Settler Colonial Determinants Of Indigenous Health: Relationship Between Indigenous Women's Level Of Allostatic Load And High Blood Pressure During Pregnancy; A Secondary Analysis Of The Strong Heart Study

by

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Land Acknowledgement

I offer my gratitude to the Ho-Chunk (Hochungra) peoples and to the ancestral lands of the Ho-Chunk Nation. I am fortunate to have grown up on and continue to reside on ancestral Ho-Chunk land. I am thankful to be able to live, work, raise my child, study, and enjoy the beauty of this land. I acknowledge that I am part of and benefit from the settler colonial structure within the United States. I recognize the colonial role within academia and healthcare. I understand this land acknowledgment is a small step towards advancing change and working towards decolonization.

Acknowledgments

To my advisor and mentor, Dr. Lisa Bratzke, I offer the deepest and most sincere gesture of gratitude. You have made a lasting impression in my life through your dedication, time, and advisement. Your constant words of encouragement and caring provided me with a foundation of inner strength and motivation. You provided unwavering support when I did not believe in myself. You helped me to find clarity and amplify my voice. Thank you.

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Lastly, thank you to my daughter Harlow. Thank you for the amazing amount of grace you've given to me throughout this program. You inspire me to aim high. I love you.

Dedication

Dedicated to my Indigenous relatives affected by disconnection of identity due to adoption.

I recognize you, I see you, I honor you.

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Foreword

I take a deep responsibility to understand the impact of the power of knowledge production. I commit to leveraging my position as a scholar to act toward decolonization. Exposing truths and promoting justice has been a lifelong pursuit for me. Understanding that all things are embodied within the self, I provide this deeper explanation of who I am, not to make this project about 'me', but, to help uncover the strengths and limitations of my work, and how my embodied ways of knowing contribute, especially when related to Indigenous health equity.

I do not aim to be a voice for Native peoples. I have no lived experiences as a Native woman. I was born as a White, cis-gendered female. I only know my maternal European ancestral heritage as my father was adopted in 1958. I was frequently told my paternal grandmother (and biological father) was Native. Given the frequent stories of his adoption, I grew to identify as having Indigenous heritage yet without the kinship, community, or family relationships that would situate me to honor Native identity. During this program, I have struggled with factors of my identity and have questioned how to, or if I should at all, approach my desire to perform Indigenous-centered research given my lack of tribal identity. My intention is for my work to help educate and impact other settlers about the impact of settler colonialism. I write this thesis to help provide truths of a settler colonial society and as an act of solidarity with Indigenous peoples towards actions of decolonization.

Throughout my twenty years of experience as a nurse, it was obvious to me that overt and covert racism led to health disparities and poorer health outcomes for those who experience racism. Before returning to graduate school, I was not aware of the relationship between colonialism and racism. Knowing that race is not biological, I sought to better understand how the health of those who experience racism resulted in potentially suboptimal biological health outcomes, and what types of deleterious current social determinants were impacting groups of

diverse populations. Although I excelled as a nurse, as a first-generation scholar, I did not have the education or awareness to understand the impact that historical and contemporary colonial and racist systemic structures could have on health outcomes.

When deciding to focus my topic of research on Indigenous populations, I quickly became introduced to topics affecting Indigenous peoples such as historical trauma theory, issues of food and data sovereignty, environmental injustices, violence, and dispossession of culture. I became completely overwhelmed with a new awareness from my self-guided learning and would frequently be overtaken with grief. I grieved over what I had not known, grieved over what I then learned, and grieved from understanding my own disconnection of culture.

Trying to synthesize these concepts into a coherent elevator speech was daunting and unmanageable. I knew there was a structure in place that was enabling these acts to cyclically reproduce, yet I didn't know how to describe what I saw and inherently felt. When I was eventually introduced to the work of critical settler colonial theorists, Eve Tuck, Joseph Gone, Kyle Whyte, and Patrick Wolfe these concepts became clearer and more concise.

I now understand that settler colonialism is a driver of racial health disparities and social injustices among Indigenous populations.

This project is an act of personal decolonization to educate myself as a settler and to educate other settlers on the truths of the reality of the current structure of settler colonialism that is in place today within the United States.

Abstract

There is a dearth of comprehensive literature relevant to the relationship between settler colonialism and health outcomes of Indigenous peoples residing in the United States (U.S.). Critical analysis of settler colonial determinants of Indigenous health will help to further shape discourse, research priorities, and policy relevant to Indigenous population health and disease distribution. This thesis will bring awareness to settler colonialism, propose relationships between settler colonialism and health outcomes, and identify specific settler colonial determinants of Indigenous health to help guide development and use of nursing theory. This dissertation argues that the structure of settler colonialism threatens and implicates the health of Indigenous peoples residing in colonized nations. The dissertation supports Patrick Wolfe's assertion that settler colonialism is a current-day structure of elimination and will build upon this notion by providing analyses to identify pathways, processes, and determinants of the embodiment of settler colonialism. The project further encourages readers to identify the presence and influence of Eurocentric power relationships between structural and systemic settler colonial determinants and Indigenous peoples, often resulting in oppressive and traumatic experiences. The exposure to exogenous hazards and continual stress and trauma resulting from settler colonialism may lead to high levels of allostatic load and/or epigenetic dysregulation. For example, Indigenous women in particular are affected by settler colonialism which may result in disproportionate maternal health disparities such as high blood pressure during pregnancy. This project will increase understanding and awareness of settler colonialism as a current-day structure and a significant determinant of Indigenous health.

This dissertation consists of three manuscripts. The first manuscript is a literature review that informed the development of a conceptual framework identifying six settler colonial determinants of Indigenous health. Frameworks describing how the structural determinants of settler colonialism result in historical and cultural trauma, and negatively impact health

outcomes via biological and social pathways, have not been developed. Therefore, I identified six interconnected settler colonial determinants of Indigenous health that I hypothesize will result in the embodiment of settler colonialism and ultimately lead to adverse health outcomes, such as hypertensive disorders of pregnancy (HDP). The six determinants are historical context, land, environmental justice, culture, settler-colonial societal context, and structural violence.

The second manuscript is a published literature review that explores the processes and pathways of the embodiment of historical trauma secondary to settler colonialism of Indigenous peoples. Guided by EcoSocial Theory, Historical Trauma Theory, and the Allostatic Load (AL) Model, this literature review provides evidence that sources of stress rooted in experiences of historical trauma resulting from the structure of settler colonialism should be investigated as sources of stress for women who are vulnerable to experiencing settler colonialism.

The third manuscript documents the results of a secondary data analysis from the Strong Heart Study (SHS) that investigates the relationship between Indigenous women's level of AL and high blood pressure during pregnancy. This secondary analysis is a quantitative, retrospective, cross-sectional, cohort design analysis using data from the Phase IV Strong Heart Study. Given that Indigenous women are at risk of experiencing settler colonialism and experience greater maternal health disparities than most all other racial/ethnic groups, I examined relationships among high blood pressure during pregnancy, AL, and factors of culture. I selected variables of settler colonialism, historical trauma, and cultural trauma (i.e., loss of access to traditional values/cultures, and native lifestyle) for this secondary analysis based on findings from the first two manuscripts.

This dissertation concludes with a final chapter that describes implications for theory, policy, nursing practice, and further research. Evidence generated from this dissertation has the potential to move the nursing field forward in ways that can lead to broad, transformative impacts for Indigenous communities. It further provides a theoretical foundation for advancing nursing knowledge and guiding future research studies.

Definition

I acknowledge the complexity of Indigenous identity. For this paper, Indigenous peoples are the rightful claimants of the land and are defined as those who self-identify as members of an Indigenous group within the United States.

Chapter One:

Introduction

It is my intention for this dissertation to provide a meaningful contribution to nursing knowledge on how the structure of settler colonialism in the United States leads to structural and systemic inequities, racism, and deleterious health outcomes of Indigenous peoples, while highlighting protective factors that buffer these assaults. Experiences of colonial-based historical and contemporary traumas, such as forced displacement, violence, and environmental injustices, are considerable social determinants of health. Settler colonial tactics are pervasive and deeply woven into systems, laws, and policies. They encourage widespread mistreatment and oppression, often resulting in adverse health outcomes. Indigenous women are at risk of experiencing settler colonialism also have high maternal health disparities, such as high blood pressure during pregnancy.

The structure of colonialism (e.g., ongoing colonial oppression, racism, etc.) results in experiences of settler colonialism through systemic acts of elimination.[1] Settler colonialism contributes to experiences of shared historical and cultural trauma. Historical trauma is defined as cumulative emotional and psychological wounding that is carried across generations (i.e., residential boarding school, child removal, etc.)[2], and is known to be a significant social determinant of Indigenous health[2]. Cultural trauma is an overwhelming, often ongoing, physical or psychological assault by an oppressive dominant group on another group's cultural resources through force, threats of force, or oppressive policies (i.e., dispossession of health-protective cultural resources such as tradition and language)[3]. Settler colonial suppression of health-protective resources results in historical and cultural trauma and continual stressors that are experienced by heterogeneous populations of Indigenous women in the United States[3]. In addition to the psychological effects of cultural and historical trauma, there are biological impacts that have a significant effect on Indigenous women/peoples. For example, as a result of

exposure to chronic colonial stressors, Indigenous women may experience the embodiment of settler colonialism, leading to increased levels of allostatic load and Indigenous maternal health disparities such as high blood pressure during pregnancy.

Embodiment is the process whereby human beings biologically embed factors of the societal and ecological context in which they live as well as their life interactions and lived experiences[4]. The process of embodiment connects and explains the relationship between the historical, societal, and ecological contexts and the biological outcome of AL. One potential explanation for significant Indigenous maternal health disparities is the embodiment of shared experiences of historical and cultural trauma caused by settler colonialism. Maternal chronic stressors rooted in settler colonialism may activate the maternal/fetal hypothalamic-pituitary-adrenal (HPA) axis, enhance maternal/fetal/intrauterine inflammatory processes, and reduce uterine and umbilical blood flow[12]. This cascade of physiologic events could serve as a pathophysiologic mechanism for high blood pressure during pregnancy, resulting in hypertensive disorders of pregnancy (HDP).

Although the global maternal mortality rate decreased by 38% between 2000 and 2017, maternal mortality has been steadily rising in the United States and HDP is a leading cause[5]. According to Pregnancy Mortality Surveillance System (PMSS) data (2007-2016), HDP disproportionately impacts Indigenous women, compared to white women[7]. HDP is an umbrella term that includes gestational hypertension, preeclampsia, preeclampsia superimposed on chronic hypertension, and eclampsia. A diagnostic criterion of HDP includes having high blood pressure during pregnancy, yet the etiology of high blood pressure during pregnancy and HDP remains poorly understood. HDP is unique from general hypertension as lifestyle modifications (e.g. diet, exercise) have little effect on maternal health outcomes related to HDP. For the mother, HDP may induce placental abruption with possible disseminated intravascular coagulation, end-organ damage, stroke, and death[8]. HDP in the postpartum period increases

risk of further sequelae, including an increased risk of hypertensive crisis and stroke.[8] HDP thus increases the risk of postpartum hospital readmission and future cardio/cerebrovascular disease. In the US, these complications resulted in an estimated cost of $2.18 billion for women and infants affected only by preeclampsia within the first 12 months of delivery in 2012[9].

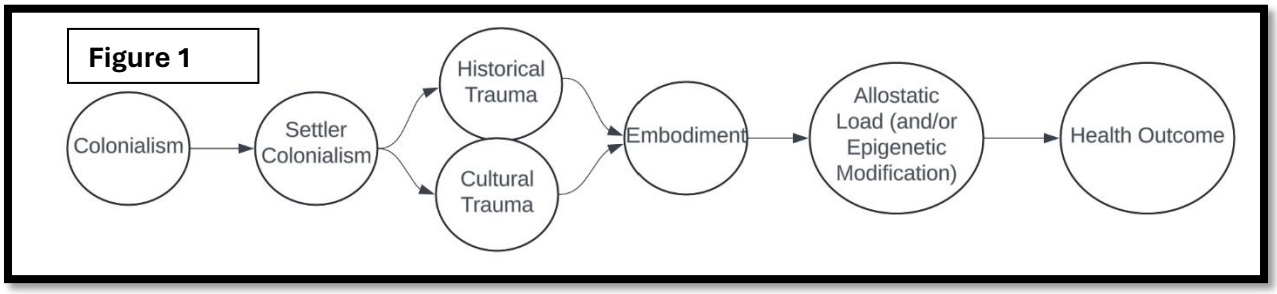
However, the causes of HDP, particularly for Indigenous women, are complex and remain unknown. Outside of pregnancy, chronic stress can lead to increased AL and hypertension [-11]. Additionally, settler colonialism is known to be a powerful determinant of health[1-3]. Yet, whether factors of settler colonialism lead to continual stressors and traumas and HDP among Indigenous women is much less clear. Given the complexity of physiologic stress reactivity and HDP, the significant disparities in rates of HDP among Indigenous women may be due to the embodiment of historical and cultural trauma experiences resulting in high AL.

This dissertation includes a secondary analysis of quantitative data gathered from a larger cardiovascular study, The Strong Heart Study, to explore the relationships between high blood pressure during pregnancy (i.e. the measurement used to identify HDP), high AL levels, and access to culture among Indigenous women in the United States. The central hypothesis for this study posits that Indigenous women in the US who had high blood pressure in pregnancy are more likely to have higher cumulative AL than those who did not have high blood pressure during pregnancy. Additionally, this study posits that the maintenance of Indigenous culture may be a factor that mitigates the risk for high blood pressure during pregnancy and increased AL. The primary aim of the dissertation is to describe relationships between high blood pressure during pregnancy and cumulative AL among Indigenous women residing the U.S. Given that the literature on settler colonialism and maternal-fetal health outcomes is significantly limited, describing these relationships will shed light on settler colonialism as a determinant of Indigenous health. Additionally, there is an exploratory aim to examine the relationship between AL and facets of culture.

This introductory chapter describes the key concepts in this dissertation, including settler colonialism, historical trauma, cultural trauma, embodiment, and AL, followed by explanations of how these concepts are connected and interact within this project. It concludes by identifying the significance of this dissertation study.

Guiding Theory of the Embodiment of Settler Colonial Determinants of Indigenous Health

There are serious gaps in our understanding of the embodiment of settler colonial determinants of Indigenous health both as a theoretical phenomenon and empirical construct. Thus far, no framework has been developed to adequately identify and explain the concepts, definitions, and relational assumptions associated with the phenomenon of the embodiment of settler colonial determinants of Indigenous health in the United States (U.S). I base my conceptualization of the process of the embodiment of settler colonial determinants of Indigenous health on the interconnected tenets of five theories: Colonialism (i.e., settler colonialism), Historical Trauma Theory (i.e., historical, intergenerational and transgenerational trauma) [2], Cultural Trauma[3], EcoSocial Theory (i.e., embodiment) [4], and the Allostatic Load Model (i.e., allostasis, allostatic load) [13]. These multiple theories have informed how I conceptualize, define, and measure settler colonialism and its downstream effects. (Figure 1).



Key Concepts

Settler colonialism provides a more focused perspective on the practices, structures, and governmentality of ongoing colonialism. Colonialism aims to *exploit* all resources; human and otherwise[14], while settler colonialism aims to *acquire control of* all resources, human and

otherwise, through ***elimination***[14]. Settler colonialism allows colonizers to obtain land and its resources, while also eliminating and replacing the Indigenous peoples of that land. Elimination of Indigenous peoples in the U.S. has been achieved in several ways: forced removal from land, limited access to quality jobs, education, and healthcare, confinement to tribal reservation lands, assimilation through dilution of blood quantum/marriage, the enactment of the Indian Removal Act resulting in child removal and forced placement into boarding schools, and land mapping (i.e., property being owned/boundaries of land created)[14]. Settler colonialism is a persistent structure in the U.S. that is advanced by seizing property from Indigenous peoples and gaining sovereignty over their land, bodies, and labor.[14] Settler colonialism is rarely visible and occurs through direct and indirect forms of violence, exclusion, and coercive systems resulting in historical and cultural trauma. Although Indigenous peoples in the U.S. live within the structures and effects of settler colonialism, few studies have examined the impact of settler colonialism in the US, its relationship to health, and its implications for nurses and nursing. The proposed study will help fill this gap by examining whether facets of settler colonialism leading to the dispossession of culture are related to HDP and cumulative levels of AL among Indigenous women in the U.S.

Historical Trauma is cumulative emotional and psychological wounding carried across generations that results from massive group trauma. Historical trauma affects groups of people who experience traumas inflicted on them due to their race, creed, or ethnicity[2]. Indigenous peoples have experienced pervasive historical group trauma and the accompanying effects of discrimination, oppression, and racism. Brave Heart describes the trauma response as a "transposition where one lives simultaneously in the past and the present with the ancestral suffering as the main organizing principle in one's life"[2]. Historical trauma response (HTR) is a constellation of symptoms associated with a reaction to historical trauma. These include unresolved grief, substance misuse, depression and anxiety, and suicide. In communities

experiencing historical trauma, individuals have disproportionately higher rates of mental and physical illness, substance misuse, and eroded family and community structures[2]. Although resilience and survivance (i.e., the conjunction between resistance and survival) are inextricable to Indigenous people, the pernicious cycle of historical trauma destroys families and communities and threatens cultures and traditions[2]. Furthermore, everyday experiences of racism, discrimination, and daily stressors rooted in historical trauma target individuals from diverse racial and ethnic groups, including Indigenous peoples. Historical trauma is not limited to the past, and in fact continues through generations of affected communities/groups[2] (Figure 2).

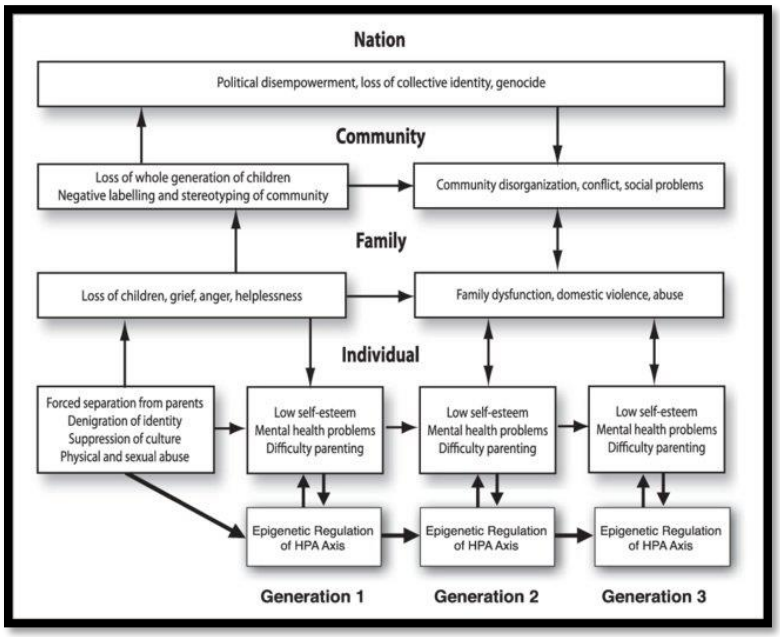


Figure 2 Historical Trauma Theory (Brave Heart, M., et al.,2011)[2]

Cultural trauma is "an overwhelming and often ongoing physical or psychological assault or stressor perpetuated by an oppressive dominant group on the culture of a group of people sharing a specific identity/affiliation" (e.g., race/ethnicity, nationality, religion)[3]. One resource at risk for elimination from cultural trauma are "cultural modes of being[3]." Cultural modes are a group's "language, norms, customs, values, and artifacts" that create the social world of that group[3]. This includes ways of living, behaving, and experiencing life in the world[3].

When cultural trauma damages cultural modes, health-protective functions can be disrupted. For instance, stress from acculturation, such as forced relocation, or requiring children to attend residential schools to be “civilized” into Western institutions (e.g., family, religious, health systems), exacerbates poverty, unemployment rates, and health disparities among Indigenous communities and is an example of cultural trauma. A cultural trauma a) is an identifiable assault/stressor, b) is inflicted by a dominant group, and c) impacts health by damaging the culture[63](Figure 3).

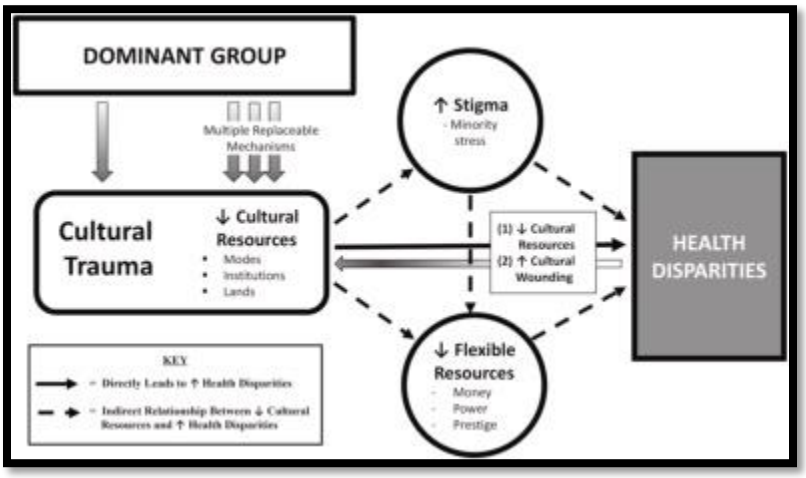


Figure 3 Cultural Trauma Theory (Subica & Link, 2022)[3]

Embodiment, a core tenant of EcoSocial Theory, explains how human beings may biologically embed lived experiences into interoception resulting in biological changes[4]. Embodiment differs from the biomedical model, which emphasizes biological determinants of disease amenable to intervention via the Western healthcare system. Instead, embodiment does not divorce biology from social context but includes multiple factors that integrate the biological and social[4]. Embodiment of settler colonialism may result in a sustained stress response from repeated exposures to significant chronic stressors and their subsequent physiological reactions (Figure 4). Thus, embodiment is one potential mechanism connecting stressors and trauma from settler colonialism to biological processes (i.e., allostatic load) that result in negative health outcomes.

