**Social support for parents who do not have help**
Technology in cars to alert parents a child is left in the car	**More shade covering at schools, playgrounds, parks and beaches**
Commercials, billboards and PSA's	**Tickets and jail time for parents who leave children in cars**
Social support for parents	**Community partnering with jobs and churches to discuss child protection from heat exposure (includes sunscreen, hydration and clothing)**
Identifying parents do not have help	
Parenting and safety classes each stage of childhood	
Amber Alerts for kids left in cars	
More shade covering at schools, playgrounds, parks and beaches	
Tickets and jail time for parents who leave children in cars	
Safety discussions at jobs and churches	
Conversations about sunscreen and protective clothing	
Putting child first	
Keeping children hydrated	
Making stores more accessible for families	
Increasing awareness before something bad happens	
Community partnering to discuss information about child protection from heat	

What do you hear parents say about preventing children from being left unattended in hot cars or unshaded areas?

Follow-up questions: Where do parents or other caregivers of children seek out information about children's health and environmental heat exposure? Who should be involved with providing information about children's health and environmental heat?

Initial categories	Secondary categories
Online resources for parents	**Parents not talking about kids left in cars**
Pediatricians providing information and classes for parents	**Resources for parents about environmental heat exposure in children: online, public, caregivers, hospitals, county/health department, government/CDC**

Public provides information about environmental heat exposure	**Pediatricians, fire departments, schools/teachers and gyms provide information and classes for parents**
Parents not talking about kids left in cars	**Parents judging others' situations and blaming parents that leave kids in a car**
Parents placing reminders in the front seat	**Parents asking why the parent left the kid and questioning parent's mental awareness**
Schools/teachers provide information and classes for parents	**Feeling parents do not know better or are stubborn**
Caregivers provide information	**Parents' behaviors: rushing and forgetting child in the car, placing reminders in the front seat, saying it could never be me**
Parents judging others' situations	**Need for more shade covering at schools and playgrounds**
Parents rushing and forgetting child in the car	**Need for a mandate similar to child abuse and a license similar to a driver's license**
Parents asking why the parent left the kid	**Involving law enforcement, DCFS, courts churches, community centers, park attendants, grandparents, counselors and anyone working with kids**
Parents' mental awareness	**Parent groups for sharing experiences and sensitivity training for all parents**
Parent groups for sharing experiences	**Hearing about kids left in cars every year, not hearing anyone say it is ok to leave a child in a car**
Receiving advice from counselors/therapist	**Parents having excuses for not using sunscreen on children and hearing mothers' excuses for leaving kids in the car**
Involving law enforcement, DCFS, courts and anyone working with kids	
Classes provided by medical professionals and fire department	
Involving hospitals, county and government to provide information	
Involving grandparents, churches, park attendants and community centers	
Parents saying it could never be me	
Not hearing anyone say it is ok to leave a child in a car	
Hearing about kids left in cars every year	
Parents having excuses for not using sunscreen on children	

Hearing parents blame parents that left a kid unattended in a car	
Information provided to mothers during classes at the gym	
Need for more shade covering at schools and playgrounds	
Hearing mothers' excuses for leaving kids in the car	
CDC or health department to provide information	
Need for a mandate similar to child abuse	
Parents are responsible for reading information	
Receiving a license similar to a driver's license	
Sensitivity training for all parents	
Feeling parents do not know better or are stubborn	

Closing question: Would you like to talk about any information that was not previously brought up during our interview?

Initial categories	Secondary categories
Asking children for input	**All remain the same as initial and all, except the first category are similar to categories listed for question #7**
Car seat technology and manufacturer accountability	
Accountability and penalties for parents that leave children in cars	
Sharing personal experience to help other parents	
Information about signs of kids overheating	

Appendix I

Research Secondary Categories

Grand tour question: How do you view safety with children and can you share what issues are important to you?

Car seat safety
Child safety in home environment (includes water/animal safety, choking hazards)
Child safety in public (includes street/parking lot, school/daycare, outside and proper clothing for weather)

Emotional safety and children

What do you know about young children and heat exposure?

Follow-up question: Can you tell us where young children may be exposed to environmental heat?