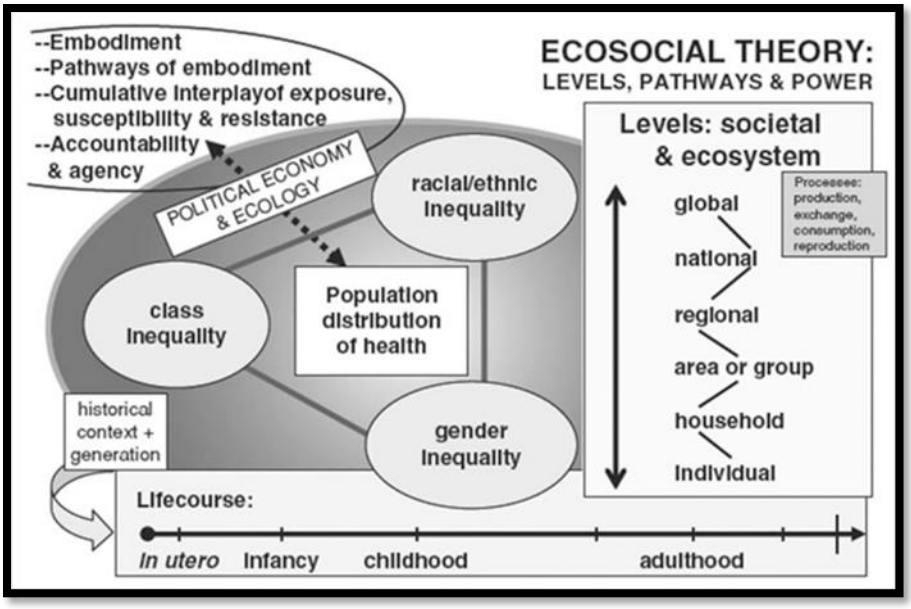


Figure 4 EcoSocial Theory (Krieger, N., 2005)[4]

Allostatic Load refers to the cumulative dysregulation of multiple physiological systems due to high cumulative chronic stress. In this study, high chronic stress occurs after exposure to multigenerational chronic stressors, which are defined as Indigenous women's repeated experiences of culturally traumatic stressors. The AL framework describes how exposures to these chronic stressors, which may be related to historical and cultural trauma, lead to sustained stress response, dysregulation of the HPA axis, altered biomarkers of stress response, and disruptions to homeostasis[13]. This leads to increased risk for, and earlier onset of, physical and mental health conditions and chronic diseases through "wear and tear" on the body, weathering, and premature disease susceptibility [13]. AL is a potential mechanism connecting cumulative experiences of settler colonialism, historical trauma, and cultural trauma to poor health outcomes. Biomarkers of AL reflect five domains of the physiological stress response: cardiovascular, neuroendocrine, inflammatory, metabolic, and anthropometric[13]. Physical and mental chronic stress, Post Traumatic Stress Disorder (PTSD), limited sociocultural access (i.e., social support, financial hardship), and lower socioeconomic status, all lead to higher AL, which is reflected in these biomarkers and results in higher morbidity and

mortality[13]. However, protective sociocultural environments may mediate physiological responses to stress and reduce the individual risk of morbidity and mortality (Figure 5)[13].

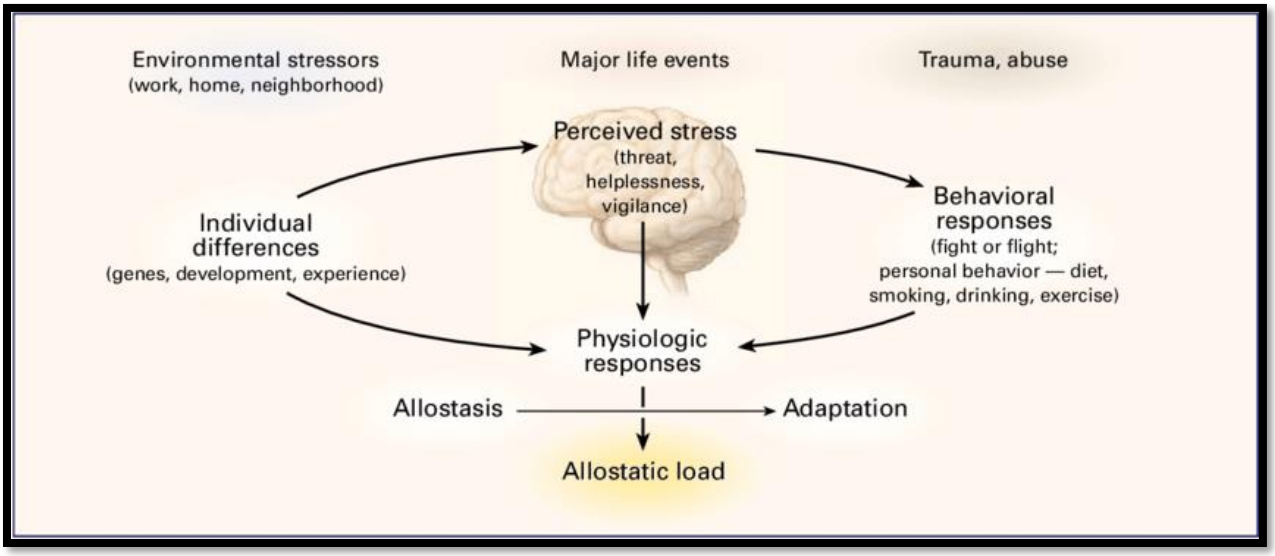


Figure 5 Allostatic Load (McEwen, BS., 1998)[13]

Summary of gaps

The process of the embodiment of settler colonialism is not fully understood or completely characterized in the literature. To my knowledge, others have not analyzed and identified viable mechanisms that describe the social and biological pathways and processes connecting the embodiment of settler colonialism and the subsequent adverse biological health outcomes. Although the literature does not elucidate the biological mechanisms contributing to the embodiment of settler colonialism, repeated exposures to settler colonial determinants (e.g., loss of land, culture, trauma, exogenous hazards, disconnection, etc.) could include the initiation of a physiological stress response such as high AL.

Specific Aims and Methods

This dissertation has three specific aims which are addressed in chapters 2-4. Chapters 2 and 4 are in the form of publishable manuscripts while chapter 3 is a published manuscript.

Dissertation specific aim 1. Examine how systemic factors reproduce the structure of settler colonialism and influence health outcomes among Indigenous peoples in the U.S.

Specific aim 1 method. Empirical and grey literature were explored to identify settler colonial determinants of Indigenous health.

Dissertation specific aim 2. Examine how systemic factors of settler colonialism influence health outcomes among Indigenous peoples in the U.S. through pathways and processes that may lead to the embodiment of settler colonial determinants of Indigenous health.

Specific aim 2 method*.* A comprehensive search of empirical and grey literature provided a foundation to explore factors related to the pathways and processes leading to the embodiment of settler colonialism.

Dissertation specific aim 3. The third dissertation aim includes three specific aims for the dissertation study:

a. Compare AL among women who had HDP, women who did not have a diagnosis of any hypertensive disorder, and women who had general HTN among SHS phase IV Indigenous women participants.
b. Compare access to traditional values/cultures and native lifestyle among women who had HDP, women who did not have a diagnosis of any hypertensive disorder, and women who had general HTN.
c. Describe the relationship between having access to traditional values/cultures and native lifestyle and AL among women who had HDP, women who did not have a diagnosis of any hypertensive disorder, and women who had general HTN.

Specific aim 3 method. This secondary analysis is a quantitative, retrospective, cross-sectional, cohort design analysis using data from the Phase IV Strong Heart Study.

Significance

There is a call in the literature to advance the understanding of the impact of settler colonialism on health outcomes with empirical evidence that supports a relationship with health disparities.[15] In response to this call, I generated a conceptual framework that can be used to guide critical research on the embodiment of settler colonialism among Indigenous peoples which is further described in chapter 2. Although mechanisms illustrating the social pathways and biological processes resulting in the embodiment of settler colonialism and associated health outcomes have not been identified and described, this framework could provide a guide to future research initiatives and policy (re)formation.

Conclusion

Still today, Indigenous peoples experience the detrimental effects of living in a settler colonial society where the logic of Western superiority remains dominant. Whereas Indigenous people already know they are forced to live within Eurocentric boundaries and have adapted by incorporating rich modes of resilience into their communities, this project is for settlers. It is not intended for settlers to 'help', 'save', or 'correct' Indigenous peoples but to gain explicit awareness of the covert and insidious facets of settler colonialism resulting in a myriad of injustices and health disparities. It is our duty as nurses and as a collective society to develop program and policy recommendations in collaboration with Indigenous communities to create substantive change.

References

1. Czyzewski, K. (2011). Colonialism as a broader social determinant of health. International Indigenous Policy Journal, 2(1). https://doi.org/10.18584/iipj.2011.2.1.5
2. Brave Heart, M. Y., Chase, J., Elkins, J., & Altschul, D. B. (2011). Historical trauma among indigenous peoples of the americas: Concepts, research, and clinical considerations. *Journal of Psychoactive Drugs*, *43*(4), 282–290. https://doi.org/10.1080/02791072.2011.628913
3. Subica, A.M. and Link, B.G., 2022. Cultural trauma as a fundamental cause of health disparities. Social Science & Medicine, 292, p.114574.
4. Krieger, N. (2012). Methods for the scientific study of discrimination and health: An ecosocial approach. American Journal of Public Health, 102(5), 936–944. https://doi.org/10.2105/ajph.2011.300544
5. Jeong W, Jang SI, Park EC, Nam JY. The Effect of Socioeconomic Status on All-Cause Maternal Mortality: A Nationwide Population-Based Cohort Study. Int J Environ Res Public Health. 2020 Jun 26;17(12):4606. doi: 10.3390/ijerph17124606. PMID: 32604879; PMCID: PMC7345089.
6. Laxmi S. Mehta, MD, FAHA, Chair, Garima Sharma, MD, Vice Chair, Andreea A. Creanga, MD, PhD, Afshan B. Hameed, MD, Lisa M. Hollier, MD, Janay C. Johnson, MPH, Lisa Leffert, MD, Louise D. McCullough, MD, Mahasin S. Mujahid, PhD, MS, FAHA, Karol Watson, MD, FAHA, Courtney J. White, Esq, on behalf of the American Heart Association Advocacy Coordinating Committee, Call to Action: Maternal Health and Saving Mothers: A Policy Statement From the American Heart Association
7. https://www.cdc.gov/reproductivehealth/maternal-mortality/pregnancy-mortality

surveillance-system.htm#print

8. Vesna D. Garovic, MD, PhD, FAHA, Chair, Ralf Dechend, MD, Thomas Easterling, MD, S. Ananth Karumanchi, MD, Suzanne McMurtry Baird, DNP, RN, Laura A. Magee, MD, FRCPC, Sarosh Rana, MD, MPH, Jane V. Vermunt, MBChB, MSc, Phyllis August, MD, MPH, FAHA, Vice Chair, on behalf of the American Heart Association Council on Hypertension; Council on the Kidney in Cardiovascular Disease, Kidney in Heart Disease Science Committee; Council on Arteriosclerosis, Thrombosis and Vascular Biology; Council on Lifestyle and Cardiometabolic Health; Council on Peripheral Vascular Disease; and Stroke Council, Hypertension in Pregnancy: Diagnosis, Blood Pressure Goals, and Pharmacotherapy: A Scientific Statement From the American Heart Association
9. Gestational Hypertension and Preeclampsia: ACOG Practice Bulletin, Number 222. Obstetrics & Gynecology 135(6):p e237-e260, June 2020. | DOI: 10.1097/AOG.0000000000003891
10. Feres José Mocayar Marón, León Ferder, Fernando Daniel Saraví & Walter Manucha (2019) Hypertension linked to allostatic load: from psychosocial stress to inflammation and mitochondrial dysfunction, Stress, 22:2, 169-181, DOI: 10.1080/10253890.2018.1542683
11. Jenny Guidi, Marcella Lucente, Nicoletta Sonino, Giovanni A. Fava; Allostatic Load and Its Impact on Health: A Systematic Review. Psychother Psychosom 15 December 2020; 90 (1): 11–27. https://doi.org/10.1159/000510696
12. Mbiydzenyuy Ngala Elvis, Hemmings Sian Megan Joanna, Qulu Lihle, Prenatal maternal stress and offspring aggressive behavior: Intergenerational and transgenerational inheritance, Frontiers in Behavioral Neuroscience, 16, 2022, URL=https://www.frontiersin.org/articles/10.3389/fnbeh.2022.977416 DOI=10.3389/fnbeh.2022.977416, ISSN=1662-5153

13. McEwen BS. Stress, adaptation, and disease. Allostasis and allostatic load. Ann N Y Acad Sci. 1998 May 1;840:33-44. doi: 10.1111/j.1749-6632.1998.tb09546.x. PMID: 9629234.

14. Settler colonialism and the elimination of the native, Wolfe ,Patrick, 2006/12/01,doi: 10.1080/14623520601056240, Journal of Genocide Research, 1462-3528

15. Prussing, E. (2014.). Historical trauma: Politics of a conceptual framework. Transcultural psychiatry. https://pubmed.ncbi.nlm.nih.gov/24787478/

Chapter 2

Title of Paper: "Identifying Settler-Colonial Determinants of Indigenous Health"

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Abstract

Aim(s)

This discursive article aims to examine how systemic factors (both) reproduce the structure of settler colonialism and influence health outcomes among Indigenous peoples in the United States through settler colonial determinants of Indigenous health.

Design

Discursive paper

Keywords Indigenous peoples, settler colonial determinants of Indigenous health, embodiment, historical trauma, settler colonialism, colonialism, allostatic load, eco-social theory, historical trauma theory, weathering, stressors

Methods

Between September 2022 and January 2023, we searched PubMed, CINAHL, and Google Scholar for empirical and grey literature to inform the identification of settler colonial determinants of Indigenous health.

Results

A conceptual framework that identifies the factors of settler colonialism and settler colonial determinants of *Indigenous* health is presented.

Conclusion

The structure of settler colonialism includes settler colonial determinants of health for Indigenous populations that have detrimental effects on health outcomes.

Implications for Nursing

To provide holistic nursing care, nurses must be aware of settler colonialism as a determinant of health. Nurses providing care to Indigenous peoples need to be attuned to the pathways and processes through which settler colonialism leads to exposures that may affect their patients' health. Moreover, nurses have a moral imperative to challenge existing structural inequities to advance health equity and social justice for all.

No Patient or Public Contribution

Chapter 2

Introduction

Indigenous peoples living beside and within colonial nations are impacted by health disparities and inequities. The health disparities and inequities are exacerbated by historical and ongoing colonial oppression. In the United States, for example, Indigenous peoples are disproportionately affected by health problems, including hypertension, diabetes, post-traumatic stress disorder, and suicide[1-4]. Indigenous women in the U.S. are more likely to experience maternal health problems and intimate partner violence (IPV) by men, most of whom are non-Indigenous[5]. These and other racial health disparities suffered by Indigenous peoples in the U.S. – such as decreased access to high-quality medical care – are notable. They are critical to highlight due to their effect on health outcomes and social connections. Colonialism is related to the production of health disparities. Colonialism is a form of exogenous domination that involves one or more groups exercising territorial control over one or more other groups – the Indigenous peoples – who have not consented to that control over them. Settler colonialism is one form of colonialism whereby the colonizing population seeks to establish and justify permanent roots by erasing the presence of the cultures, ecosystems, and political systems of the colonized people, thereby eliminating Indigenous peoples. Settler colonialism uses policies and tactics that aim to dispossess Indigenous peoples of their territories, suppress Indigenous rights and cultures, and create the illusion that the violence of colonialism is either necessary or morally legitimate[1,2,3]. Settler colonialism is a powerful determinant of health, through acts of elimination and modes such as acculturation (i.e., loss of language and/or cultural traditions)[6-9]. Settler colonialism can also suppress health-protective resources for Indigenous peoples, contributing to continual, health-impacting stressors. While Indigenous peoples have diverse cultures, languages, landscapes,

health systems, political rights, and relationships with governing bodies whose jurisdictions surround their territories, U.S. settler colonialism drives morbidity and mortality disparities and inequities across tribal nations [1,2,3,10,11,12]. Despite centuries of settler-colonial suppression of Indigenous cultures, Indigenous peoples have maintained ties to their communities, languages, and lands as a form of survivance[1,4,5,12], which they have also used as one of the basis for making interventions to reduce health disparities.

As an entry point into understanding the relationship between health and settler colonialism, research presented at the International Symposium on the Social Determinants of Indigenous Health (2007) demonstrated that the determinants of Indigenous health differ from those of the dominant settler population[13]. Presenters stated that "[r]esearch and dialogue at the international level have demonstrated a common element that exists for all Indigenous peoples and affects every issue confronting them as a collective: the history of colonization and the associated subjugation of Indigenous peoples"[13]. In the presentation, determinants of Indigenous health include the lack of understanding of Indigenous culture and worldviews, which has prompted an urgent call to remedy the danger this creates for Indigenous people's health and well-being[14]. Other authors have highlighted how the more general social determinants of health (SDoH) (e.g., low socioeconomic status, low-quality healthcare, or poor access to healthcare, etc.), "the conditions in which people are born, grow, live, work, and age," contribute to "unfair and avoidable differences in health" among all populations, including Indigenous populations[8]. In this article, we take up how these larger upstream or distal determinants, such as settler colonialism, impact groups of people and result in unhealthy life conditions. Although SDoH are important for health, they do not include factors central to the collective health of Indigenous and

Black peoples. This article focuses on Indigenous populations, but the authors recognize that settler colonialism has a significant impact on people of African descent living in the U.S., stemming from forced displacement from their Indigenous lands, the history of slavery, and the continued prominence of the settler colonial structure of elimination that exists today[15].

The health disparities between groups of people are unjust and inequitable. They require measurement of potentially causative exposures. To advance justice, researchers must design studies that reflect the contribution of factors reflecting persistent power differences between peoples and systems to health and well-being[16]. Yet, frameworks that identify and integrate processes of colonization, especially, here, in relation to settler colonialism, that result in negative health outcomes among Indigenous peoples are limited or even absent.

To understand why there's such a striking degree of Indigenous health inequities and social determinants for Indigenous peoples (i.e., unresolved trauma, poverty), we must contextualize the impact of intentional and recurring acts of settler colonialism on the collective and individual histories of Indigenous peoples[1]. Such contextualization allows for the possibility to go beyond inequity observations to reach the goal of an appropriate and reliable explanation[17]. Relatedly, we must improve our understanding of how current life stressors and traumatic events are experienced by Indigenous peoples under conditions of settler colonialism. However, identifying the determinants of Indigenous health that result from settler colonialism has to date been challenging given the lack of existing theoretical or conceptual frameworks to guide this research. To fill this significant gap in theoretical knowledge, and guide future studies on the social determinants of Indigenous health and health outcomes of Indigenous peoples, we

identified six critical, interconnected settler colonial determinants of Indigenous health based on literature review.

METHODS

We searched PubMed, CINAHL, and Google Scholar between September 2022 and January 2023 for empirical and grey literature that documented settler colonial determinants of Indigenous health. After pooling literature from this review, articles were included that mentioned settler colonialism or matched the operational definition and reported a health impact. Preliminary categories and emerging concepts were noted based on repetition within the literature. Peer-reviewed and gray literature were purposively searched based on the emerging concepts. Domains were identified after the articles were categorized by the similarity of the topics of settler colonialism. The articles in these categories were then inductively thematically coded to represent the general overarching settler colonial determinant of Indigenous health. It is likely that there are articles missing from this review, given the broad-ranging topic of settler colonial determinants of Indigenous health. However, this paper is meant to encourage further discussion of and collaboration to address settler colonial determinants of Indigenous health and is not intended to include all of the challenges to Indigenous health and related studies.

FINDINGS

This review identified six interconnected settler colonial pathways as determinants of Indigenous health, which are described in detail. The settler colonial determinants of Indigenous health form the basis of a conceptual framework that portrays how they may lead to dysregulation of biological mechanisms, subsequent biological changes, and negative health outcomes through mechanisms such as epigenetic modifications and allostatic load.

Settler-Colonial Determinants of Indigenous Health

The six settler colonial determinants of Indigenous health are historical context, culture, land, political violence, settler colonial societal context, and environmental justice. Each is presented with evidence from the literature identified in this review.

Historical Context: Settler colonialism is "a distinct expression of colonialism that uses structures to eliminate Indigenous populations to replace them with settler societies"[16]. The term structures refers to the different arrangements and organizations of institutions, norms, and social climate by which a society sets up the life conditions for those who live in that society. U.S. structures of settler colonialism were created through the unthinkable acts by the U.S. government (i.e., genocide, theft, slavery, failure to uphold treaties/trusts) that resulted in cumulative physical, emotional, and psychological wounding that is carried across generations. These and current governmental actions have led to the collective soul-wounding of Indigenous peoples, which has been countered by an extensive degree of resistance, resilience, and resurgence[18-20]. Soul wounding affects those directly impacted by governmental actions and is transmitted to subsequent generations, a process that Indigenous researchers and practitioners refer to as historical trauma[21]. Historical trauma is part of dominant racial, religious, and ethnic institutions that make up structures of settler colonialism in the U.S. and other nations. It affects groups of people who experience traumas due to their race, creed, or ethnicity[21]. Brave Heart describes the experience of historical trauma as a "transposition where one lives simultaneously in the past and the present with the ancestral suffering as the main organizing principle in one's life"[18]. Outcomes of settler colonialism that result in historical trauma, such as collective grief from disconnection from culture and land, are related to increased incidence of mental health problems such as depression, anxiety, other types of trauma (e.g., IPV, motor vehicle accidents), and hypertension[10], all of which occur at disproportionate rates among Indigenous peoples. The

context and conditions leading to historical trauma are known to affect communities whose members experience higher rates of mental and physical illness, substance abuse, and eroded family and community structures[21-22]. Although resilience and survivance are inherent to Indigenous people, the soul-wounding cycle of historical trauma destroys families and communities and threatens cultures and traditions[21]. Furthermore, everyday experiences of racism, discrimination, and daily stressors are part of institutions that are rooted in historical contexts that target individuals from diverse racial and ethnic groups, including Indigenous peoples[22]. Persistent, current-day experiences of the life conditions under settler colonialism are part of societal structures that reflect future, compounded manifestations of historical trauma in addition to what happened in the past[21].