Locations where children are exposed to environmental heat
Limited parental knowledge about climate change and children's health
Parental experiences and fears related to children overheating or left in cars
Monitoring/protecting children in hot weather (includes signs of overheating, hydration, proper clothing)
Hearing about children left in hot cars

Can you tell us what you know about the effects of climate change on young children's health?

Follow-up question: What climate temperature do you feel is harmful for a young child?

Effects of climate change on children's health/mental health
Close monitoring and protecting children in warm/hot weather (includes sunscreen, proper clothing and hydration)
Lack of parental knowledge about signs of overheating in children
Limited safe green spaces in neighborhoods without economic resources

What scenarios can you think of where children might be exposed to environmental heat?

Follow-up question: How might this scenario occur?

Outdoor playgrounds and school yards without covering
Cars
Attending sports events/sports practices in summer
Homes/apartments without AC
Backyards and gardens
Lakes and outdoor pools

Vacation locations and amusement parks in warm weather

Have you seen, heard or experienced a situation where a young child was left unattended in a car or unshaded area?

Follow-up questions: What happened? How long ago did this happen? Do you know the events that led up to the child being left unattended in the car or unshaded area? What was the outcome for the child? What was the parent or other caregivers of children's reaction?

Past childhood experiences with being left unattended in cars
Personal experiences with leaving a child in the car
Hearing stories about children and animals left in cars
No observations of children unattended in cars or outside
Observing children unattended in cars at stores
Expressed fear of leaving a child in a car
Bystander reactions to African-American children vs. Caucasian children left unattended in cars
Advocacy to protect children from being left in cars

How often have you seen young children left unattended in a car or unshaded area?

Follow-up: Can you share your thoughts or feelings about parents or other caregivers of children who have left a young child unattended in a car or unshaded area?

Feelings of anger, confusion and irritation with parents
Sympathy and understanding for parents without excusing the behavior
Identifying parents are overwhelmed, distracted and lack family support
Feelings of sadness for children who are left in cars
No personal experience seeing a child unattended in a car
Observing unattended children playing in the heat outside
Hearing stories about children left in cars

Need for parent training related to car seats
Desire to protect children from being left in cars and available car safety resources
Personal experience with leaving/forgetting a child in the car
Past childhood experiences with being left in a car
Personal experience with seeing children left in cars
Past observed responses from bystanders based on the ethnicity of children left in cars

What have you heard about Pediatric Vehicular Heatstroke (children dying in hot cars)?

Follow-up questions: Where have you received information about children dying in hot cars? How often have you heard information about young children left unattended in cars?

Receiving information about PVH from news stories and pediatrician
Parental actions that contribute to children being left in cars
Parents' responsibility to protect kids and reminders for parents
Parental guilt associated with children dying in cars
Lack of hearing information about PVH
Physical symptoms of PVH
Legal actions and PVH (includes meetings to find solutions)
Hearing about pets and kids left in cars
Receiving information about children left in cars at care provider meetings
Feelings about older kids left unattended in cars

What do you think are some steps to help prevent young children from being left unattended in unshaded areas or cars?

Follow-up questions: What else is needed? What preventative education do you think parents or other caregivers of children will find helpful?

Classes for parents about signs/effects of heat exposure in children and protection (held at schools and medical offices)

Parenting/car safety classes for each stage of childhood and educational materials
Technology in cars to alert parents a child is left behind and Amber Alerts
Commercials, billboards and PSA's to increase awareness before something bad happens
Text message reminders on hot days
Social support for parents who do not have help
More shade covering at schools, playgrounds, parks and beaches
Tickets and jail time for parents who leave children in cars
Community partnering with jobs and churches to discuss child protection from heat exposure (includes sunscreen, hydration and clothing)

What do you hear parents say about preventing children from being left unattended in hot cars or unshaded areas?

Follow-up questions: Where do parents or other caregivers of children seek out information about children's health and environmental heat exposure? Who should be involved with providing information about children's health and environmental heat?