Culture: Cultural trauma is "an overwhelming and often ongoing physical or psychological assault or stressor perpetuated by an oppressive dominant group on the culture of a group of people sharing a specific shared identity/affiliation", such as race/ethnicity, nationality, or religion [23]. A cultural trauma is an identifiable assault or stressor inflicted by a dominant group that impacts health by damaging the culture of the oppressed group[23]. Collective and historical traumas may also meet this definition; however, cultural trauma is unique, because it focuses on the impact of the traumatic events on a group's culture and cultural resources instead of its collective or individual psychological or physical well-being[23]. The assault is initially described as an aggression against the culture. Particularly at risk of cultural trauma are "cultural modes of being[23]." Cultural modes are a group's "language, norms, customs, values, and artifacts" that create the group's collective social world[23]. This includes ways of living, behaving, and experiencing life in the world[23]. Cultural trauma that damages cultural modes can disrupt health-protective functions. For instance, stress from acculturation, such as forced relocation, or

requiring children to attend residential schools so they can be "civilized" into settler institutions (e.g., family, religious, health systems), exacerbates poverty, unemployment rates, and health disparities among Indigenous communities. A growing body of evidence shows that connection to culture (i.e., language, land-based cultural practices) is a source of identity and social connectedness and is associated with multiple positive health outcomes[10]. One study found that communities reporting more factors reflecting cultural continuity, such as self-governance, language, and traditional practices, had up to an 85% reduction in suicides compared to communities with fewer cultural factors present[24]. Cultural trauma contributes to substantial health disparities between cultural groups. However, cultural factors, including Indigenous cultures and ways of knowing, are absent from the widely accepted SDoH framework, making it less applicable to Indigenous peoples of the U.S. Because culture represents the way that ideas, language, media, and ways of being become embodied through traditional practices, it is inextricably linked to health and wellbeing[25]. Thus, it is one of the six core elements incorporated into the Settler Colonial Determinants of Indigenous Health.

Land: Most Indigenous peoples describe their diverse relationships with Land as similar to kin relationships or spiritual connections, depending on the community and culture[10]. Such relationships have been articulated by a number of Indigenous persons, including scholars, as supporting caretaking for the land and being taken care of by the land as tenets of inner harmony and peace that result from taking responsibility for the welfare of Mother Earth. Pragmatically, they have shown that entire food and medicinal systems, supply chains, and sustainability of biodiversity and clean air and water are functions of these kin-based, spiritual, and caretaking relationships. By contrast, across a number of settler societies, settlers privilege land as individual property by which the owners have a range of freedoms to treat the land as they wish,

including degrading it. In some cases, settler beliefs in the primacy of private property are traceable to European intellectuals whose work continues to be remembered, such as John Locke's theory of property rights from [1690]. Locke argued then, no different from how some settlers talk about land today, that Indigenous peoples fail to make use of land. This mistaken belief, historically and today, has long served as justification for land theft, and its ongoing occupation[15]. A widespread result of this dispossession is food injustice. Due to significant paper and steel mill pollution of their ancestral land, members of the Sault Marie Tribe of Chippewa Indians now have limited access to culturally congruent and economically valuable foods. The pollutants and additional hazards from a limestone mine threaten their crops and the animals that graze on the land[12]. Indigenous peoples experience settler colonialism through how culture, space, and time contribute to differences in power and authority in how the States govern the occupancy and use of land. It also highlights the fact that the deconstruction of settler colonial land systems requires dismantling intersecting forces of power, such as capitalism, forced displacement for the benefit of profitable corporations, patriarchy, and colonialism[11].

Political Violence: Political violence is defined as "those acts of an inter-group nature that are seen by those on both sides or one side, to constitute violent behavior carried out to influence power relations between the two sets of participants"[26]. Political violence is also a form of structural violence whereby social institutions, such as racism, laws, or policies, harm people by preventing them from meeting their basic needs due to threats and impositions of pain, suffering, and death[27]. Indigenous women, for example, are inextricably connected to their Land through ceremonial and birthing practices. Women are symbols of strength in Indigenous cultures and serve in family, community, and political leadership roles. Violent acts of settler colonialism that result in Indigenous women being silenced, made invisible, and at risk for

murder further threaten the survival of Indigenous communities, as they work to disconnect Indigenous women from Land and suppress their leadership[28]. One example of political violence perpetrated against Indigenous women is the vast discrepancy between two national missing persons databases. While the U.S. Department of Justice Missing Persons database included 5,712 reports of missing or murdered Indigenous women and girls in the U.S. in 2016, the National Missing and Unidentified Persons System only recorded 116 of those cases. Reasons for this discrepancy are unknown but are likely related to racial misclassification or omission of racial data for missing persons.[29-30]. Worse, approximately 4200 of the cases identified in the DoJ database remain unsolved[29]. The forced erasure of Indigenous women's bodies through violence that results in them being missing from their home communities is firmly rooted within settler-colonial violence and the failure of law enforcement to act.

We also identify mass incarceration as a way of perpetrating political violence, as incarceration rates are disproportionately high for Indigenous peoples[1]. This settler colonial determinant of Indigenous health exposes incarcerated individuals to political violence and removes their agency to earn an income, have adequate health insurance, and build a career. These factors also affect children of incarcerated individuals, who witness the unjust circumstances perpetuated by the dominant culture and are then removed from their Elder kin[26] and their home community.

One particularly damaging act of settler colonization via political violence is the forced removal of Indigenous children. Although the Indian Child Welfare Act, a program adopted in 1978, was enacted to protect the removal of Indigenous children from Indigenous families and communities, child welfare programs still remove Indigenous children at a rate six times that of non-Indigenous children[31]. This form of political violence disrupts social processes and

behavioral cues, removing children's exposure to and engagement in health-protective cultural traditions passed down by their elders, and leading to poor later life health outcomes.

Settler Colonial Societal Context: Settler societies do not allow Indigenous peoples the full and free expression of their rights to self-determination, consent, and self-governance. Indigenous peoples have not been able to foster and institutionalize their own institutions and measures for securing health. There are negative health impacts for colonized people when they have to live through the constant daily reminders that their self-determination, consent, and self-governance are not respected. For years, government policies have systematically undermined the capacity for self-determination of Indigenous people by limiting opportunities to create their own healthy communities. Loss of culture-based practices from settler colonization, poverty, violence, poor housing, and environments of deprivation have had a broad impact on Indigenous peoples of the U.S. These disparities are related to economic, political, and social inequities that are shaped and driven by settler colonialism. Despite these glaring inequities, reconciliation of the denial of self-determination, consent, and self-governance has not occurred in the U.S[32], even though the U.S. does have laws and policies – enacted to varying degrees – that are intended to honor and implement treaty rights, the government-to-government relationships (with US federally recognized tribes), and the US trust and other general and specific responsibilities to tribal nations, Native Hawaiians, and Indigenous peoples of state and unrecognized tribes and in U.S. territories. This lack of acknowledgment and responsibility from the U.S. creates and enables inequities for Indigenous peoples including chronic illness, food insecurity, mental health crises, and environmental injustices.

Environmental Justice: Given Indigenous people's close relationship with Land, Indigenous health is particularly affected by the health of Land. Air, soil, and water can be

affected by contaminants, increasing the risk of contaminated food sources, air pollution, and work hazards, such as mining[33]. In the 19th and early 20th centuries in the US, the industries that began to unleash the known causes of climate change, including the rapid growth of fossil fuel dependency and commercial forestry, agriculture, and mining, were only able to proliferate to scale because they could obtain access to the needed lands and supply chains. The US forced these industries onto Indigenous peoples' territories, whereas these industries would have never been able to establish themselves so quickly and extensively if only the lands of privileged white people were targeted. Today, the literature shows that Indigenous peoples both live in and near polluted and degraded territories, but are now experiencing more severe harm and risks from the climate change impacts. Environmental injustices and climate change often compound existing potential vulnerabilities and risks for many Indigenous peoples. Upheaval from colonialism, resource extraction, loss of human rights and self-determination, and inequitable wealth distribution are deeply interconnected with environmental crises and affect multiple health outcomes[34]. The example of food injustice perpetrated on numerous Indigenous communities often result from violations of treaty rights of the Tribe with the U.S government for self-determination over Indigenous food systems, which negatively affects health.[12].

A Conceptual Model of Settler Colonial Determinants of Indigenous Health

One potential explanation for significant Indigenous health disparities is through the embodiment of stressors resulting from shared experiences of historical and cultural trauma caused by settler colonialism, which then impacts allostatic load and alters epigenetic mechanisms, such as DNA methylation, which ultimately changes gene expression. The conceptual model of the Settler Colonial Determinants of *Indigenous* Health (SCDoIH) introduced here aims to synthesize the literature and the potential pathways, processes, domains, spatiotemporal (i.e. both space and

time) considerations, and levels of origins that researchers can incorporate into studies of Indigenous health, particularly when investigating potential settler-colonial determinants of health (Figure 1). The SCDoIH is categorized into 6 determinants: Historical Context, Culture, Land, Political Violence, Settler Colonial Context, and Environmental Justice.

The goal of this model is not to decontextualize the numerous and interconnected exposures to settler-colonialism that Indigenous peoples experience, but to provide a starting point to expose the truth of this country's past and present and allow researchers and clinicians to better locate the multifaceted and collective determinants and indicators of Indigenous peoples' health and well-being. Studies cannot and should not measure every domain or, specified process, at each level, and in all relevant spatiotemporal occurrences. Rather, researchers can use this model to conceptualize and measure salient and unique factors impacting the health of Indigenous peoples. It is important to note that the creation of this model is in draft form and has not yet received participation or feedback from Communities. The model posits that colonialism (i.e., racism, patriarchy, etc.) is the overarching determinant of the SDoH, and is also the overarching determinant of the proposed settler colonial determinants of Indigenous health.

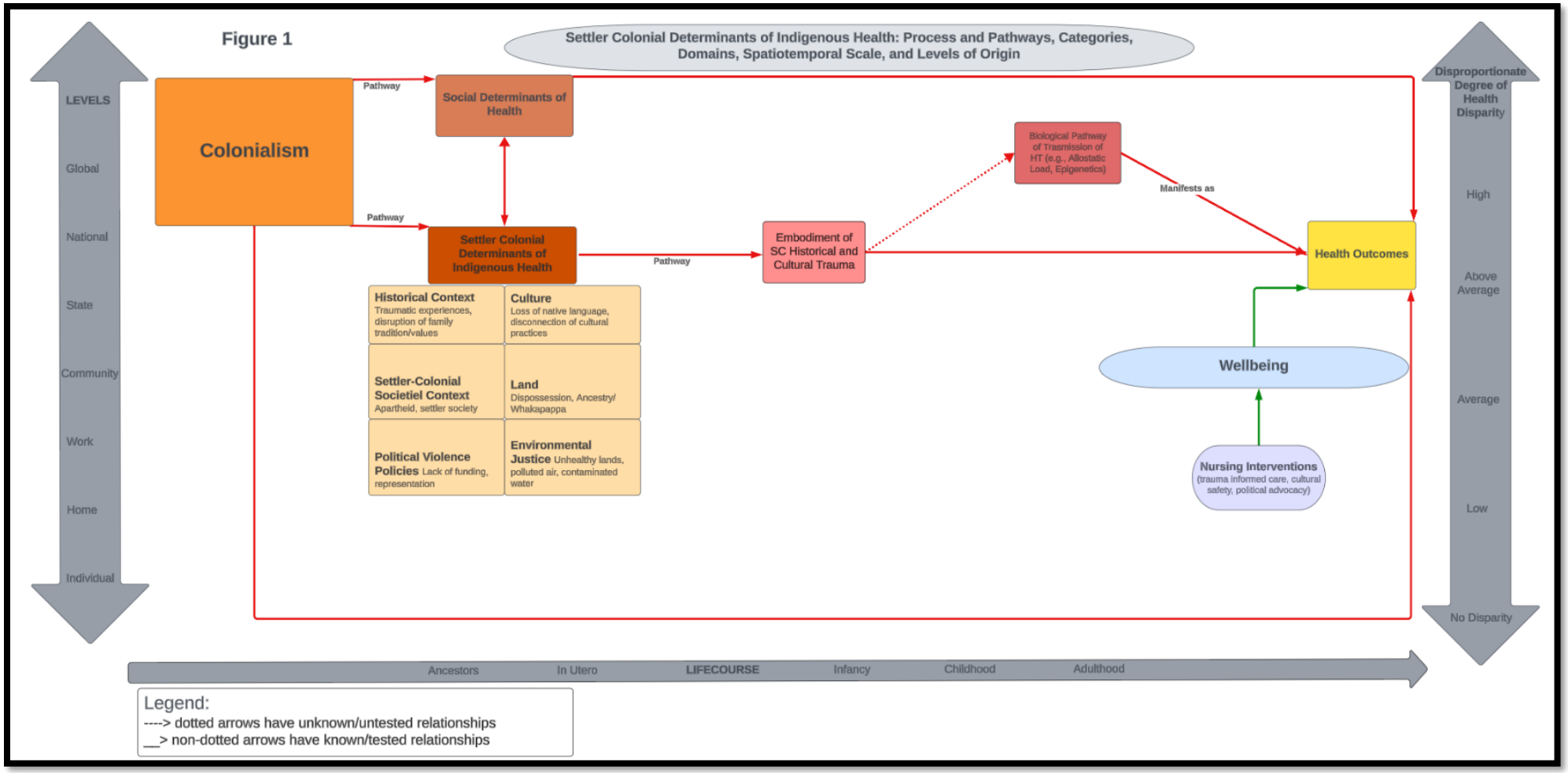
Figure 1
Settler Colonial Determinants of Indigenous Health: Process and Pathways, Categories, Domains, Spatiotemporal Scale, and Levels of Origin
LEVELS
Global
National
State
Community
Work
Home
Individual
Colonialism
Pathway
Social Determinants of Health
Pathway
Settler Colonial Determinants of Indigenous Health
Pathway
Embodiment of SC Historical and Cultural Trauma
Biological Pathway of Trasmission of HT (e.g., Allostatic Load, Epigenetics)
Manifests as
Health Outcomes
Historical Context
Traumatic experiences, disruption of family tradition/values
Culture
Loss of native language, disconnection of cultural practices
Settler-Colonial Societiel Context
Apartheid, settler society
Land
Dispossession, Ancestry/ Whakapappa
Political Violence Policies
Lack of funding, representation
Environmental Justice
Unhealthy lands, polluted air, contaminated water
Wellbeing
Nursing Interventions
(trauma informed care, cultural safety, political advocacy)
Disproportionate Degree of Health Disparity
High
Above Average
Average
Low
No Disparity
Ancestors
In Utero
LIFECOURSE
Infancy
Childhood
Adulthood
Legend:
----> dotted arrows have unknown/untested relationships
__> non-dotted arrows have known/tested relationships

Mechanisms

Embodiment is the process through which human beings biologically embed their lived experiences, which occur in their unique societal and ecological contexts, resulting in changes in biological characteristics[15]. Embodiment is therefore an inescapable aspect of life in all its social, temporal, and place-based permutations. As an example, inequitable exposures to, exogenous hazards from environmental pollutants are embodied, generate a physiological response, and result in negative health outcomes from both the physical effects of the pollutant and psychological stress due to living in a polluted area[15]. Embodiment is one mechanism connecting the historical and current-day experiences of settler colonialism to biological processes that can lead to negative mental and physical health outcomes and may result in a sustained stress response, due to repeated exposures to significant chronic stressors and subsequent physiological reactions[1]. The level of the exposure, and factors related to its spatiotemporal position, must also be assessed, as seen in the SCDoIH conceptual model presented in Figure 1.

Embodiment of the significant chronic stressors resulting from settler colonialism can lead to high levels of AL and epigenetic dysregulation, two potential mechanisms for Indigenous health disparities. **Stress-induced epigenetic modifications** are one potential process of embodiment that ultimately impacts health[33]. Epigenetic modifications do not change the genomic sequence. Instead, they alter gene expression, which can affect the regulation of physiological systems across the stress, immune, and cardiovascular systems[31]. A second epigenetic process that could affect Indigenous health is settler colonial stress experienced by previous generations, which can affect the epigenome of their descendants through intergenerational trauma and its biological effects[33]. Given the potential risks of Western biological reductionism and the ongoing injustices

that make separation from historical and present harms challenging, more research is needed to elucidate this proposed mechanism[35].

Allostatic load refers to the cumulative dysregulation of multiple physiological systems due to high cumulative chronic stress. Settler colonial determinants of Indigenous health can lead to multigenerational chronic stress exposures in Indigenous populations, resulting in high chronic stress at the individual level. The conceptual model we developed reflects the embodiment of the SCDoIH, which, encompasses the biological process of AL. AL provides a biological framework to help explain how cumulative and chronic experiences of life stress lead to poor health outcomes through a sustained stress response, dysregulation of the hypothalamic-pituitary-adrenal (HPA) axis, altered biomarkers of the stress response, and disruptions to homeostasis[18,21]. This leads to increased risk for, and earlier onset of, physical and mental health conditions and chronic diseases through "wear and tear" on the body, weathering, and premature disease susceptibility[21]. AL is another potential mechanism connecting cumulative experiences of settler colonialism to poor health outcomes. Measuring of biomarkers of AL can improve understanding of how cumulative stress may impact the premature development of chronic diseases. Biomarkers of AL reflect five domains of the physiological stress response: cardiovascular, neuroendocrine, inflammatory, metabolic, and anthropometric[18,21]. Physical and mental chronic stress, PTSD, limited sociocultural access (i.e., social support, financial hardship), and lower socioeconomic status all lead to higher AL[21]. In earlier studies, high AL predicted morbidity, mortality, chronic disease, and physical and cognitive function among elders[10]. However, protective sociocultural environments may reduce the individual risk of morbidity and mortality[21].

Mediating and Moderating Factors Impacting Health Outcomes

This model illustrates that SDoH mediates the relationship between SCDoIH and health outcomes, while factors of resistance and resilience moderate the relationship. Additionally, the model shows that nursing interventions mediate and moderate the effects of health outcomes through acts of settler harm reduction (i.e., cultural safety, trauma-informed care).

Levels: The levels and spatiotemporal scale of the model illustrate the diverse contexts in which SCDoIH occurs. Studies using the model should include the factors related to the relationship of the SCDoIH and the levels in which they are occurring relative to the spatiotemporal scale and historical context[36].

DISCUSSION

This framework fills a substantial gap in the conceptual and theoretical knowledge of the settler colonial determinants of Indigenous health. The framework was developed based on existing knowledge in multiple fields, including Indigenous health, allostatic load, epigenetics, and critical Indigenous and settler-colonial studies. By integrating knowledge from numerous fields, this framework helps to fill a need for conceptual frameworks that address health and well-being in diverse populations.

Factors of resilience and resistance moderate and mediate the effects of stress-resilience among many populations through social buffering, cultural buffers, and other processes[41-42]. However, there is limited literature investigating how nursing practices moderate and mediate the development of poor health outcomes by promoting and supporting stress resilience and resistance among Indigenous populations. To our knowledge, few studies identify how nursing

practices can impact the stress-resilience of Indigenous peoples. Nursing theorists such as Peggy Chin, Dorothy Orem, Betty Neuman and Callista Roy have highlighted the importance of nursing practice[43-46]. They define nursing as a holistic practice that recognizes the importance of individuals' environments and the need for constant adaptation to maintain homeostasis. According to their theories, nursing interventions must respect individuals' unique needs and differences[47], which requires nursing practice to adapt and provide nursing interventions across the contexts in which disparities are occurring across the life course. Thus, nursing practice and interventions have the potential to mediate and moderate the degree of disparate health outcomes from SCDoIH as well as mediate and moderate the effects of anti-colonial resistance and interpersonal resilience and improve health and well-being in Indigenous populations. To do so, nurses must act as political advocates on the macro level while developing and implementing interventions based on trauma-informed care and cultural sensitivity at the micro level.

Despite these advances in conceptualizations, there are limitations. First, we were unable to identify an existing framework of settler colonial determinants of Indigenous health, despite numerous calls to advance this area of knowledge, especially in other countries (i.e., Canada, Australia). Second, identifying domains of settler colonialism may decontextualize the often-interconnected experiences of settler colonialism to merely quantify outcomes. Doing so could work in opposition to decolonizing colonial knowledge structures and minimize the impact of these experiences. Third, this framework was not done in consultation with Community participation and therefore gives a very limited view of Indigenous ways of knowing.

CONCLUSION

A gap exists in our knowledge of SCDoIH and this framework seeks to fill that gap and provide potential mechanisms of mediation/moderation. Future research should seek to clarify relationships and identify/clarify mediators/moderators that may inform interventions.