Parents not talking about kids left in cars
Resources for parents about environmental heat exposure in children: online, public, caregivers, hospitals, county/health department, government/CDC
Pediatricians, fire departments, schools/teachers and gyms provide information and classes for parents
Parents judging others' situations and blaming parents that leave kids in a car
Parents asking why the parent left the kid and questioning parent's mental awareness
Feeling parents do not know better or are stubborn
Parents' behaviors: rushing and forgetting child in the car, placing reminders in the front seat, saying it could never be me

Need for more shade covering at schools and playgrounds
Need for a mandate similar to child abuse and a license similar to a driver's license
Involving law enforcement, DCFS, courts churches, community centers, park attendants, grandparents, counselors and anyone working with kids
Parent groups for sharing experiences and sensitivity training for all parents
Hearing about kids left in cars every year, not hearing anyone say it is ok to leave a child in a car
Parents having excuses for not using sunscreen on children and hearing mothers' excuses for leaving kids in the car

Closing question: Would you like to talk about any information that was not previously brought up during our interview?

Initial categories	Secondary categories
Asking children for input	**All remain the same as initial and all, except the first category are similar to categories listed for question #7**
Car seat technology and manufacturer accountability	
Accountability and penalties for parents that leave children in cars	
Sharing personal experience to help other parents	
Information about signs of kids overheating	

Appendix J

Research Question: What knowledge and perceptions do parents or other caregivers of children have about adverse environmental heat exposure among newborns and children up to four-years of age?

Specific Aim 1: Explore the perceptions of adult parents or other caregivers regarding behaviors leading to children being exposed to adverse environmental heat.

Main Categories

1) **General child safety concerns: in home environment (includes water/animal safety, choking hazards), Child safety in public (includes street/parking lot, school/daycare, outside and proper clothing for weather), Emotional safety**

2) **Physical location/scenarios where children are exposed to environmental heat: Outdoor playgrounds and school yards without covering, Attending sports events/sports practices in summer, cars, Homes/apartments without AC, Backyards and gardens, lakes and outdoor pools, vacation locations and amusement parks in warm weather**

3) **Parental behaviors and observations: Monitoring/protecting children in hot weather (includes signs of overheating, hydration, proper clothing), no observations of children left in cars, observing children unattended in cars at stores, observing unattended children playing in the heat outside, bystander reactions to African-American children vs. Caucasian children left unattended in cars, Advocacy to protect children**

4) **Parental experiences and fears: related to children overheating or left in cars, Past childhood experiences with being left in a car**

5) **Feelings and thoughts about other parents or caregivers: who have left children unattended, hearing about children and animals left in hot cars, sadness, anger, confusion and irritation with parents, sympathy, feelings about older kids left in cars, feelings of sadness for children left in cars**

Specific Aim 2: Identify adult parents or other caregivers' knowledge about adverse environmental heat exposure and risks to health of children ages newborn to four-years.

Main categories:

1) **General knowledge: effects of climate change on children's health/mental health, limited parental knowledge about climate change and children's health, lack of knowledge about signs of overheating in children**

2) **Receiving information about PVH: physical symptoms of PVH, sources of information- news stories, social media, hearing stories, pediatrician, care provider meetings, lack of hearing information about PVH**

3) **Parents questioning and judging other parents: rushing and forgetting child, parental guilt associated with children dying in cars, judging and blaming**

parents, questioning parent's mental awareness, parents having excuses, parents not talking about kids left in cars

4) **Parental accountability: tickets and jail time for parents who leave kids in cars, need a mandate similar to child abuse and license similar to a driver's license, parents responsibility to protect kids and meetings to find solutions**

5) **Environmental concerns: limited safe green spaces in neighborhoods without economic resources, need for more shade covering at schools, parks, beaches and playgrounds, some African-American parents' excuses for not using sunscreen**

6) **Social support for parents: parent groups for sharing experiences and sensitivity training, parenting/car safety classes for each stage of childhood, classes provided at medical offices, schools, fire departments and gyms to teach parents about heat exposure in children, text message reminders on hot days**

7) **Community partnering to increase awareness: jobs and churches to discuss child protection from heat exposure (includes sunscreen, hydration, clothing), involving community centers, park attendants, law enforcement, courts, child protection services, counselors, grandparents, anyone working with kids, Increasing awareness: commercials, billboards, PSA's to increase awareness before something bad happens, technology in cars, involving car seat manufacturers, amber alerts, resources for parents about environmental heat exposure: online, health department, CDC, public, caregivers, hospitals, health department/county**