References

1.Warne, D., Lajimodiere, D AI Health disparities 2015 social and Personality Psychology Compass 9/10 (2015): 567–579, 10.1111/spc3.12198 American Indian health disparities: psychosocial influences North Dakota State University
2.Arias E, Xu J, Jim MA. Period life tables for the non-Hispanic American Indian and Alaska Native population, 2007–2009. Am J Public Health 2014;104(Suppl 3):S312–9. 10.2105/AJPH.2013.301635 [PMC free article] [PubMed] [CrossRef] [Google Scholar]
3.Cobb N, Espey D, King J. Health behaviors and risk factors among American Indians and Alaska Natives, 2000-2010. Am J Public Health 2014;104(Suppl 3):S481–9 . [PMC free article] [PubMed] [Google Scholar]
4.AHA, Heart disease and stroke statistics—2022 update: A report from the American Heart Association. (2022). Circulation, 146(10). https://doi.org/10.1161/cir.0000000000001074
5.Noursi, S., et al. U.S. Department of Health and Human Services. (n.d.). ORWH leadership publishes article on intimate partner violence and maternal morbidity and mortality. National Institutes of Health. Retrieved December 10, 2022, from https://orwh.od.nih.gov/in-the-spotlight/all-articles/orwh-leadership-publishes-article-intimate-partner-violence-and
6.Krieger, N. (2012). Methods for the scientific study of discrimination and health: An ecosocial approach. American Journal of Public Health, 102(5), 936–944. https://doi.org/10.2105/ajph.2011.300544
7.Warne Frizell (2014) American Indian Health Policy: Historical Trends and Contemporary Issues
8.World Health Organization. About social determinants of health. World Health Organization. Available from: http://www.who.int/ social_determinants/sdh_definition/en/.
9.Subica, A.M. and Link, B.G., 2022. Cultural trauma as a fundamental cause of health disparities. Social Science & Medicine, 292, p.114574.
10.Beltrán R;Schultz K;Fernandez AR;Walters KL;Duran B;Evans-Campbell T;, R. (n.d.). From ambivalence to revitalization: Negotiating cardiovascular health behaviors related to environmental and historical trauma in a northwest American Indian Community. American Indian and Alaska native mental health research (Online). Retrieved December 6, 2022, from https://pubmed.ncbi.nlm.nih.gov/29889950/
11.Snelgrove, C., Dhamoon, R., & Corntassel, J. (n.d.). Unsettling settler colonialism: The discourse and politics of settlers, and solidarity with Indigenous Nations. Decolonization: Indigeneity, Education & Society. Retrieved December 6, 2022, from https://jps.library.utoronto.ca/index.php/des/article/view/21166
12.Whyte, K.P. 2017 (forthcoming). Food Sovereignty, Justice and Indigenous Peoples: An Essay on Settler Colonialism and Collective Continuance. Oxford Handbook on Food Ethics. Edited by A. Barnhill, T. Doggett, and A. Egan. Oxford University Press
13.Czyzewski, K. (2011). Colonialism as a broader social determinant of health. International Indigenous Policy Journal, 2(1). https://doi.org/10.18584/iipj.2011.2.1.5
14.Carson, B., Dunbar, T., Chenhall, R. D., & Bailie, R. (Eds.). (2020). Social determinants of Indigenous health. Routledge.
15.Glenn, E. N. (2015). Settler colonialism as structure. Sociology of Race and Ethnicity, 1(1), 52–72. https://doi.org/10.1177/2332649214560440
16.Public Health Critical Race Praxis/Methodology, which specifically calls for this: Ford, C. L.,

& Airhihenbuwa, C. O. (2010). The public health critical race methodology: Praxis for antiracism research. Social Science & Medicine (1982), 71(8), 1390–1398. https://doi.org/10.1016/j.socscimed.2010.07.030
17. Krieger, N. Ecosocial theory, embodied truths, and the people's health. New York, NY: Oxford University Press (2021).
18. Brave Heart MY. Wakiksuyapi: carrying the historical trauma of the Lakota. Tulane Stud Soc Welfare. 2000;21:245-266
19. Simpson, LB. Dancing on our turtle's back: stories of Nishnaabeg re-creation, resurgence and a new emergence. Winnipeg: Arbeiter Ring Pub (2011).
20. Alfred, GR. Wasa′se: indigenous pathways of action and freedom. Peterborough, Ont: Orchard Park, N.Y: Broadview Press (2005).
21. UNM.(N.D) https://extension.umn.edu/trauma-and-healing/historical-trauma-and-cultural-healing#sources-809760
22. Evans-Campbell, T (2008).Historical Trauma in American Indian/Native Alaska Communities Teresa Evans-Campbell Journal of Interpersonal Violence 2008 23:3, 316-338
23. Tonja R. Conerly, Kathleen Holmes, Asha Lal Tamang Publisher/website: OpenStax Book title: Introduction to Sociology 3e
24. Chandler, M. and C. Lalonde, Cultural Continuity as a Hedge Against Suicide in Canada's First Nations. Transcultural Psychiatry, 1998. 35(2): p. 191-219.
25. (Lovett, 2022). In the beginning it was our people's law. What makes us well; to never be sick. Cohort profile of Mayi Kuwayu: the National Study of Aboriginal and Torres Strait Islander Wellbeing [English title]Raymond Lovett Australian National University and AIATSIS
26. Weingarten, K (2004). Witnessing the effects of political violence in families: mechanisms of intergenerational transmission and clinical interventions
27. Avalos, N. What Does It Mean to Heal From Historical Trauma? Natalie Avalos, PhD
28. (Mcguire-adams). This is what I heard at Naicatchewenin": Disrupting embodied settler colonialism Volume 6 | Issue 1 Article 7, February 2021
29. Bia Missing and Murdered Indigenous People Crisis | Indian Affairs (bia.gov)
30. Haozous, E.A., Strickland, C.J., Palacios, J.F. and Solomon, T.G.A., 2014. Blood politics, ethnic identity, and racial misclassification among American Indians and Alaska Natives. Journal of environmental and public health, 2014.
31. George, E. , Mackean, T. , Baum, F. , Fisher, M. (2019). Social Determinants of Indigenous Health and Indigenous Rights in Policy: A Scoping Review and Analysis of Problem Representation. Th e International Indigenous Policy Journal, 10(2) . DOI: 10.18584/iipj.2019.10.2.4\
32. Kim PJ (2019) Social determinants of health inequities in Indigenous Canadians through a life course approach to colonialism and the residential school system, Health Equity 3:1, 378–381, DOI: 10.1089/heq.
33. Klengel, T., Dias, B. & Ressler, K. Models of Intergenerational and Transgenerational Transmission of Risk for Psychopathology in Mice. Neuropsychopharmacol 41, 219–231 (2016). https://doi.org/10.1038/npp.2015.249
34. Callison, C. Climate Change Communication and Indigenous Publics. Oxford Research Encyclopedia of Climate Science. Retrieved 13 Dec. 2022, from https://oxfordre.com/climatescience/view/10.1093/acrefore/9780190228620.001.0001/acrefore-9780190228620-e-411.

35.Paradies, Y. Colonisation, racism and indigenous health. J Popul Res (Canberra). (2016) 33:83–96. doi: 10.1007/s12546-016-9159-yhttps://www.ncbi.nlm.nih.gov/pmc/articles/PMC6307350/
36.Krieger, N. (2005). Embodiment: A conceptual glossary for Epidemiology. Journal of Epidemiology & Community Health, 59(5), 350–355. https://doi.org/10.1136/jech.2004.024562
37.Michaels, Rousseau, and Yang, 2010.
38.Brave Heart, M. Y., Chase, J., Elkins, J., & Altschul, D. B. (2011). Historical trauma among indigenous peoples of the americas: Concepts, research, and clinical considerations. Journal of Psychoactive Drugs, 43(4), 282–290. https://doi.org/10.1080/02791072.2011.628913
39.Brave Heart, M. Y. H. & DeBruyn, L. M. (1998). The American Indian Holocaust: Healing historical unresolved grief. American Indian and Alaska Native Mental Health Research, 8(2), 60–82.
40.Walters, K. L., Mohammed, S. A., Evans-Campbell, T., Beltrán, R. E., Chae, D. H., & Duran, B. (2011). Bodies don't just tell stories, they tell histories. Du Bois Review: Social Science Research on Race, 8(1), 179–189. https://doi.org/10.1017/s1742058x1100018x
41.Walters, K. L., & Simoni, J. M. (2002). Reconceptualizing native Women's Health: An “Indigenist” stress-coping model. American Journal of Public Health, 92(4), 520–524. https://doi.org/10.2105/ajph.92.4.520
42.Sucheki Front. Behav. Neurosci., 22 November 2021Sec. Individual and Social Behaviors https://doi.org/10.3389/fnbeh.2021.795312
43.Chinn, P. L., & Falk-Rafael, A. (2018). Embracing the focus of the discipline of nursing: Critical caring pedagogy. Journal of Nursing Scholarship, 50(6), 687–694. https://doi.org/10.1111/jnu.12426
44.Orem, D. E., Taylor, S. G., & Renpenning, K. M. (1995). Nursing: Concepts of practice.,
45.Neuman, B. M., & Fawcett, J. (1989). The Neuman systems model (2nd ed.). Norwalk, CT: Appleton & Lange.
46.Roy, C., Whetsell, M. V., & Frederickson, K. (2009). The Roy adaptation model and research: Global perspective. Nursing science quarterly, 22(3), 209-211.
47.Szanton, S. L., & Gill, J. M. (2010). Facilitating resilience using a society-to-cells framework: a theory of nursing essentials applied to research and practice. Advances in Nursing Science, 33(4), 329-343.

Chapter 3: “Pathways and Processes to the Embodiment of Historical Trauma Secondary to Settler Colonialism”

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Abstract

Aim(s)

This discursive article aims to examine how systemic factors of settler colonialism influence health outcomes among Indigenous peoples in the United States through pathways and processes that may lead to the embodiment of historical trauma.

Design

Discursive paper

Keywords Indigenous peoples, embodiment, historical trauma, settler colonialism, colonialism, allostatic load, eco-social theory, historical trauma theory, weathering, stressors

Methods

We completed a comprehensive search of empirical and grey literature between September 2022-January 2023 in PubMed, CINAHL, and Google Scholar. Using these articles as a foundation, we explored factors related to the pathways and processes leading to the embodiment of historical trauma rooted in settler colonialism.

Results

A conceptual framework of the pathways and processes of the embodiment of historical trauma secondary to settler colonialism was developed, and is presented.

Conclusion

The societal and historical context for Indigenous peoples includes harmful settler colonial structures and ideologies, resulting in stressors and historical trauma that impact health outcomes and disparities through the phenomenon of the process of embodiment.

Implications for Nursing

To provide holistic nursing care, nurses must be aware of settler colonialism as a determinant of health. They must be attuned to the pathways and processes through which settler colonial exposures may impact health among Indigenous peoples. Nurses must challenge existing structural inequities to advance health equity and social justice.

No Patient or Public Contribution

Chapter 3

Introduction

The concept of health and well-being for Indigenous peoples is often derived from place and land[1]. Many Indigenous peoples share the collective belief that place and body interconnect within an intricately woven and significant relationship with ancestral lands and spirit[1]. Cultural beliefs guide Indigenous peoples' traditional health practices, are based upon a reciprocal relationship of kinship with the land, and promote positive well-being. Caretaking of the land and land-based practices within Nature are "integral to one's sense of being which is also central to both individual and collective spiritual health and wellness"[1]. For instance, those who practice traditional health practices, such as using sacred teas/herbs or engaging in ceremony often report lower anxiety and depression.[2] However, settler colonial ideologies and practices have resulted in a settler society that poses threats to land-based cultural practices and access to traditional medicine. The settler colonial structure within the United States is built upon acts of elimination (i.e., elimination of people, culture, and dispossession of land) which continues to occur, and has deleterious effects on Indigenous peoples despite the inherent resilience to these settler colonial systems[3]. Examples of events resulting from colonization and settler colonialism include racism and sexism, as well as genocide, dispossession of land and culture, forced removal of children (e.g., boarding schools, adoption to non-Indigenous families), and reproductive injustices (i.e., forced sterilization).[4] Furthermore, complex infrastructures between tribal nations and the U.S government has resulted in significant social, economic, cultural, environmental, and political inequalities.[5] The cumulative effects of these colonial and oppressive inequalities has contributed to the continued growth of many health disparities.[5,6] In the United States, compared with other racial/ethnic groups, Indigenous peoples are disproportionately impacted by health disparities and inequities, that occur across the lifespan and are exacerbated by the practices and ideologies of colonization, settler colonialism, and historical trauma.[7] Indigenous peoples are at greater risk for chronic conditions, lower life

expectancy, and lower quality of life[8]. For instance, age-adjusted death rates attributable to diabetes (per 100,000 people) in 2019 were 48.2 for Indigenous males vs. 24.8 for non-Hispanic white (NHW) males, and 35.7 for Indigenous women vs. 14.2 for NHW females[9]. In 2018, the prevalence of coronary heart disease among Indigenous peoples was 8.6%, compared to 5.7% among NHWs[9]. Indigenous peoples also have disproportionate rates of post-traumatic stress disorder (PTSD) and suicide[9].

Indigenous women, in particular, have been the target of catastrophic historical and current events that continue to impact their health and well-being.[4] For instance, in the U.S., more than twice as many Indigenous women die from pregnancy-related conditions, compared to non-Hispanic White (NHW) women (32.5 deaths per 100,000 live births compared to 13 deaths per 100,000 live births)[10.] Yet, maternal mortality review committees (MMRC) report that over 60% of pregnancy-related deaths (PRDs) are preventable.[6] Indigenous women also experience intimate partner violence (IPV) at a disproportionately higher rate than all other racial/ethnic groups, including during pregnancy[11]. In 2013 the rate of stillbirth was almost 1.5 times higher for Indigenous females, compared to NHW females (6.22 per 1000 live births vs. 4.88 per 1000 live births)[12].

Few factors mitigate these risks to Indigenous peoples' health. For example, educational attainment (EA) does not appear to have the same buffering effect on pregnancy-related mortality rates (PRMR) as it does on other health outcomes.[6] Indigenous and non-Hispanic Black women with any college education have higher PRMR than women of all other racial/ethnic groups who have less than a high school diploma, even in states with the lowest pregnancy-related mortality ratios (PRMR).[6] Of additional concern, PRMR exponentially increases in Indigenous women who are older than 25 years.[13] These findings underscore the

impact of social constructions within a woman's environment on maternal morbidity and mortality.[13]

Heterogeneous populations of Indigenous peoples in the U.S. experience chronic, acute, and prolonged discrimination-based stressors related to the historical trauma that results from settler colonialism. Although health inequities and disparities within and between nations and societies are gaining increased attention, the underlying historical and structural pathways and processes are not well understood, despite significant knowledge gained from frameworks such as the social determinants of health (SDoH) [14]. Social determinants of health are "the conditions in which people are born, grow, live, work, and age,"[15] (e.g., low socioeconomic status, low quality, or poor access to healthcare, etc.), and contribute to "unfair and avoidable differences in health"[14].

However, SDoH do not explain the degree or historical origins of significant health disparities between populations[16]. This is a significant barrier in the advancement of health and social justice. To understand the striking degree of disparities experienced by Indigenous peoples across the life course, we must understand the historical traumas and other upstream determinants, such as unresolved trauma and colonial structures, that lead to Indigenous health inequity.[17] This will help to provide context for understanding lived experiences of settler colonialism by those who are affected by it and the impact of these experiences on health. The authors assert that establishing settler colonialism in the U.S. as a determinant of Indigenous health will help identify and thus facilitate acts to deconstruct harmful systems built upon colonial power structures.

Some scholars have called on experts to expand empirical evidence of the impact of historical trauma on health disparities and how adverse health may develop in response to experiences.[18]

Answering this call requires considering how exposure to settler colonial structures results in embodiment of historical trauma and poor health outcomes. In this context, embodiment provides a mechanism for the relationships between social and environmental conditions and a variety of adverse health outcomes. In this article, embodiment is conceptualized as the process connecting social pathways to emotional responses to historical trauma to physiological/biological pathways that ultimately affect biological processes and health outcomes. We refute the narrow focus of the biomedical model, and instead will provide an explanation of disproportionate adverse health outcomes affecting Indigenous peoples through the process of embodiment of historical trauma resulting from settler colonialism.

This paper provides a review of potential social and physiological pathways leading to embodiment, the process of embodiment, subsequent biological processes that impact health, current gaps in the literature, and implications for future research, clinical practice, and policy. Conceptual definitions are provided first, followed by an overview of the process of embodiment, and lastly the pathways and processes of how settler colonialism may become embodied as historical trauma and in turn manifested as adverse health outcomes. Finally, a conceptual framework will be presented.

Positionality

We take deep responsibility to situate and acknowledge our positionality. We understand the impact of knowledge production and strive to decolonize hurtful narratives and indigenize nursing research. Understanding that all things are embodied within self, we provide this deeper explanation of *who* we are by situating ourselves in place and community. Doing so will serve to illustrate how our worldviews have been shaped by our social and cultural experiences. We provide an examination of our reflexivity so the strengths and limitations of our work can be identified for our readers.

I (NT, the first author), hope to one day be recognized as an ally of Indigenous peoples and communities. I am a privileged middle-class, first-generation academic and registered nurse. I am mother to Harlow and daughter to my mother and step-father. I am a settler of European ancestry and have a mixed background that includes Armenian and Indigenous heritage (unknown tribal identity due to parental adoption). I investigate settler-colonial determinants of Indigenous health in an effort to deconstruct colonial power structures. A recurring tension for me is how to present perspectives, voices, and the inherent strengths of Indigenous peoples alongside the community without having connections or lived experiences within community. I have in turn curated a collective group of Indigenous and non-Indigenous co-authors that will help me fill the voids where my lack of lived experiences or expertise may have biased my scholarship and will serve to weave together both Indigenous and non-Indigenous ways of knowing. Lastly, I'd like to acknowledge that I am fortunate to have grown up on and continue to reside on ancestral Ho-Chunk (Hochungra) land. I am thankful to be able to live, work, raise my child, study, and enjoy the beauty of this land. I recognize the colonial role within academia and healthcare. I acknowledge my positionality and embodied ways of knowing has influenced this project. BO is of Settler (Welsh/English) and Indigenous (Hoocak) ancestry, raised bi-culturally. She is a graduate nursing student studying Indigenous health equity. ALE is a white nursing professor who recognizes her privileged position in society. She is dedicated to NT's development as a nurse scholar, and is equally as dedicated to learning about Indigenous peoples, their health and well-being and how she can be an ally to Indigenous peoples. LCB is a settler of Scandinavian descent. Similar to the first author, a first-generation scholar who has grown up on and continues to reside on ancestral Ho-Chunk (Hochungra) land. She is a nursing professor, researcher and mother of Olivia.

Definitions

We acknowledge the complexity of Indigenous identity. For the purpose of this paper, Indigenous peoples are the rightful claimants of the land and those who self-identify as a member of an Indigenous group within the United States.

Colonialism is defined as a) "the control or governing influence of a nation over a dependent country, territory, or people; b) the system or policy by which a nation maintains or advocates such control or influence".[19] The past and present process of colonization in the U.S. has numerous, devastating, and insidious impacts on the health and well-being of Indigenous peoples. These result from the intimately interconnected societal constructs that maintain domination and privilege over others such as racism, patriarchy, heterosexism, and gender binarism[19]. Indigenous peoples experience numerous social, economic, and political disadvantages in the U.S. due to colonialism. These disadvantages have a negative impact on health. Examples include the long-standing history of the U.S. government underfunding its trust responsibility for the Indian Health Services (IHS), which provide health services to many Indigenous peoples. The IHS is underfunded every year. This occurs despite the fact that it is a trust obligation and should be an entitlement program akin to Medicare. Instead, it remains a discretionary program at risk for dissolution at any time[20]. Another outcome of colonialism is the Food Distribution Program on Indian Reservations (FDPIR), frequently called the "commodity food" program. This program exposes Indigenous peoples that typically reside in food deserts with unfarmable lands and limited access to grocery stores to poor-quality, low-nutrient, high-calorie foods[20]. Despite the development of many healthy Indigenous food innovations, policies and programs such as these have contributed to significant health disparities among Indigenous peoples such as diabetes[20].

Settler-colonialism is a more focused structure of colonialism and is a powerful determinant of health. Settler-colonialism is a persistent structure in the U.S. that is advanced by seizing property and gaining sovereignty over land, bodies, and labor of Indigenous peoples.[21] It occurs through direct and indirect forms of violence, exclusion, and coercive

systems resulting in historical trauma. Settler colonialism is further characterized by the acknowledgment and understanding of the dispossession of Indigenous lands, and elimination of Indigenous peoples, and has a dominating force of power. Although Indigenous peoples in the U.S. live within the structures and effects of settler-colonialism, few studies have examined settler colonialism, its relationship to health and its implications for nurses and nursing. Additional scientific examination of how settler-colonialism and HT harm the health of Indigenous peoples in the United States is needed.

Settler colonialism provides a more focused perspective on the practices, structures, and governmentality of ongoing colonialism. Colonization has the goal to *exploit* all resources; human and otherwise.[21] While, settler colonialism aims to acquire control of all resources, human and otherwise, through *elimination*.[21] Settler colonialism allows colonizers to obtain land and its resources, while also eliminating the Indigenous peoples of that land. Elimination has been achieved in a number of different ways: forced removal, confinement to tribal reservation lands, assimilation through dilution of blood quantum/marriage, enactment of the Indian Removal Act, child removal and placement into boarding schools, and land mapping (i.e., property being owned)[21].

Indigenous women are at even greater risk of experiencing the effects of settler colonialism, as they are inextricably connected to their land through ceremonial and birthing practices and are seen as symbols of strength. In turn, Indigenous women are silenced, made invisible, and at increased risk for dying by homicide due to violence resulting from settler colonialism.[22] In 2016, 5,712 Indigenous women and girls in the U.S. were reported as missing or murdered in the U.S. Department of Justice missing person's database. Yet, the National Missing and Unidentified Persons System, an information clearinghouse and resource center for missing, unidentified, and unclaimed persons, funded by the federal government, recorded only 116 of the 5,712 cases for unknown reasons[23]. Approximately 4,200 cases remain unsolved[23].

The forced erasure of Indigenous women's bodies is firmly rooted within settler colonial violence. The multifaceted practice of settler colonialism has been shaped by relations of racism, gender, class, sexuality, capitalism, and ableism[24]. These practices have created a settler society that has induced collective current-day historical traumas for Indigenous peoples. Considering such practices through a settler-colonial lens enables specificity for researchers to identify relationships of power by considering the ways that culture, space, and time contribute to different government policies for different groups of people. The deconstruction of settler colonialism requires dismantling the intersecting forces of power, such as racism, capitalism, patriarchy, and colonialism.[24]

Trauma is a perceived or actual event that is life-threatening or overwhelms a person's normal coping skills, often further characterized by a sense of horror and helplessness. Types of trauma include complex, acute, chronic, system-induced, secondary, vicarious, multi/intergenerational, historical, cultural, environmental, and current. [25,26] Trauma can be experienced as a single or continuous event, including historical events and personal events that persist across generations.[25,26] Indigenous health and well-being in the U.S is disproportionately affected by all types of trauma.[25] For example, Indigenous children are 2.5 times more likely to experience trauma than other races. Indigenous teens have the highest rates of suicide of any population in the U.S.—at least 3.5 times higher than the national average. Even without accurate reporting or databases, Indigenous women are 10 times more likely to be murdered, compared to national averages, while 6 in 10 will be assaulted. [25,27]

The Indian Country Childhood Trauma Center (ICCTC) defines trauma among Indigenous populations to provide context and address specific conditions and experiences of Indigenous peoples as a "unique individual experience associated with a traumatic event or enduring conditions, which can involve an actual death or other loss, serious injury, or threat to a child's well-being, often related to the cultural trauma, historical trauma, and intergenerational trauma

that has accumulated in Indigenous communities through centuries of exposure to racism, warfare, violence, and catastrophic disease". [25]

Historical trauma theory was developed by Braveheart (1998) and describes historical trauma as the "cumulative emotional and psychological wounding across generations, including the lifespan, which emanates from massive group trauma"[28]. Wounding has resulted from ongoing colonization. A key feature of historical trauma is that psychological and emotional wounding resulting from the trauma experience is transferred to subsequent generations, resulting in intergenerational and transgenerational cycles of trauma[28] As such, historical trauma is characterized as collective, cumulative trauma of colonization experienced by one generation that can negatively impact the well-being of future generations, by currently unknown mechanisms.[28] Ongoing cumulative stressors from historical trauma include a constant state of mourning resulting from limited sovereignty, loss of culture, language, religion, and access to traditional medicine/healing practices, and unequal opportunities for socioeconomic growth[28].

The response to historical trauma, known as historical trauma response (HTR), includes elevated mortality rates and health problems emanating from examples such as hypertension, depression, anxiety, alcohol misuse, and suicidal behavior which is the result of unresolved grief and feelings of historical loss.[28] Braveheart (1998) describes HTR as a "constellation of features associated with a reaction to massive group trauma", which have characteristics similar to post-traumatic stress disorder (PTSD) and unresolved grief [28].

Whitbeck and colleagues (2004) developed empirical measures of historical trauma and HTR. The Historical Loss Scale (HLS) and the Historical Loss Associated Symptoms Scale (HLAS) provide standardized measurement of historical loss[29]. These scales detect present-day perceptions of feelings about loss of cultural and material items resulting from colonization[29]. The scales focus on twelve types of losses, including the loss of land, language, traditions, values, family ties, trust, and respect, which are all consequences of subjugation and assimilation[29]. The HLS measures how frequently people think about these losses, whereas the

HLAS captures the range of emotional responses to these losses[29]. Reminders of losses serve as persistent re-exposures to feelings of historical loss, which can trigger a HTR. Multiple potential pathways and mechanisms connect the HTR from embodiment to manifestation in health outcomes[30]. People with higher scores for historical loss were more likely to report depression, anxiety, anger, and avoidance[29], demonstrating the connection between the shared collective past, which is compounded by current trauma(s) and stressors, and emotional aspects of the HTR[29]. We assert that settler colonialism creates persistent reproduction of dispossession, disenfranchisement, and oppression, leading to prolonged and repeated exposure to traumatic stressors. This results in the embodiment of historical trauma, premature weathering, and significant inequities in physical, mental, and emotional health and well-being for Indigenous peoples of the U.S.

Embodiment occurs when lived experiences, which develop in an individual's social and ecological context, result in changes in the biological characteristics of that individual.[31] Embodiment of historical trauma from settler colonialism, such as collective grief resulting from strategies of elimination including the removal from and disconnection of land and culture, increases risks of depression, anxiety, and exposure to other types of trauma (e.g., IPV, motor vehicle accidents), as well as hypertension[1]. These mental and physical health conditions occur at disproportionate rates among Indigenous peoples[1,28]. The embodiment of historical trauma secondary to settler colonialism may have similar impacts on as-yet-unstudied aspects of health among Indigenous peoples.

Phenomenon of Embodiment of Historical Trauma, Pathways and Processes

Phenomenon of Embodiment of Historical Trauma

EcoSocial Theory[31-35], Historical Trauma Theory[28,36,37], and the Indigenist Stress Coping Model[38,39], which are well-known Indigenous-centered theories and models , highlight the importance of an embodied research lens for understanding how the collective lived experiences of historical trauma rooted in settler colonialism occur across the life course,

transmit among families and negatively impact disproportionate health inequities[33]. An embodied approach to research considers how micro (e.g., individual) and macro (e.g., societal context) levels of exposure to the embodiment of historical trauma affect the distribution of diseases[33].

Exploring embodiment as a process requires measuring the social conditions causing harm and the biological processes by which they are embodied.[32] Social conditions may originate as physical, chemical, biological, or social exposures[32]which affect individual biology in different ways. The biological impact is influenced by the biological response to the exposure. The effects of these primarily exogenous exposures cannot be inferred from gene-environment interactions or gene frequencies without explicit examination of the impact of social conditions on the exogenous exposure[32]. As such, embodiment is situated at the inescapable intersection of our experiences of reality and how we have come to know that reality and can occur through multiple different pathways. For instance, exogenous hazards from environmental pollutants can be embodied from the physical exposure to the pollutant, as well as the psychological stressor of knowing that oneself and the Land have been exposed to environmental pollutants. Regardless of which pathways are used, embodiment of such exposures can result in negative health outcomes. Thus, embodiment is a complex and multi-faceted process that can result from the biological embedding of an array of different environmental exposures (i.e., exogenous hazards, emotional responses). This paper highlights how exposures to settler colonial structures result in historical trauma and emotional responses to that trauma. In contrast, embodiment of traditional cultural practices may be seen in the relationship between the use of Indigenous teas and positive health outcomes, or how experiences of enculturation, the process of identifying with one's culture, can decrease negative health outcomes such as drinking alcohol.[40]

Yet, what is not clear in literature is how the psychological stressor of historical trauma is embodied through biological processes that lead to chronic disease and premature aging. We

base our conceptualization of the process of embodiment of historical trauma via emotional responses and its effects on Indigenous people's health in the US on tenets of four theories: EcoSocial Theory (i.e., embodiment) [32], Historical Trauma Theory (i.e., historical, intergenerational and transgenerational trauma) [28,36], Allostatic Load Model (i.e., allostasis, allostatic load) [41,42], and the Weathering Hypothesis (i.e., premature onset of chronic diseases)[43].

Embodiment of historical trauma occurs when exposure to the systemic, ideological processes of colonialism (i.e., subjugation, racism, oppression) result in the structure of settler colonialism (i.e., strategies of elimination) that are experienced as a significant stressor (i.e., historical trauma). This stressor triggers conscious or subconscious emotional reactions (e.g., anger, loss, and degradation), activating a stress response (i.e., allostasis) that impacts health (i.e., weathering). The viable pathways to the embodiment of HT from settler-colonialism include repeated exposure to: a) settler-colonial risk factors, and b) experiences of historical trauma. Processes of embodiment are not well-understood. Therefore, we hypothesize that emotional responses are the salient, under-investigated missing link that can connect the process of embodiment of historical trauma due to settler colonial structures and systems to biological outcomes via biological processes (i.e., allostasis), social processes, and behavioral cues (i.e., self-care) that ultimately lead to suboptimal health outcomes.

Emotional responses to historical trauma have not been comprehensively examined as contributing to embodiment. Evidence suggests that embodied trauma “reveal[s] stories that are hidden, forbidden, not conscious, or even denied by individuals or groups"[32,44], which can be observed in poor physical or mental health outcomes. **These are the marks left on our living bodies that tell the stories when our voice is unable to[44]. Regardless of our conscious cognitive ability to recognize or to speak about the experiences of historical trauma, the human body takes inventory and speaks through health outcomes.** An embodied understanding will consider how patterns of disease and disparities can be found within the

societal, material, and ecological contexts in which we live. This contrasts with the consideration of factors that highlight decontextualized and disembodied characteristics such as behaviors, lifestyles, and genes[32]. This approach is needed, given the collective impact of elimination strategies through settler colonialism on Indigenous peoples, their varied experiences of historical trauma, and the significant health disparities and inequities that are experienced.

This paper aims to understand how risk factors of settler-colonialism and resulting historical trauma are embodied through emotional responses to these traumas and related to biological changes that negatively impact health outcomes of Indigenous peoples in the U.S.

Pathway to Embodiment: Settler-Colonial Determinants of Health

Exposure to settler colonial risk factors and their subsequent processes may create a pathway to the embodiment of settler-colonial historical trauma via emotional responses (i.e., conscious or subconscious). Embodiment of the lived experiences of societal and ecological contexts of human beings occurs via social pathways and biological processes that result in health outcomes[45]. These authors conceptualize that the embodiment of historical trauma may be initiated when individuals are exposed to risk factors of settler colonialism that result in historical trauma, which may include:

- Settler-colonial disconnection (e.g., disruption of connectedness to Land, traditional food systems, cyclical lifeways, culture, community, family, identity)
- Trauma (e.g., discrimination, boarding schools, relocation, and other forms of violence and abuse)
- Social and community context (e.g., social and economic deprivation, apartheid, mass incarceration)
- Lack of cultural safety, disruption in the transmission of traditional healing practices
- Degradation of ecosystems (e.g., polluted air, contaminated waters)[31,38,46]

Processes of the Embodiment Of Historical Trauma (Allostatic Load, Weathering)

Allostatic Load Model

The Allostatic Load (AL) model describes how exposures to stressors related to historical trauma lead to sustained stress response, dysregulation of the hypothalamic-pituitary-adrenal (HPA) axis, altered biomarkers of stress response, and disruptions to homeostasis[41,42]. This leads to increased risk for, and earlier onset of physical and mental health conditions and chronic diseases. Embodiment of historical trauma rooted in settler colonialism may result in a sustained stress response from repeated exposures to significant chronic stressors and their subsequent emotional reactions.

Biomarkers of AL reflect five domains of the physiological stress response: cardiovascular, neuroendocrine, inflammatory, metabolic, and anthropometric.[41] Chronic stress, sociocultural access (i.e., social support, financial hardship), and protective social environments affect AL, resulting in physiological changes that are reflected in biomarkers.[41] Physical and mental chronic stress, PTSD, and lower socioeconomic status lead to higher AL, and higher morbidity and mortality[41]. Protective sociocultural environments may mediate physiological responses to stress and reduce the individual risk of morbidity and mortality[41].

The AL model, when approached with an embodied and Indigenous-centered lens, illustrates how chronic, cumulative, discriminatory, and powers-based societal contexts can lead to adverse outcomes such as accelerated aging and earlier disease onset. Embodiment of historical trauma activates an ongoing stress response, which may function as the biophysical catalyst for the clinical manifestation of symptoms and disease.

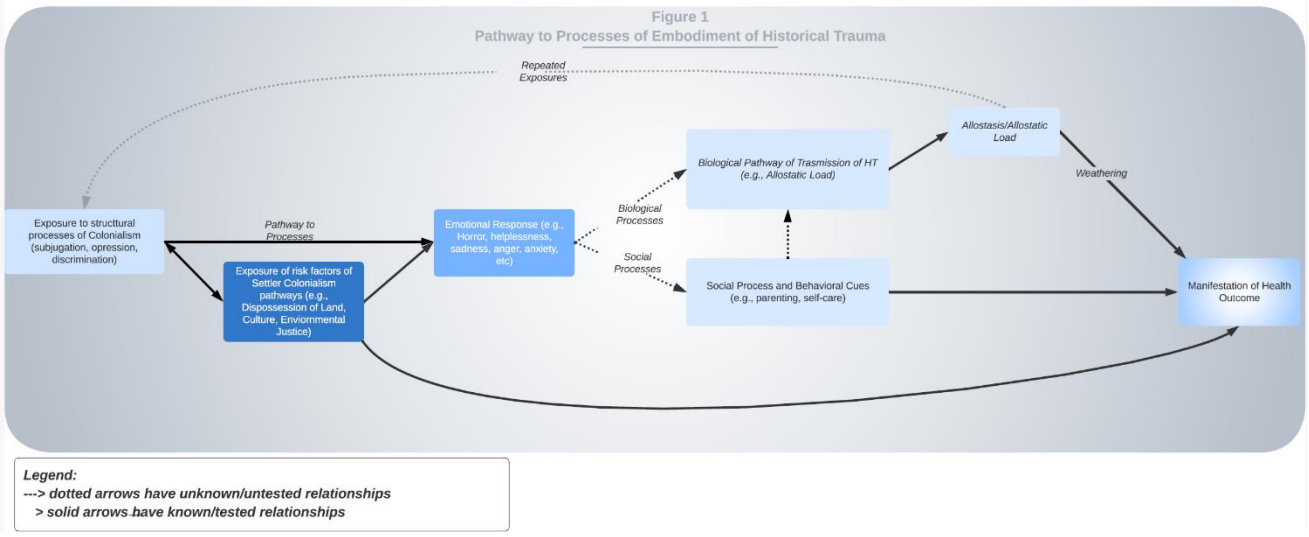
Weathering describes how “the cumulative biological impact of being chronically exposed to, and having to cope with, socially structured stressors can increase health vulnerability and accelerate aging in marginalized populations”[43]. Weathered health results from chronic exposure to lower socioeconomic position and racism, which specifically includes segregation from social, economic, and political systems. These factors accelerate premature aging causing poor health outcomes[43]. The persistent stress and challenges of implicit or explicit

racism or discrimination in addition to lower SES is hypothesized to cause repeated activation of a physiological stress response. Inequitable societal structures among marginalized populations result from race-conscious beliefs, policies, and practices that segregate populations, threaten their social identities, and are fundamental causes of poor health.[43] Empirical indicators of weathering (i.e., premature aging, poor health outcomes) due to discriminatory environmental stressors include high AL and shortened telomere length measurements[43].

Conceptual Framework

The process of embodiment of historical trauma from settler colonialism is neither fully understood nor completely characterized in the literature. To our knowledge, others have not analyzed and identified viable mechanisms that describe the social and biological pathways and processes connecting embodiment of historical trauma to health outcomes. To do so, we will build upon the interconnections found among EcoSocial Theory[31-35] (i.e., embodiment), Historical Trauma Theory[28,36,37] (i.e., historical, intergenerational and transgenerational trauma), the Allostatic Load Model (i.e., allostasis, allostatic load)[41,42], and the Weathering Hypothesis (ie., premature onset of chronic diseases)[43]. Based on these theories, historical trauma from settler colonialism is embodied through repeated exposures to processes (e.g., subjugation, oppression, degradation, etc.), settler colonial pathways (e.g., loss of land, culture, etc.), and experiences of settler colonial historical trauma (e.g., trauma, exogenous hazards, disconnection, etc.) (see figure 1). These pathways are thought to have a direct causal relationship with poor health outcomes through either physical exposures or emotional responses that initiate biological processes, such as allostasis, or suboptimal social processes or behavioral cues. Although the literature does not elucidate the biological mechanisms contributing to the embodiment of historical trauma, these could include the initiation of a physiological stress response such as high AL. Emotional responses occurring as a result of historical trauma are associated with loss and depression, anger and PTSD [1,16,28,32,36,43]. Frequently cited emotions related to historical trauma include horror, helplessness, loss, grief,

degradation, sadness, anxiety, anger, and avoidance[1,16,28,32,36,43,32-39]. These and other emotional responses may a) activate a biological mechanism, which then acts as a process to embody historical trauma and/or b) transmit via suboptimal social processes and behavioral cues (see Figure 1).



Discussion

The process of embodiment of historical trauma from settler-colonialism is not fully understood nor completely characterized in the literature. Biological processes that lead to the embodiment of historical trauma secondary to settler colonialism have not been comprehensively described. There is a call in the literature to advance the understanding of the impact of historical trauma on health outcomes with empirical evidence that supports an association with health disparities. In response to this call, we generated a conceptual framework that can be used to guide critical research on embodiment of historical trauma from settler colonialism among Indigenous peoples. Although, mechanisms illustrating the social pathways and biological processes resulting in the embodiment of historical trauma from settler colonialism and associated health outcomes have not been identified and described, this framework could provide a guide to future research on this topic. Because of limited literature on the embodiment of historical trauma and adverse health outcomes related to settler colonialism, this analysis is limited by its reliance on the interpretation of prior research, the hypothesis, and conceptual framework.

Conclusion

This paper suggests that research in nursing should consider root cause analyses of societal inequities when investigating populations that have been historically marginalized. Nurses would then have the contextual knowledge to be able to work toward policy reform and nursing interventions that would advance factors of social justice. Additionally, examining culturally congruent and safe interventions that offset negative relationships between settler colonialism and poor health outcomes is of high importance. Such interventions could include creating and practicing an Indigenous-centered trauma-informed model of care and facilitating consciousness-raising to work against oppressive elements. Future research is wide-ranging. Empirical research to further explore embodiment of historical trauma via emotional responses to exposures and effects on biological processes that impact health outcomes is needed. An Indigenous framework identifying settler colonial determinants of health is needed to accurately characterize the risk factors of settler colonialism and the impact of settler colonialism on Indigenous health. Research should also explore protective buffers used by Indigenous peoples and communities that foster intergenerational factors of resilience and resistance. This would provide nurses the knowledge to advocate for and promote effective, culturally congruent interventions.

References

1. Beltrán R;Schultz K;Fernandez AR;Walters KL;Duran B;Evans-Campbell T;, R. (n.d.). From ambivalence to revitalization: Negotiating cardiovascular health behaviors related chenAmerican Indian and Alaska native mental health research (Online). Retrieved December 6, 2022, from https://pubmed.ncbi.nlm.nih.gov/29889950/
2. WALTERS, K. (n.d.). *Indigenous Perspectives in Survey Research*. Indigenous Perspectives in Survey Research | Ngā Pae o te Māramatanga Media Centre. Retrieved February 28, 2023, from http://mediacentre.dev.npmwebprd01.reign.co.nz/content/indigenous-perspectives-survey-research
3. Wolfe, P., (2006) Settler colonialism and the elimination of the native, Journal of Genocide Research, 8:4, 387-409, DOI: 10.1080/14623520601056240
4. Bent-Goodley, T. B. (2007). Health Disparities and Violence Against Women. Trauma, Violence, & Abuse, 8(2), 90–104. https://doi.org/10.1177/1524838007301160
5. Hampton, M., Bourassa, C., Mckay-Mcnab, K. (2004). Racism, Sexism and Colonialism (1st ed., Vol. 24). CANADIAN WOMAN STUDIES.
6. Gingrey, P. J “Maternal Mortality: A US Public Health Crisis”, American Journal of Public Health 110, no. 4 (April 1, 2020): pp. 462-464
7. Warne, D., Lajimodiere, D Al Health disparities 2015 social and Personality Psychology Compass 9/10 (2015): 567–579, 10.1111/spc3.12198 American Indian health disparities: psychosocial influences North Dakota State University
8. Arias E, Xu J, Jim MA. Period life tables for the non-Hispanic American Indian and Alaska Native population, 2007–2009. Am J Public Health 2014;104(Suppl 3):S312–9. 10.2105/AJPH.2013.301635 [PMC free article] [PubMed] [CrossRef] [Google Scholar]
9. AHA, Heart disease and stroke statistics—2022 update: A report from the American Heart Association. (2022). Circulation, 146(10). https://doi.org/10.1161/cir.0000000000001074
10. Petersen, E. E., Davis, N. L., Goodman, D., Cox, S., Mayes, N., Johnston, E., Syverson, C., Seed, K., Shapiro-Mendoza, C. K., Callaghan, W. M., & Barfield, W. (2019). Vital Signs: Pregnancy-Related Deaths, United States, 2011-2015, and Strategies for Prevention, 13 States, 2013-2017. MMWR. Morbidity and mortality weekly report, 68(18), 423–429. https://doi.org/10.15585/mmwr.mm6818e1
11. Luebke, Jeneile Marie, "Intimate Partner Violence in the Lives of Urban Wisconsin American Indian Women- a Continuation of Colonial Injustice" (2020). Theses and Dissertations. 2554.https://dc.uwm.edu/etd/2554
12. AHA, Heart disease and stroke statistics—2022 update: A report from the American Heart Association. (2022). Circulation, 146(10). https://doi.org/10.1161/cir.0000000000001074
13. Varagic, J., Desvigne-Nickens, P., Gamble-George, J., Hollier, L., Maric-Bilkan, C., Mitchell, M., … Redmond, N. (2020). Maternal Morbidity and Mortality: Are We Getting to the “Heart” of the Matter? Journal of Women's Health. https://doi.org/10.1089/jwh.2020.8852
14. Harvard. *Racism is a public health crisis*. News. (2021, June 17). Retrieved December 16, 2022, from https://www.hsph.harvard.edu/news/racism-is-a-public-health-

crisis/
15. World Health Organization. About social determinants of health. World Health Organization. Available from: http://www.who.int/social_determinants/sdh_definition/en/.
16. Walters, K. L., Mohammed, S. A., Evans-Campbell, T., Beltrán, R. E., Chae, D. H., & Duran, B. (2011). Bodies don't just tell stories, they tell histories. Du Bois Review: Social Science Research on Race, 8(1), 179–189. https://doi.org/10.1017/s1742058x1100018x
17. Warne, D., Lajimodiere, D AI Health disparities 2015 social and Personality Psychology Compass 9/10 (2015): 567–579, 10.1111/spc3.12198 American Indian health disparities: psychosocial influences North Dakota State University
18. Prussing, E. (2014.). Historical trauma: Politics of a conceptual framework. Transcultural psychiatry. https://pubmed.ncbi.nlm.nih.gov/24787478/
19. Czyzewski, K. (2011). Colonialism as a broader social determinant of health. International Indigenous Policy Journal, 2(1). https://doi.org/10.18584/iipj.2011.2.1.5
20. Warne, D., Frizell (2014) American Indian Health Policy: Historical Trends and Contemporary Issues
21. Glenn, E. N. (2015). Settler colonialism as structure. Sociology of Race and Ethnicity, 1(1), 52–72. https://doi.org/10.1177/2332649214560440
22. Mcguire, A(2021) This is what I heard at Naicatchewenin": Disrupting embodied settler colonialism Volume 6 | Issue 1 Article 7,
23. Bia Missing and Murdered Indigenous People Crisis | Indian Affairs (bia.gov)
24. Snelgrove, C., Dhamoon, R., & Corntassel, J. (n.d.). Unsettling settler colonialism: The discourse and politics of settlers, and solidarity with Indigenous Nations. Decolonization: Indigeneity, Education & Society. Retrieved December 6, 2022, from https://jps.library.utoronto.ca/index.php/des/article/view/21166
25. The National Indian Child Welfare Association in partnership with SAMHSA, (2014). Trauma-Informed Fact Sheet
26. The National Child Traumatic Stress Network. (N.D).Families and Trauma | The National Child Traumatic Stress Network (nctsn.org)
27. Whitebear, L., (N.D). #MMIW. A Primer on Missing and Murdered Indigenous Women. Fact Sheet [#MMIW: A PRIMER ON MISSING AND MURDERED INDIGENOUS WOMEN (portlandoregon.gov)
28. Brave Heart, M. Y. H. & DeBruyn, L. M. (1998). The American Indian Holocaust: Healing historical unresolved grief. American Indian and Alaska Native Mental Health Research, 8(2), 60–82.
29. Whitbeck, L.B., Adams, G.W., Hoyt, D.R. and Chen, X. (2004), Conceptualizing and Measuring Historical Trauma Among American Indian People. American Journal of Community Psychology, 33: 119-30. https://doi.org/10.1023/B:AJCP.0000027000.77357.31
30. Heck, J. L., Jones,E. J., Bohn,D., McCage,S., Goforth Parker,J., Parker,M., Pierce,S.L., and Campbell, J. Journal of Women's Health.Feb 2021.220-229.http://doi.org/10.1089/jwh.2020.8890
31. Krieger, N. (2012). Methods for the scientific study of discrimination and health: An ecosocial approach. American Journal of Public Health, 102(5), 936–944. https://doi.org/10.2105/ajph.2011.300544
32. Krieger, N. (2005). Embodiment: A conceptual glossary for Epidemiology. Journal of Epidemiology & Community Health, 59(5), 350–355. https://doi.org/10.1136/jech.2004.024562
33. Krieger, N. (2012). Methods for the scientific study of discrimination and health: An

ecosocial approach. American Journal of Public Health, 102(5), 936–944. https://doi.org/10.2105/ajph.2011.300544

34. Krieger, N. (2012). Methods for the scientific study of discrimination and health: An ecosocial approach. American Journal of Public Health, 102(5), 936–944. https://doi.org/10.2105/ajph.2011.300544
35. Krieger N. Epidemiology and the web of causation: has anyone seen the spider? Soc Sci Med. 1994 Oct;39(7):887-903. doi: 10.1016/0277-9536(94)90202-x. PMID: 7992123.
36. Brave Heart, M. Y., Chase, J., Elkins, J., & Altschul, D. B. (2011). Historical trauma among indigenous peoples of the americas: Concepts, research, and clinical considerations. *Journal of Psychoactive Drugs*, *43*(4), 282–290. https://doi.org/10.1080/02791072.2011.628913
37. Sotero, M. (2009, February 27). A conceptual model of historical trauma: Implications for public health practice and research. SSRN. Retrieved December 6, 2022, from https://papers.ssrn.com/sol3/papers.cfm?abstract_id=1350062
38. Walters, K. L., & Simoni, J. M. (2002). Reconceptualizing native Women's Health: An “Indigenist” stress-coping model. *American Journal of Public Health*, 92(4), 520–524. https://doi.org/10.2105/ajph.92.4.520
39. Walters, K. L.; Simoni, J. M.; Evans-Campbell, T. (2002). Substance Use Among American Indians and Alaska Natives: Incorporating Culture in an “Indigenist” Stress-Coping Paradigm. *Public Health Reports*, 117(1), 104-117
40. (Walters, Zimmerman)
41. Juster, R.-P., McEwen, B. S., & Lupien, S. J. (2010). Allostatic load biomarkers of chronic stress and impact on health and cognition. Neuroscience & Biobehavioral Reviews, 35(1), 2–16. https://doi.org/10.1016/j.neubiorev.2009.10.002
42. Seeman, T. E., Burton H. Singer, PhD; John W. Rowe, MD; Ralph I. Horwitz, MD; Bruce S. McEwen, PhD (1997). Price of adaptation--allostatic load and its health consequences. MacArthur studies of Successful Aging. Archives of Internal Medicine, 157(19), 2259–2268. https://doi.org/10.1001/archinte.157.19.2259
43. Geronimus, A, (1996), Black/white differences in the relationship of maternal age to birthweight: A population-based test of the weathering hypothesis, Social Science & Medicine; 42:589-597
44. Walters, K. L., Mohammed, S. A., Evans-Campbell, T., Beltrán, R. E., Chae, D. H., & Duran, B. (2011). Bodies don't just tell stories, they tell histories. Du Bois Review: Social Science Research on Race, 8(1), 179–189. https://doi.org/10.1017/s1742058x1100018x
45. Klengel, T., Dias, B. & Ressler, K. Models of Intergenerational and Transgenerational Transmission of Risk for Psychopathology in Mice. *Neuropsychopharmacol* **41**, 219–231 (2016). https://doi.org/10.1038/npp.2015.249
46. Lovett, R. (2022) IINRS. Presentation

Chapter 4: Relationship Between Indigenous Women's Level of Allostatic Load and High Blood Pressure During Pregnancy; A Secondary Analysis of The Strong Heart Study

Abstract

Background: In the United States, Indigenous women are disproportionately impacted by maternal health disparities, such as high blood pressure during pregnancy resulting in hypertensive disorders of pregnancy (HDP)[1-4]. Indigenous women experience settler colonialism through acts of elimination and modes such as acculturation (i.e., loss of language and/or cultural traditions)[2,3,4]. The structure of colonialism (e.g., ongoing colonial oppression, racism) leads to exogenous psychological stressors that can be embodied and affect allostatic load (AL), a physiological measure of cumulative stress on the body. AL and acculturation are related to general hypertension across diverse populations[5]. AL may provide a biological explanation for the development of high blood pressure and HDP among pregnant Indigenous women, as a result of increased cumulative stress from settler colonial stressors. However, our understanding of the relationships among HDP, AL, and cultural factors in Indigenous women is limited.

Objective: The purpose of this study was to investigate relationships among HDP, AL, and cultural factors.

Methods: A secondary analysis of Strong Heart Study (SHS) phase IV data was completed to examine relationships among high blood pressure during pregnancy, AL, acculturation, and enculturation. This study analyzed quantitative, retrospective, cross-sectional, cohort data from Indigenous women with high blood pressure during pregnancy (n=65) across 13 tribal nations throughout the U.S. Clinical laboratory reference ranges were used to dichotomize AL variables and calculate a composite score. Questions from the Cultural Factors Questionnaire were used to create a measure of enculturation and acculturation. Descriptive statistics, t-tests, and Kruskall-Wallis Test, and point-biserial correlation were used to explore relationships between high blood pressure during pregnancy, AL, enculturation, and acculturation.

Results: There were significant differences in measures of AL among HTN categories, with moderate effect sizes demonstrated. Significant differences were documented between HTN categories and enculturation/acculturation, with small effect sizes noted. Significant relationship between enculturation and measures of allostatic load were also identified.

Conclusion: Additional research is needed to investigate the relationships among high blood pressure during pregnancy, AL, and cultural factors.

Chapter 4

Introduction

Indigenous women die from hypertensive disorders of pregnancy (HDP) at twice the rate of non-Hispanic White (NHW) women in the United States (12.8% vs. 6.7%)[10]. Poor HDP-related health outcomes include increased risk of placental abruption with possible disseminated intravascular coagulation, end-organ damage, stroke, chronic hypertension, and cardiovascular disease (CVD), including ischemic heart disease and death[11,12]. HDP that continues into the postpartum period also results in an increased risk of hypertensive crisis and stroke[11,12]. HDP thus increases the risk of postpartum hospital readmission and future cardio/cerebrovascular disease[11,12]. However, risk factors for HDP in Indigenous women are not well understood.

HDP and Allostatic Load (AL)

Many factors increase the risk of developing hypertension, including increased stress exposure[10]. Indigenous women are at increased risk of experiencing high stress exposure resulting from settler colonialism, which refers to policies and tactics that aim to dispossess Indigenous peoples of their territories, suppress Indigenous rights and cultures, and create the illusion that the violence of colonialism is necessary or morally legitimate[13]. Embodiment of settler colonialism activates an ongoing stress response, which can lead to high AL. Biological measures of AL reflect the cumulative effect of stress on the body in the context of individuals' social and physical environments, lived experiences, and genetics. Viewed with an embodied and Indigenous-centered lens, AL provides a biological index of how chronic, cumulative, discriminatory, and power-based societal contexts, such as settler colonialism, generate chronic stress that can lead to adverse outcomes, such as accelerated aging and earlier disease onset. In older adults, high AL predicts future morbidity, mortality, chronic disease, and physical and cognitive function[14], and high AL in non-pregnant individuals is also associated with

hypertension[15-16]. However, limited studies have examined whether high AL contributes to disparate rates of maternal mortality and morbidity in Indigenous women, including HDP.

HDP, AL and cultural factors

Most Indigenous women residing in the United States experience significant chronic stress exposure due to colonization and settler colonialism, which can lead to acculturation[17]. Acculturation is the cultural and psychological process that occurs "when groups or individuals of different cultures come into contact, whether continuous or intermittent, firsthand or indirect with subsequent changes in the original culture patterns of one or more parties" [18]. Involuntary acculturation due to forced colonization may include loss of place/land, inability to receive traditional medical practices, and loss of language and culture, leading to acculturative stress. While Indigenous peoples have diverse cultures, languages, landscapes, health systems, political rights, and relationships with governing bodies surrounding their territories, U.S. settler colonialism leads to acculturative stress, which can lead to changes in health, health behaviors, beliefs, and values. These alterations can result in disparities and inequities in morbidity and mortality, including elevated risk for HDP[19].

However, despite centuries of settler colonial suppression of Indigenous cultures, Indigenous peoples also experience enculturation. In contrast to acculturation, enculturation is the process of learning about and identifying with one's ethnic culture.[20] Indigenous peoples experience enculturation by maintaining ties to their communities, languages, and lands as a form of survivance. Indigenous cultural practices are diverse actions or activities that are based on Indigenous values, knowledge, tradition, spirituality, identity, and language.[20] This knowledge and identity create pride in cultural heritage and participation in traditional cultural activities. Enculturation can buffer assaults from acculturation[20], such as the embodiment of settler colonialism and its impact on maternal health disparities. Yet, the damaging and suppressive collective acts rooted in settler colonialism limit access to cultural factors, making it more difficult to experience enculturation.

Study Purpose & Hypotheses

Despite the increased risk of HDP and death in Indigenous women, few studies have investigated the potential negative physical health effects of settler colonialism. The primary objective of this study is to examine the relationship between high blood pressure during pregnancy and cumulative AL. The central hypothesis for this study posits that Indigenous women in the US who had high blood pressure in pregnancy are more likely to have high AL than those who did not have any diagnosis of hypertension. We also hypothesized that women who had high blood pressure during pregnancy and those with general hypertension (i.e. not related to pregnancy) would have similar findings. Furthermore, we hypothesized that the maintenance of Indigenous culture via enculturation may mitigate the risk for HDP and increased AL.

Specific Aims: This secondary analysis of the Strong Heart Study dataset had the following aims:

Aim 1: Compare AL between women who had HDP, women who did not have a diagnosis of any hypertensive disorder, and women who had general HTN.

Aim 2: Compare access to traditional values/cultures and native lifestyle between women who had HDP, women who did not have a diagnosis of any hypertensive disorder, and women who had general HTN.

Aim 3: Describe the relationship between having access to traditional values/cultures and native lifestyle and AL among all women who had HDP, women who did not have a diagnosis of any hypertensive disorder, and women who had general HTN.

Methods

Research Design: This analysis examined the relationship between high blood pressure during pregnancy and AL using a quantitative, retrospective, cross-sectional, cohort

approach. We completed a secondary analysis of data from the phase IV Strong Heart Study (SHS)[21]. The SHS, a population-based longitudinal study of prevalent and incident cardiovascular disease in Indigenous peoples, has been previously described in detail[21]. In brief, the SHS invited members of 13 American Indigenous tribes in Arizona, North and South Dakota, and Oklahoma to participate in serial evaluations, including personal interviews, physical examinations, and ascertainment of cardiovascular disease.

Participants: The sample for this secondary analysis is a subset of Phase IV of the SHS. The Phase IV Exam continued and expanded the Family Study initiated in Phase III. Phase IV recruited an additional 2700 individuals across 64 families. When combined with the pilot family study from Phase III, the Phase IV family study includes 3,776 individuals from 94 families. Of these, 2741 were women, of whom 65 were diagnosed with high blood pressure during pregnancy and 810 were diagnosed with general hypertension occurring outside pregnancy. Data for this study included medical records confirming the diagnosis of hypertension and HDP, and laboratory tests and physical exam data that provided measures of AL. Participants provided fasting serum samples and had a single physical examination including anthropometric measures (height, weight, waist circumference, hip circumference), and blood pressure (diastolic and systolic). Women self-reported race, income, and education, and completed a cultural factors questionnaire that measured acculturation and enculturation. All measures that had variables missing at greater than 10% were removed.

Measures

Hypertensive Disorders of Pregnancy: High blood pressure during pregnancy (HDP) was measured on the SHS reproductive health questionnaire. Subjects were asked to indicate (yes/no) if they had any of a set of diagnoses or indicators of high blood pressure during pregnancy. These included: “high blood pressure only during pregnancy,” and reports of Gestational Hypertension, Preeclampsia, Superimposed Preeclampsia with Chronic

Hypertension, Chronic Hypertension (diagnosed between 1-20 weeks of pregnancy), Eclampsia, or H.E.L.L.P.

Allostatic load: Based on prior studies[6-8,22], an AL index was calculated using 18 biomarkers that are primary and secondary mediators of the cardiovascular, inflammatory, and metabolic systems (Table 1). Results for each biomarker were converted from continuous to binary variables. Dichotomization was based on clinical reference ranges from the laboratory performing the analyses. Values within or lower than reference ranges were coded as 0, and values higher than reference ranges were coded as 1, except for HDL, which was reverse-coded. The dichotomous variables were summed within each physiological system to create scores for each system. The 18 individual biomarker scores were then summed to create a total AL score of 0-18, with higher scores indicating higher AL. Studies show that those scoring over a 3-4 for total AL, calculated using this approach, have higher AL.[23]

Table 1	Cardiovascular System (Range, 0-6)	Inflammatory System (Range, 0-4)	Metabolic System (Range, 0-8)
Primary AL Mediators	Total Cholesterol Total Triglyceride HDL Cholesterol	Fibrinogen High-sensitivity CRP Interleukin 6 (IL6) Insulin	LDL Cholesterol Albumin Apo AI Apo B Fasting Glucose Creatinine for eGFR
Secondary AL Mediators	SBP DBP Pulse Pressure		BMI Waist-to-hip ratio

Cultural Factors (Enculturation and Acculturation): The cultural factors questionnaire has seven questions related to culture in two categories a) traditional values/cultures, and b) native lifestyle (Table 2).

Table 2 **Traditional values/cultures**	 **Native Lifestyle**

How well do you understand your Indian language?	How much do you identify yourself with your own tribal tradition?
Can you speak your native language?	How much do you identify yourself with non-Indian culture?
How often do you speak your native language?	How comfortable do you feel in your own tribal tradition?
	How comfortable do you feel in the non-Indian culture?

Questions were recategorized to reflect processes of acculturation and enculturation (Table 3)[26]. Two questions were removed for high amounts of missing data. These were "Can you speak your native language?" (28% missing), and "How often do you speak your native language?" (58% missing). Likert scale responses were converted to a factor score, a numerical value representing each respondent's exposure to acculturation and enculturation. To achieve this, text-based Likert scale responses were converted to numerical values (Table 3). Values for the questions in each category were summed to generate a total score for each cultural factor for each participant. The total scale scores are continuous measures, with higher scores reflecting higher levels of acculturation and enculturation[24].

Table 3 **Enculturation Range = 0-9**	 **Acculturation Range=0-6**
How well do you understand your Indian language? 0=None, 1=Little, 2=Almost All, 3=All	How comfortable do you feel in the non-Indian culture? 0=None, 1=Little, 2=Some, 3=A lot
How much do you identify yourself with your own tribal tradition? 0=N/A, 1=Little, 2=Some, 3=A lot	How much do you identify yourself with non-Indian culture? 0=None, 1=Little, 2=Some, 3=A lot
How comfortable do you feel in your own tribal tradition? 0=N/A, 1=Little, 2=Some, 3=A lot	

Statistical Analysis

Statistical analyses were conducted using SPSS version 29 software. Data were inspected for outliers and anomalous data entries. Outliers and missing data were removed and testing for assumptions of normality and equal variances was completed. Descriptive statistics were used to summarize demographic variables, including age, education, and household income. Kruskal-Wallis (non-parametric) and independent sample t-tests were performed to detect differences in means between groups. Point biserial correlation analysis was used to identify effect sizes. To avoid biased or misleading interactions due to the potential nonlinearity of HTN and Cardiovascular AL we re-ran the model using SBP and DBP as measures of HTN, instead of the categorical variable for HTN, but the results did not differ.

Appendix 1 provides the distribution curves for the Kruskal-Wallis test variables.

Results

The sample included data from 2290 women across the 3 groups: those with HDP (n=65, 3%), those with general HTN (n=531, 23%), and those without any hypertension-related diagnosis (n=1694, 74%). Age and income were similar across all groups. The mean amount of education across all groups was 12 years (Table 4).

Table 4 Demographics

Variable	HDP n=65	cHTN n=552	No HTN n=1714
	Mean (sd)	Mean (sd)	Mean (sd)
Age	33.8 (10.3)	43.4 (11.3)	33.4 (12.6)
Education	12.5 (2.2)	12.53 (2.2)	12.2 (2.2)
	%	%	%
Household income meets needs	60%	72%	76%
Annual income < $50/year	72%	80%	68%

Aim 1 results: Mean AL scores were higher among those with chronic HTN, followed by those with HDP, and those with no HTN (table 5). Tables 6-9 document the differences between HTN category and AL subscales and total AL. Significant differences were noted between women with HDP and chronic HTN and women with chronic HTN and no HTN in total AL, cardiovascular AL, and metabolic AL. The overall models were significant for total AL (*H*=284.817, *P*=<0.001), inflammatory AL (*H*=54.084, *P*=<0.001), cardiovascular AL (*H*=315.073, *P*=<0.001), and metabolic AL (*H*=214.960, *P*=<0.001). HDP and cardiovascular AL, metabolic AL, and total AL, were negatively correlated (all p<0.01), indicating that those with HDP had lower AL scores (Table 10).

Table 5 AL means by hypertension category

Variable	HDP Mean (sd)	cHTN Mean (sd)	No HTN Mean (sd)
Inflammatory	2.22 (0.49)	2.26 (0.51)	2.12 (0.48)
Cardiovascular	2.32 (1.25)	3.73 (1.36)	2.60 (1.48)
Metabolic	2.59 (0.93)	3.35 (1.02)	2.54 (1.29)
Total Allostatic Load	7.24 (2.02)	9.32 (2.16)	7.35 (2.55)

Table 6: Pairwise comparisons of hypertension category: total allostatic load

Category comparison	Test statistic	Standard error	Significance	Adjusted significance
HDP/no HTN	78.627	89.142	0.378	1.000
HDP/c HTN	581.714	91.030	<0.001	0.000
no HTN/c HTN	503.087	30.189	<0.001	0.000

Table 7: Pairwise comparisons of hypertension category: inflammatory allostatic load

Category comparison	Test statistic	Standard error	Significance	Adjusted significance
HDP/no HTN	-110.987	69.858	0.112	0.336
HDP/c HTN	60.319	71.320	0.398	1.000
no HTN/c HTN	171.306	23.443	<0.001	0.000

Table 8: Pairwise comparisons of hypertension category: cardiovascular allostatic load

Category comparison	Test statistic	Standard error	Significance	Adjusted significance
HDP/no HTN	175.823	96.269	0.068	0.203
HDP/c HTN	737.126	98.351	<0.001	0.000
no HTN/c HTN	561.303	32.305	<0.001	0.000

Table 9: Pairwise comparisons of hypertension category: metabolic allostatic load

Category comparison	Test statistic	Standard error	Significance	Adjusted significance
HDP/no HTN	53.470	93.520	0.567	1.000
HDP/c HTN	509.004	95.534	<0.001	0.000
no HTN/c HTN	455.534	31.387	<0.001	0.000

Table 10 AL magnitude of effects

Allostatic Load factor	Correlation (significance)
Inflammatory *(n=554)*	-0.022 (ns)
Cardiovascular *(n=613)*	-0.308 (0.000)
Metabolic *(n=596)*	-0.226 (0.000)
Total *(n=538)*	-0.289 (0.000)

Aim 2 results: Mean enculturation and acculturation scores were highest among those women with chronic HTN and lowest among those women with HDP (Table 11). Kruskus-Wallis tests revealed overall significant models for both enculturation (*H*= 50.017, *P*=<0.001) and acculturation (*H*=17.254, *P*=<0.001). Significant differences were noted between women with HDP and chronic HTN and women with chronic HTN and no HTN in both enculturation and acculturation (Table 12-13). Enculturation and acculturation were negatively correlated with (Table 14).

Table 11 Enculturation and acculturation means by hypertension category

Variable	HDP	cHTN	No HTN

	Mean (sd)	Mean (sd)	Mean (sd)
Enculturation	7.89 (1.99)	8.62 (1.96)	8.19 (1.90)
Acculturation	5.32 (1.79)	5.76 (1.63)	5.61 (1.66)

Table 12: Pairwise comparisons of hypertension category: enculturation

Category comparison	Test statistic	Standard error	Significance	Adjusted significance
HDP/no HTN	157.915	96.751	0.103	0.308
HDP/c HTN	374.516	98.897	<0.001	0.000
no HTN/c HTN	216.601	32.414	<0.001	0.000

Table 13: Pairwise comparisons of hypertension category: acculturation

Category comparison	Test statistic	Standard error	Significance	Adjusted significance
HDP/no HTN	145.213	95.812	0.130	0.389
HDP/c HTN	263.792	97.932	0.007	0.021
no HTN/c HTN	118.579	32.090	<0.001	0.001

Table 14 Enculturation and acculturation magnitude of effects

Culture factor	Correlation (significance)
Enculturation *(n=601)*	-0.114 (0.005)
Acculturation *(n=602)*	-0.082 (0.044)

Aim 3 Results: There were significant correlations between AL and measures of culture. Enculturation was positively correlated with all AL subscales and total AL, while acculturation was positively correlated with cardiovascular AL, metabolic AL, and total AL (Table 15).

Table 15 Correlations between AL and enculturation/acculturation

Allostatic Load Factor	Enculturation (n=2280) Correlation (significance)	Acculturation (n=2280) Correlation (significance)
Inflammatory	0.035 (ns)	-0.013 (ns)
Cardiovascular	0.073 (0.001)	0.035 (ns)

Metabolic	0.138 (0.000)	0.012 (ns)
Total	0.108 (0.000)	0.030 (ns)

Discussion

This secondary analysis was the first to explore the relationships among high blood pressure during pregnancy, AL, acculturation, and enculturation in Indigenous women. This analysis was also the first to examine quantitative measures of concepts from the SCDoIH model. Findings showed that there were significant differences in measures of AL between individuals with general HTN and those with HDP. Individuals with HTN had significantly higher measures of cardiovascular AL, metabolic AL, and total AL. Contrary to our hypothesis, there were no significant differences between those with HDP and those without any diagnosis of HTN. One potential explanation for this finding is that measurement of AL occurred *after* women in this study were pregnant, so the measures for AL do not reflect AL at the time of pregnancy. Another potential explanation for our findings is that those with HDP who did not transition into having general hypertension may have had lower levels of AL than the cohort who did develop chronic hypertension. However, we were unable to examine this possibility, because the dataset does not identify women who had HDP and then transitioned into having general hypertension. Persistent HTN for a prolonged period of time may also lead to more wear and tear on the body. Mean AL scores were highest for the cardiovascular and metabolic AL scales between those with HTN, those without hypertension, and those with HDP. However, the mean total AL score in all three groups ranged from 7.24-9.26. Previous studies using the same formula for AL scores reported that total AL scores of 3 or 4 were associated with differences in morbidity and mortality.[23] The mean total AL scores for all 3 groups of women in this analysis indicate that they had high total AL, regardless of whether they developed general HTN or HDP. This supports that further investigations in partnership with Indigenous communities should be done

to better understand Indigenous women's embodiment to exposures to stress and the impact on AL.

Significant differences were also found for acculturation and enculturation when comparing women with HTN and those with HDP. Those with HTN were more acculturated, which aligns with findings from prior studies[25]. Alternatively, since scores of acculturation are less in those with HDP, this could also mean that individuals with HDP are more affected by factors of acculturation than individuals with general hypertension. Those with general HTN are also more enculturated than those with HDP. Lower scores for enculturation in women with HDP should be explored. Enculturation has been found to improve resilience to stress exposures, but to our knowledge, this is the first study to explore relationships between HDP and enculturation. Participating in traditional Indigenous culture may provide a buffer to the development of HDP, yet this analysis showed the opposite. Other factors that have not been accounted for may have impacted these findings. Alternatively, enculturation may be a buffer to the development of HDP but not general hypertension, and those with general HTN may develop high blood pressure despite their level of enculturation. There are significant correlations between AL and cultural factors. Enculturation shows a significant relationship with all systems of AL and total AL, which has not been previously documented. This may imply that those who are more enculturated carry a burden of stress related to practicing culture outside of the dominant culture. Acculturation has significant relationships with cardiovascular AL, metabolic AL, and total AL, which supports prior findings[25-26]. Other variables may be affecting this relationship such as depression. Further exploration is needed that includes a mediation analysis of the CES-D scores.

In the long term, this analysis informs our understanding of factors that may contribute to high blood pressure during pregnancy and AL among Indigenous women. The findings may also help to expose and deconstruct the harmful societal settler colonial constructs resulting in

chronic stressors and experiences of settler colonialism that have a negative impact on health outcomes.

These findings also provide a foundation for future prospective studies to examine AL before pregnancy or when women find out they are pregnant, then examine whether AL differs between those who do and do not develop high blood pressure during pregnancy. Such analyses will provide tribal communities with a better understanding of whether factors resulting from settler colonialism and historical and cultural trauma may increase the burden of disease. These findings will also inform future studies exploring whether standard biological measures of chronic stress (i.e., AL) demonstrate a relationship with the embodiment of settler colonial-induced stress among Indigenous women, and whether further investigation is needed. These studies could help identify contributors to disparities in morbidity and mortality between Indigenous peoples and members of majority groups, as well as some of the mitigating causes. More research needs to be directed toward identifying the potential pathways for high blood pressure during pregnancy. When multiple pathways leading to HDP are more clearly understood, effective identification and interventions can be developed to reduce the occurrence of HDP.

Limitations

Although this analysis had novel findings, there are limitations to this study. First, this study was exploratory and did not employ a power analysis. Second, due to data limitations, AL in this study does not include neuroendocrine biomarkers or hemoglobin A1c. Third, missing data were noted across several variables (enculturation questions; “Can you speak your native language?”, “How often do you speak your native language?”, Hgb A1C), which required deletion of those variables, possibly decreasing sensitivity of the measures. Fourth, participants gave birth up to several years before the measurement of the AL biomarkers. Therefore, the AL index may reflect the continuing effects of physiological changes after the onset of high blood

pressure during pregnancy. However, understanding the relationship between high blood pressure during pregnancy and the cumulative level of AL will provide a foundation for research on the risk factors Indigenous women in the United States experience and their association with health outcomes. Future prospective studies that measure AL before pregnancy will support analyses of potential relationships between high cumulative stress, measured using biomarkers of AL, and HDP, in order to address the limitations of this secondary analysis.

Conclusion

This study further develops nursing knowledge on HDP and AL in Indigenous women. It provides new insight into the relationships among HDP, AL, and enculturation. Of particular interest is identifying culture as a clinically significant buffer to development of high blood pressure.

References

1.Petersen EE, Davis NL, Goodman D, et al. Vital Signs: Pregnancy-Related Deaths, United States, 2011–2015, and Strategies for Prevention, 13 States, 2013–2017. MMWR Morb Mortal Wkly Rep 2019;68:423–429. DOI: http://dx.doi.org/10.15585/mmwr.mm6818e1

2.J. Phillip Gingrey, "Maternal Mortality: A US Public Health Crisis", American Journal of Public Health 110, no. 4 (April 1, 2020): pp. 462-464

3.Hampton, M., Bourassa, C., Mckay-Mcnab, K. (2004). Racism, Sexism and Colonialism (1st ed., Vol. 24). Canadian woman studies

4.Spruill T. M. (2010). Chronic psychosocial stress and hypertension. Current hypertension reports, 12(1), 10–16. https://doi.org/10.1007/s11906-009-0084-8

5.D'Alonzo KT, Munet-Vilaro F, Carmody DP, Guarnaccia PJ, Linn AM, Garsman L. Acculturation stress and allostatic load among Mexican immigrant women. Rev Lat Am Enfermagem. 2019 Apr 29;27:e3135. doi: 10.1590/1518-8345.2578.3135. PMID: 31038629; PMCID: PMC6528633.

6.Juster, R. P., Bizik, G., Picard, M., Arsenault-Lapierre, G., Sindi, S., Trepanier, L., ... & Lupien, S. J. (2011). A transdisciplinary perspective of chronic stress in relation to psychopathology throughout life span development.

7.Juster, R. P., McEwen, B. S., & Lupien, S. J. (2010). Allostatic load biomarkers of chronic stress and impact on health and cognition. Neuroscience & Biobehavioral Reviews, 35(1), 2-16

8.Riggan, K. A., Gilbert, A., & Allyse, M. A. (2021). Acknowledging and addressing allostatic load in pregnancy care. Journal of racial and ethnic health disparities, 8(1), 69-79.

9.Snelgrove, C., Dhamoon, R., & Corntassel, J. (n.d.). Unsettling settler colonialism: The discourse and politics of settlers, and solidarity with Indigenous Nations. Decolonization: Indigeneity, Education & Society. Retrieved December 6, 2022, from https://jps.library.utoronto.ca/index.php/des/article/view/21166

10.Bent-Goodley, T. B. (2007). Health Disparities and Violence Against Women. *Trauma, Violence, & Abuse*, *8*(2), 90–104. https://doi.org/10.1177/1524838007301160

11.J. Phillip Gingrey, "Maternal Mortality: A US Public Health Crisis", *American Journal of Public Health* 110, no. 4 (April 1, 2020): pp. 462-464.

12.Johnson, J. D., & Louis, J. M. (2020). Does race or ethnicity play a role in the origin, pathophysiology, and outcomes of preeclampsia? An expert review of the literature. American Journal of Obstetrics and Gynecology. https://doi.org/10.1016/j.ajog.2020.07.038

13.Wispelwey B, Tanous O, Asi Y, Hammoudeh W, Mills D. Because its power remains naturalized: introducing the settler colonial determinants of health. Front Public Health. 2023 Jul 11;11:1137428. doi: 10.3389/fpubh.2023.1137428. PMID: 37533522; PMCID: PMC10393129.

14. Seeman, T. E., McEwen, B. S., Rowe, J. W., & Singer, B. H. (2013). Allostatic load as a marker of cumulative biological risk: MacArthur studies of successful aging. In *Stress and the Brain* (pp. 198-203). Routledge.

15. Porcelli P, Laera D, Mastrangelo D, Di Masi A. Prevalence of allostatic overload syndrome in patients with chronic cardiovascular disease. Psychother Psychosom. 2012;81(6):375–7.

16. Jenny Guidi, Marcella Lucente, Nicoletta Sonino, Giovanni A. Fava; Allostatic Load and Its Impact on Health: A Systematic Review. Psychother Psychosom 15 December 2020; 90 (1): 11–27. https://doi.org/10.1159/000510696

17. Gone JP. Redressing First Nations historical trauma: Theorizing mechanisms for indigenous culture as mental health treatment. Transcultural Psychiatry. 2013;50(5):683-706. doi:10.1177/1363461513487669
18. Ferguson, G. M., Causadias, J., & Simenec, T. (in press). Acculturation and psychopathology. Annual Review of Clinical Psychology. 19.
20. Zimmerman, M.A., Ramirez-Valles, J., Washienko, K.M., Walter, B. and Dyer, S. (1996), The development of a measure of enculturation for Native American youth. American Journal of Community Psychology, 24: 295-310. https://doi.org/10.1007/BF02510403
21. Strong Heart Study - Center for American Indian Health Research - College of Public Health. (n.d.). Retrieved December 15, 2022, from https://strongheartstudy.org/Research/Research-Overview
22. Carbone JT, Clift J, Alexander N. Measuring allostatic load: Approaches and limitations to algorithm creation. J Psychosom Res. 2022 Dec;163:111050. doi: 10.1016/j.jpsychores.2022.111050. Epub 2022 Oct 3. PMID: 36228435.
23.Geronimus AT, Hicken M, Keene D, Bound J. "Weathering" and age patterns of allostatic load scores among blacks and whites in the United States. Am J Public Health. 2006 May;96(5):826-33. doi: 10.2105/AJPH.2004.060749. Epub 2005 Dec 27. PMID: 16380565; PMCID: PMC1470581.
24.Zimmerman MA, Ramirez-Valles J, Washienko KM, Walter B, Dyer S. The development of a measure of enculturation for Native American youth. Am J Community Psychol. 1996 Apr;24(2):295-310. doi: 10.1007/BF02510403. PMID: 8795263.
25. Cedillo, Y. E. (2019). Significance Of Acculturation, Assimilation, And Allostatic Load As Risk Factors For Obesity Among Hispanics.
26. Logan, J. G., & Barksdale, D. J. (2008). Allostasis and allostatic load: expanding the discourse on stress and cardiovascular disease. *Journal of clinical nursing*, *17*(7b), 201-208.

Chapter 5: Discussion

Chapter 5

Introduction

An initial review of the literature indicated that research related to settler colonialism and health is nascent. This dissertation provides a meaningful contribution to how the structure of settler colonialism in the United States has relationships to structural and systemic inequities, racism, and deleterious health outcomes of Indigenous peoples while highlighting protective factors that buffer these assaults. This was achieved by deepening the knowledge of settler colonialism. This dissertation helps to move the conceptualization of settler colonialism beyond mere erasure and omission to instead see settler colonialism in the more particular ways in which it transforms institutions, livelihoods, health, and identity.

Summary of Literature Gaps

This dissertation addresses several considerable gaps in the literature related to critical settler colonial knowledge, identification of settler colonial determinants of Indigenous health, and the potential pathways and processes of embodiment of settler colonialism. There has not been a theoretical or conceptual framework of settler colonialism to guide nursing scholarship. This gap was addressed by creating the settler colonial determinants of Indigenous health framework.

In Study 1, the scoping review introduced the first settler colonial determinants of Indigenous health (SCDoIH) framework. This framework is not meant to decontextualize the many different experiences of settler colonialism that Indigenous people may experience but instead be used to conceptualize and operationalize salient and unique factors impacting the health of Indigenous peoples. The framework presents settler colonialism as an emerging interest in nursing. The framework further encourages the nursing discipline to include settler colonialism as a research, education, and practice priority, and for nurses to learn how to implement settler harm reduction strategies such as trauma-informed care and cultural safety, to enhance well-being by delivering Indigenous-focused care.

In Study 2, the scoping review further describes the pathways and processes of the embodiment of historical trauma secondary to settler colonialism which has previously been limited in the literature. The results of this literature review subsequently provide evidence that settler colonialism leads to experiences of historical trauma, creating stress exposures unique to Indigenous peoples. This review identified that Indigenous women in particular are at risk for experiencing the effects of settler colonialism. The review provides support that the embodiment of settler colonialism may be related to emotional responses resulting from trauma. The review additionally highlights that traditional cultural practices may buffer psychosocial assaults from settler colonialism.

Study 3 was the first study to use the settler colonial determinants of Indigenous health framework to guide the research design. The study analyzes culture as a settler colonial determinant of Indigenous health. Analyses examined relationships among hypertensive disorders of pregnancy, allostatic load, and factors of culture. Despite the increased risk of HDP and death in Indigenous women, to my knowledge, no one has investigated how trauma exposures leading to the embodiment of chronic stress exposures from settler colonialism may result in HDP from high cumulative stress among Indigenous women.

The study provides novel findings. First, there were significant differences in measures of AL between individuals with HTN and those with HDP such that those with HTN have higher measures of AL. This could be due to more wear and tear on the body and provides support for additional research. HDP and cardiovascular AL, metabolic AL, total AL, acculturation, and enculturation were negatively correlated (all $p<0.01$), indicating that those with HDP had lower scores. Those with HTN are noted to be more acculturated, which supports prior studies. They are also noted to be more enculturated, which is counterintuitive to this study's hypothesis. This could imply that those who are more enculturated carry a burden of stress related to practicing

culture outside of the dominant culture, but further research is needed to explore this hypothesis.

Summary of Findings

Study 1. The first study was a literature review that identified six interconnected settler colonial pathways as the settler colonial determinants of Indigenous health. The six settler colonial determinants of Indigenous health include historical context, culture, land, political violence, settler colonial societal context, and environmental justice. The settler colonial determinants of Indigenous health form the basis of a conceptual framework that portrays how these determinants may lead to dysregulation of biological processes, subsequent biological changes, and negative health outcomes, through mechanisms such as epigenetic modifications and allostatic load. The framework fills a substantial gap in the conceptual and theoretical knowledge of the settler colonial determinants of Indigenous health and its impact on health. Of importance, the model also supports a strengths-based approach by encouraging the identification of factors of resilience and resistance and explicitly suggests nursing interventions to mediate and moderate Indigenous wellness and health with settler harm reduction tactics (cultural safety, trauma-informed care). Focused areas of the SCDoIH framework were used in studies 2 and 3.

Study 2. This study is a literature review that answered a call in the literature to advance the understanding of the impact of historical trauma on health outcomes.[3] This review subsequently investigated the embodiment of historical trauma through processes such as allostasis. The review identified that the embodiment of emotional responses resulting from chronic stressors or trauma may activate allostasis as a biological mechanism for the impact of the embodiment of historical trauma on health outcomes. It builds upon Study 1 that settler colonial determinants of Indigenous health should be examined when implications of Indigenous health are identified. Utilizing this approach with an Indigenous-centered lens illustrates how

discriminatory and powers-based societal contexts can lead to accelerated aging, adverse health outcomes, and earlier disease onset. This paper suggests that research in nursing should consider root-cause analyses of societal inequities when investigating Indigenous populations. Nurses would then have the contextual knowledge to be able to work toward policy reform and nursing interventions that would advance factors of social justice and employ settler harm reduction interventions.

Study 3. Given that the first two studies identified that women are affected by settler colonialism and disproportionate levels of hypertensive disorders of pregnancy, this third study examined relationships among high blood pressure during pregnancy, AL, acculturation, and enculturation of Indigenous women. Study 3 is a secondary analysis of data from the Strong Heart Study (SHS) phase IV and analyzed quantitative, retrospective, cross-sectional, cohort data from Indigenous women with high blood pressure during pregnancy (n=65) across 13 tribal nations throughout the U.S. The findings from this secondary analysis quantitatively operationalized settler colonial determinants of Indigenous health by measuring acculturation and enculturation. Findings were the first to explore the relationship between high blood pressure during pregnancy, AL, acculturation, and enculturation.

Findings showed that there were significant differences in measures of AL between individuals with HTN and those with HDP. Individuals with HTN have significantly higher measures of AL. Mean AL scores were highest for the cardiovascular and metabolic AL indices in those with HDP.

Additionally, there are significant correlations between AL and culture measures. Enculturation shows a significant positive relationship with all systems of AL and total AL which has not been previously documented and is counterintuitive to our hypothesis. Acculturation has significant positive relationships with cardiovascular AL, metabolic AL, and total AL which support prior findings.

These findings support the need for future research to investigate relationships between enculturation and hypertensive disorders. The findings further support the need to investigate the role of enculturation as a factor of resilience against allostasis given the counter-intuitive results.

Contribution of the Dissertation Research Study

The methodological and theoretical gaps related to the embodiment of settler colonialism have adverse consequences on Indigenous peoples. This dissertation fills a void in the literature. It illuminates settler colonialism as an insidious structure within all facets of Indigenous life. It further supports that exposure to settler colonialism has impacts on health beyond those from environmental exogenous hazards. Understanding settler colonialism in this light allows this dissertation to map important facets of how Indigenous people's health is impacted by settler colonialism, particularly the health of Indigenous women. In this conception of settler colonialism, nurses can identify the injustices that are rooted in systemic structures and have been operationalized in ways that privilege the dominant population. Nursing scholarship will benefit from this additional understanding and should work to partner with communities to perform and interpret Indigenous-centered research while also implementing settler harm reduction interventions to bedside care.

Limitations

This dissertation is affected by many limitations. First, because of the limited literature on settler colonial determinants of Indigenous health and the embodiment of settler colonialism, all three analyses are limited by the reliance on the interpretation of prior research, the hypothesis, and the SCDoIH conceptual framework introduced in Study 1. Second, as suggested throughout all three analyses, identifying domains of settler colonialism may decontextualize the often-interconnected experiences of settler colonialism to merely quantify outcomes. Doing so could work in opposition to decolonizing colonial knowledge structures and minimize the impact of these experiences. Third, the cross-sectional design limits the trustworthiness of the causality

between study variables and causality should not be inferred. Fourth, the biomarker measures of AL were taken after episodes of pregnancy which does not paint a clear picture of the subject's pre-pregnancy levels of AL that could potentially be impacting their pregnancy. Last, the framework was not done in consultation with Community participation and therefore gives a very limited view of Indigenous ways of knowing.

Future Directions

Future research is wide-ranging. My long-term career goal is to work towards the theory building of the settler colonial determinants of Indigenous health framework that was introduced within this dissertation. In the short term, there are multiple additional analyses that could be completed using the SHS dataset. Options include analyses of Life's Essential 8 measurements and HDP/HTN, breastfeeding and HDP/HTN, and an Epigenetic cohort analysis. Lastly, post hoc mediation analysis between the CES-D and HDP could be performed. Based on the findings of this dissertation and the desire to perform community-based research one potential future study is to partner with an Indigenous community to investigate protective factors of enculturation further such as language, food sovereignty/subsistence, etc., on allostatic load and/or HDP/HTN. Additionally, I aim to establish a research program that advances Indigenous women's health through community partnerships with Indigenous populations seeking to deconstruct settler colonial determinants of Indigenous health utilizing the SCDoIH framework. I also have plans to perform a validation study of the SCDoIH framework. Furthermore, I hope for the framework to be adopted by studies that advance the understanding and identification of acts (i.e., discriminatory policies, treaties not being upheld, etc.) resulting in settler colonial determinants of Indigenous health (e.g., historical context, culture, land, political violence, settler colonial societal context, and environmental justice). This dissertation does not encourage the proposed framework or findings to be used to further extract data "from" Indigenous peoples but instead to be used in partnership with Indigenous communities to help expose and deconstruct the harmful societal constructs present within colonized nations.

Conclusion

This dissertation research study fills a significant gap in the empirical literature by examining factors of settler colonialism and subsequent health outcomes. It clarifies settler colonialism as a concept affecting health and describes its impact on Indigenous peoples. Moreover, it explains the interrelationship and processes between settler colonial determinants of Indigenous health. To conclude, the findings are significant and contribute to advancing science related to Indigenous health equity. Moreover, findings are significantly important in informing the deconstruction of harmful settler colonial structures.

References

AHA, Heart disease and stroke statistics—2022 update: A report from the American Heart Association. (2022). Circulation, 146(10). Https://doi.org/10.1161/cir.0000000000001074

Alfred, GR. Wasa′se: indigenous pathways of action and freedom. Peterborough, Ont: Orchard Park, N.Y: Broadview Press (2005).

Arias E, Xu J, Jim MA. Period life tables for the non-Hispanic American Indian and Alaska Native population, 2007–2009. Am J Public Health 2014;104(Suppl 3):S312–9. 10.2105/AJPH.2013.301635 [PMC free article] [PubMed] [CrossRef] [Google Scholar]

Avalos, N. What Does It Mean to Heal From Historical Trauma? This is what I heard at Naicatchewenin": Disrupting embodied settler colonialism Volume 6 | Issue 1 Article 7, February 2021

Beltrán R;Schultz K;Fernandez AR;Walters KL;Duran B;Evans-Campbell T;, R. (n.d.). From ambivalence to revitalization: Negotiating cardiovascular health behaviors related to environmental and historical trauma in a northwest American Indian Community. American Indian and Alaska native mental health research (Online). Retrieved December 6, 2022, from https://pubmed.ncbi.nlm.nih.gov/29889950/

Bent-Goodley, T. B. (2007). Health Disparities and Violence Against Women. Trauma, Violence, & Abuse, 8(2), 90–104. https://doi.org/10.1177/1524838007301160

Bia Missing and Murdered Indigenous People Crisis | Indian Affairs (bia.gov)

Brave Heart MY. Wakiksuyapi: carrying the historical trauma of the Lakota. Tulane Stud Soc Welfare. 2000;21:245-266

Brave Heart, M. Y., Chase, J., Elkins, J., & Altschul, D. B. (2011). Historical trauma among indigenous peoples of the americas: Concepts, research, and clinical considerations. *Journal of Psychoactive Drugs*, *43*(4), 282–290. https://doi.org/10.1080/02791072.2011.628913

Brave Heart, M. Y. H. & DeBruyn, L. M. (1998). The American Indian Holocaust: Healing historical unresolved grief. American Indian and Alaska Native Mental Health Research, 8(2), 60–82.

Callison, C. Climate Change Communication and Indigenous Publics. Oxford Research Encyclopedia of Climate Science. Retrieved 13 Dec. 2022, from https://oxfordre.com/climatescience/view/10.1093/acrefore/9780190228620.001.

0001/acrefore-9780190228620-e-411.

Carbone JT, Clift J, Alexander N. Measuring allostatic load: Approaches and limitations to algorithm creation. J Psychosom Res. 2022 Dec;163:111050. doi: 1 0.1016/j.jpsychores.2022.111050. Epub 2022 Oct 3. PMID: 36228435.

Carson, B., Dunbar, T., Chenhall, R. D., & Bailie, R. (Eds.). (2020). Social determinants of Indigenous health. Routledge.

Cedillo, Y. E. (2019). Significance Of Acculturation, Assimilation, And Allostatic Load As Risk Factors For Obesity Among Hispanics.

Chandler, M. and C. Lalonde, Cultural Continuity as a Hedge Against Suicide in Canada's First Nations. Transcultural Psychiatry, 1998. 35(2): p. 191-219.

Chinn, P. L., & Falk-Rafael, A. (2018). Embracing the focus of the discipline of nursing: Critical caring pedagogy. Journal of Nursing Scholarship, 50(6), 687–694. https://doi.org/10.1111/jnu.12426

Cobb N, Espey D, King J. Health behaviors and risk factors among American Indians and Alaska Natives, 2000-2010. Am J Public Health 2014;104(Suppl 3):S481–9 . [PMC free article] [PubMed] [Google Scholar]

Conerly, Tonja R., Kathleen Holmes, Asha Lal Tamang Publisher/website: OpenStax Book title: Introduction to Sociology 3e

Czyzewski, K. (2011). Colonialism as a broader social determinant of health. International Indigenous Policy Journal, 2(1). https://doi.org/10.18584/iipj.2011.2.1.5

D'Alonzo KT, Munet-Vilaro F, Carmody DP, Guarnaccia PJ, Linn AM, Garsman L. Acculturation stress and allostatic load among Mexican immigrant women. Rev Lat Am Enfermagem. 2019 Apr 29;27:e3135. doi: 10.1590/1518-8345.2578.3135. PMID: 31038629; PMCID: PMC6528633

Evans-Campbell, T (2008).Historical Trauma in American Indian/Native Alaska Communities Teresa Evans-Campbell Journal of Interpersonal Violence 2008 23:3, 316-338

Feres José Mocayar Marón, León Ferder, Fernando Daniel Saraví & Walter Manucha (2019) Hypertension linked to allostatic load: from psychosocial stress to inflammation and mitochondrial dysfunction, Stress, 22:2, 169-181, DOI: 10.1080/10253890.2018.1542683

Ferguson, G. M., Causadias, J., & Simenec, T. (in press). Acculturation and psychopathology. Annual Review of Clinical Psychology. 19.

George, E. , Mackean, T. , Baum, F. , Fisher, M. (2019). Social Determinants of Indigenous Health and Indigenous Rights in Policy: A Scoping Review and Analysis of Problem Representation. Th e International Indigenous Policy Journal, 10(2) . DOI: 10.18584/iipj.2019.10.2.4\

Geronimus, A, (1996), Black/white differences in the relationship of maternal age to birthweight: A population-based test of the weathering hypothesis, Social Science & Medicine; 42:589-597

Geronimus AT, Hicken M, Keene D, Bound J. "Weathering" and age patterns of allostatic load scores among blacks and whites in the United States. Am J Public Health. 2006 May;96(5):826-33. doi: 10.2105/AJPH.2004.060749. Epub 2005 Dec 27. PMID: 16380565; PMCID: PMC1470581.

Gestational Hypertension and Preeclampsia: ACOG Practice Bulletin, Number 222. Obstetrics & Gynecology 135(6):p e237-e260, June 2020. | DOI: 10.1097/AOG.0000000000003891

Gingrey, P. J “Maternal Mortality: A US Public Health Crisis”, American Journal of Public Health 110, no. 4 (April 1, 2020): pp. 462-464

Glenn, E. N. (2015). Settler colonialism as structure. Sociology of Race and Ethnicity, 1(1), 52–72. https://doi.org/10.1177/2332649214560440

Gone JP. Redressing First Nations historical trauma: Theorizing mechanisms for indigenous culture as mental health treatment. Transcultural Psychiatry. 2013;50(5):683-706. doi:10.1177/1363461513487669

Guidi, J., Marcella Lucente, Nicoletta Sonino, Giovanni A. Fava; Allostatic Load and Its Impact on Health: A Systematic Review. Psychother Psychosom 15 December 2020; 90 (1): 11–27. https://doi.org/10.1159/000510696

Hampton, M., Bourassa, C., Mckay-Mcnab, K. (2004). Racism, Sexism and Colonialism (1st ed., Vol. 24). CANADIAN WOMAN STUDIES

Harvard. *Racism is a public health crisis*. News. (2021, June 17). Retrieved December 16, 2022, from https://www.hsph.harvard.edu/news/racism-is-a-public-health-crisis/

Haozous, E.A., Strickland, C.J., Palacios, J.F. and Solomon, T.G.A., 2014. Blood politics, ethnic identity, and racial misclassification among American Indians and Alaska Natives. Journal of environmental and public health, 2014.

Heck, J. L., Jones,E. J., Bohn,D., McCage,S., Goforth Parker,J., Parker,M., Pierce,S.L.,

and Campbell, J. Journal of Women's Health.Feb 2021.220-229.http://doi.org/10.1089/jwh.2020.8890

Jeong W, Jang SI, Park EC, Nam JY. The Effect of Socioeconomic Status on All-Cause Maternal Mortality: A Nationwide Population-Based Cohort Study. Int J Environ Res Public Health. 2020 Jun 26;17(12):4606. doi: 10.3390/ijerph17124606. PMID: 32604879; PMCID: PMC7345089.

Johnson, J. D., & Louis, J. M. (2020). Does race or ethnicity play a role in the origin, pathophysiology, and outcomes of preeclampsia? An expert review of the literature. American Journal of Obstetrics and Gynecology. https://doi.org/10.1016/j.ajog.2020.07.038

Juster, R. P., Bizik, G., Picard, M., Arsenault-Lapierre, G., Sindi, S., Trepanier, L., ... & Lupien, S. J. (2011). A transdisciplinary perspective of chronic stress in relation to psychopathology throughout life span development.

Juster, R. P., McEwen, B. S., & Lupien, S. J. (2010). Allostatic load biomarkers of chronic stress and impact on health and cognition. Neuroscience & Biobehavioral Reviews, 35(1), 2-16

Kim PJ (2019) Social determinants of health inequities in Indigenous Canadians through a life course approach to colonialism and the residential school system, Health Equity 3:1, 378–381, DOI: 10.1089/heq.

Klengel, T., Dias, B. & Ressler, K. Models of Intergenerational and Transgenerational Transmission of Risk for Psychopathology in Mice. Neuropsychopharmacol 41, 219–231 (2016). https://doi.org/10.1038/npp.2015.249

Krieger, N. Ecosocial theory, embodied truths, and the people’s health. New York, NY: Oxford University Press (2021).

Krieger, N. (2005). Embodiment: A conceptual glossary for Epidemiology. Journal of Epidemiology & Community Health, 59(5), 350–355. https://doi.org/10.1136/jech.2004.024562

Krieger N. Epidemiology and the web of causation: has anyone seen the spider? Soc Sci Med. 1994 Oct;39(7):887-903. doi: 10.1016/0277-9536(94)90202-x. PMID: 7992123.

Krieger, N. (2012). Methods for the scientific study of discrimination and health: An ecosocial approach. American Journal of Public Health, 102(5), 936–944. https://doi.org/10.2105/ajph.2011.300544

Laxmi S. Mehta, MD, FAHA, Chair, Garima Sharma, MD, Vice Chair, Andreea A.

Creanga, MD, PhD, Afshan B. Hameed, MD, Lisa M. Hollier, MD, Janay C. Johnson, MPH, Lisa Leffert, MD, Louise D. McCullough, MD, Mahasin S. Mujahid, PhD, MS, FAHA, Karol Watson, MD, FAHA, Courtney J. White, Esq, on behalf of the American Heart Association Advocacy Coordinating Committee, Call to Action: Maternal Health and Saving Mothers: A Policy Statement From the American Heart Association https://www.cdc.gov/reproductivehealth/maternal-mortality/pregnancy-mortality surveillance-system.htm#print

Logan, J. G., & Barksdale, D. J. (2008). Allostasis and allostatic load: expanding the discourse on stress and cardiovascular disease. *Journal of clinical nursing*, *17*(7b), 201-208.

Lovett, 2022. In the beginning it was our people's law. What makes us well; to never be sick. Cohort profile of Mayi Kuwayu: the National Study of Aboriginal and Torres Strait Islander Wellbeing [English title]Raymond Lovett Australian National University and AIATSIS

Lovett, R. (2022) IINRS. Presentation

Luebke, Jeneile Marie, "Intimate Partner Violence in the Lives of Urban Wisconsin American Indian Women- a Continuation of Colonial Injustice" (2020). Theses and Dissertations. 2554.https://dc.uwm.edu/etd/2554

Mbiydzenyuy Ngala Elvis, Hemmings Sian Megan Joanna, Qulu Lihle, Prenatal maternal stress and offspring aggressive behavior: Intergenerational and transgenerational inheritance, Frontiers in Behavioral Neuroscience, 16, 2022, URL=https://www.frontiersin.org/articles/10.3389/fnbeh.2022.977416 DOI=10.3389/fnbeh.2022.977416, ISSN=1662-5153

Mcguire, A(2021) This is what I heard at Naicatchewenin": Disrupting embodied settler colonialism Volume 6 | Issue 1 Article 7,

McEwen BS. Stress, adaptation, and disease. Allostasis and allostatic load. Ann N Y Acad Sci. 1998 May 1;840:33-44. doi: 10.1111/j.1749-6632.1998.tb09546.x. PMID: 9629234.

Michaels, Rousseau, and Yang, 2010.

National Child Traumatic Stress Network. (N.D).Families and Trauma | The National Child Traumatic Stress Network (nctsn.org)

National Indian Child Welfare Association in partnership with SAMHSA, (2014). Trauma-Informed Fact Sheet

Neuman, B. M., & Fawcett, J. (1989). The Neuman systems model (2nd ed.). Norwalk, CT: Appleton & Lange.

Noursi, S., et al. U.S. Department of Health and Human Services. (n.d.). ORWH leadership publishes article on intimate partner violence and maternal morbidity and mortality. National Institutes of Health. Retrieved December 10, 2022, from https://orwh.od.nih.gov/in-the-spotlight/all-articles/orwh-leadership-publishes-article-intimate-partner-violence-and

Orem, D. E., Taylor, S. G., & Renpenning, K. M. (1995). Nursing: Concepts of practice.,

Paradies, Y. Colonisation, racism and indigenous health. J Popul Res (Canberra). (2016) 33:83–96. doi: 10.1007/s12546-016-9159-yhttps://www.ncbi.nlm.nih.gov/pmc/articles/PMC6307350/

Petersen EE, Davis NL, Goodman D, et al. Vital Signs: Pregnancy-Related Deaths, United States, 2011–2015, and Strategies for Prevention, 13 States, 2013–2017. MMWR Morb Mortal Wkly Rep 2019;68:423–429. DOI: http://dx.doi.org/10.15585/mmwr.mm6818e1

Petersen, E. E., Davis, N. L., Goodman, D., Cox, S., Mayes, N., Johnston, E., Syverson, C., Seed, K., Shapiro-Mendoza, C. K., Callaghan, W. M., & Barfield, W. (2019). Vital Signs: Pregnancy-Related Deaths, United States, 2011-2015, and Strategies for Prevention, 13 States, 2013-2017. MMWR. Morbidity and mortality weekly report, 68(18), 423–429. https://doi.org/10.15585/mmwr.mm6818e1

Porcelli P, Laera D, Mastrangelo D, Di Masi A. Prevalence of allostatic overload syndrome in patients with chronic cardiovascular disease. Psychother Psychosom. 2012;81(6):375–7.

Prussing, E. (2014.). Historical trauma: Politics of a conceptual framework. Transcultural psychiatry. https://pubmed.ncbi.nlm.nih.gov/24787478/

Public Health Critical Race Praxis/Methodology, which specifically calls for this: Ford, C. L., & Airhihenbuwa, C. O. (2010). The public health critical race methodology: Praxis for antiracism research. Social Science & Medicine (1982), 71(8), 1390–1398. https://doi.org/10.1016/j.socscimed.2010.07.030

Riggan, K. A., Gilbert, A., & Allyse, M. A. (2021). Acknowledging and addressing allostatic load in pregnancy care. Journal of racial and ethnic health disparities, 8(1), 69-79.

Roy, C., Whetsell, M. V., & Frederickson, K. (2009). The Roy adaptation model and

research: Global perspective. Nursing science quarterly, 22(3), 209-211.

Seeman, T. E., Burton H. Singer, PhD; John W. Rowe, MD; Ralph I. Horwitz, MD; Bruce S. McEwen, PhD (1997). Price of adaptation--allostatic load and its health consequences. MacArthur studies of Successful Aging. Archives of Internal Medicine, 157(19), 2259–2268. https://doi.org/10.1001/archinte.157.19.2259

Seeman, T. E., McEwen, B. S., Rowe, J. W., & Singer, B. H. (2013). Allostatic load as a marker of cumulative biological risk: MacArthur studies of successful aging. In *Stress and the Brain* (pp. 198-203). Routledge.

Simpson, LB. Dancing on our turtle's back: stories of Nishnaabeg re-creation, resurgence and a new emergence. Winnipeg: Arbeiter Ring Pub (2011).

Snelgrove, C., Dhamoon, R., & Corntassel, J. (n.d.). Unsettling settler colonialism: The discourse and politics of settlers, and solidarity with Indigenous Nations. Decolonization: Indigeneity, Education & Society. Retrieved December 6, 2022, from https://jps.library.utoronto.ca/index.php/des/article/view/21166

Sotero, M. (2009, February 27). A conceptual model of historical trauma: Implications for public health practice and research. SSRN. Retrieved December 6, 2022, from https://papers.ssrn.com/sol3/papers.cfm?abstract_id=1350062

Spruill T. M. (2010). Chronic psychosocial stress and hypertension. Current hypertension reports, 12(1), 10–16. https://doi.org/10.1007/s11906-009-0084-8

Strong Heart Study - Center for American Indian Health Research - College of Public Health. (n.d.). Retrieved December 15, 2022, from https://strongheartstudy.org/Research/Research-Overview

Subica, A.M. and Link, B.G., 2022. Cultural trauma as a fundamental cause of health disparities. Social Science & Medicine, 292, p.114574.

Sucheki Front. Behav. Neurosci., 22 November 2021Sec. Individual and Social Behaviors https://doi.org/10.3389/fnbeh.2021.795312

Szanton, S. L., & Gill, J. M. (2010). Facilitating resilience using a society-to-cells framework: a theory of nursing essentials applied to research and practice. Advances in Nursing Science, 33(4), 329-343.

UNM.(N.D) https://extension.umn.edu/trauma-and-healing/historical-trauma-and-cultural-healing#sources-809760

Varagic, J., Desvigne-Nickens, P., Gamble-George, J., Hollier, L., Maric-Bilkan, C., Mitchell, M., … Redmond, N. (2020). Maternal Morbidity and Mortality: Are We Getting to the "Heart" of the Matter? Journal of

Women's Health. https://doi.org/10.1089/jwh.2020.8852

Vesna D. Garovic, MD, PhD, FAHA, Chair, Ralf Dechend, MD, Thomas Easterling, MD, S. Ananth Karumanchi, MD, Suzanne McMurtry Baird, DNP, RN, Laura A. Magee, MD, FRCPC, Sarosh Rana, MD, MPH, Jane V. Vermunt, MBChB, MSc, Phyllis August, MD, MPH, FAHA, Vice Chair, on behalf of the American Heart Association Council on Hypertension; Council on the Kidney in Cardiovascular Disease, Kidney in Heart Disease Science Committee; Council on Arteriosclerosis, Thrombosis and Vascular Biology; Council on Lifestyle and Cardiometabolic Health; Council on Peripheral Vascular Disease; and Stroke Council, Hypertension in Pregnancy: Diagnosis, Blood Pressure Goals, and Pharmacotherapy: A Scientific Statement From the American Heart Association

Walters, K. L., & Simoni, J. M. (2002). Reconceptualizing native Women's Health: An “Indigenist” stress-coping model. American Journal of Public Health, 92(4), 520–524. https://doi.org/10.2105/ajph.92.4.520

Walters, K. L.; Simoni, J. M.; Evans-Campbell, T. (2002). Substance Use Among American Indians and Alaska Natives: Incorporating Culture in an “Indigenist” Stress-Coping Paradigm. *Public Health Reports*, 117(1), 104-117

Walters, K. L., Mohammed, S. A., Evans-Campbell, T., Beltrán, R. E., Chae, D. H., & Duran, B. (2011). Bodies don't just tell stories, they tell histories. Du Bois Review: Social Science Research on Race, 8(1), 179–189. https://doi.org/10.1017/s1742058x1100018x

WALTERS, K. (n.d.). *Indigenous Perspectives in Survey Research*. Indigenous Perspectives in Survey Research | Ngā Pae o te Māramatanga Media Centre. Retrieved February 28, 2023, from http://mediacentre.dev.npmwebprd01.reign.co.nz/content/indigenous-perspectives-survey-research

Warne Frizell (2014) American Indian Health Policy: Historical Trends and Contemporary Issues

Warne, D., Lajimodiere, D AI Health disparities 2015 social and Personality Psychology Compass 9/10 (2015): 567–579, 10.1111/spc3.12198 American Indian health disparities: psychosocial influences North Dakota State University

Weingarten, K (2004). Witnessing the effects of political violence in families: mechanisms of intergenerational transmission and clinical interventions

Wispelwey B, Tanous O, Asi Y, Hammoudeh W, Mills D. Because its power remains naturalized: introducing the settler colonial determinants of health. Front Public Health. 2023 Jul 11;11:1137428. doi: 10.3389/fpubh.2023.1137428. PMID: 37533522; PMCID: PMC10393129.

Whitebear, L., (N.D). #MMIW. A Primer on Missing and Murdered Indigenous Women. Fact Sheet [#MMIW: A PRIMER ON MISSING AND MURDERED INDIGENOUS WOMEN (portlandoregon.gov)

Whitbeck, L.B., Adams, G.W., Hoyt, D.R. and Chen, X. (2004), Conceptualizing and Measuring Historical Trauma Among American Indian People. American Journal of Community Psychology, 33: 119-30. https://doi.org/10.1023/B:AJCP.0000027000.77357.31

Whyte, K.P. 2017 (forthcoming). Food Sovereignty, Justice and Indigenous Peoples: An Essay on Settler Colonialism and Collective Continuance. Oxford Handbook on Food Ethics. Edited by A. Barnhill, T. Doggett, and A. Egan. Oxford University Press

Wolfe ,P., Settler colonialism and the elimination of the native, 2006/12/01,doi: 10.1080/14623520601056240, Journal of Genocide Research, 1462-3528

World Health Organization. About social determinants of health. World Health Organization. Available from: http://www.who.int/ social_determinants/sdh_definition/en/.

Zimmerman MA, Ramirez-Valles J, Washienko KM, Walter B, Dyer S. The development of a measure of enculturation for Native American youth. Am J Community Psychol. 1996 Apr;24(2):295-310. doi: 10.1007/BF02510403. PMID: 8795263.

Appendix 1

Figure 1: Distribution of total allostatic load

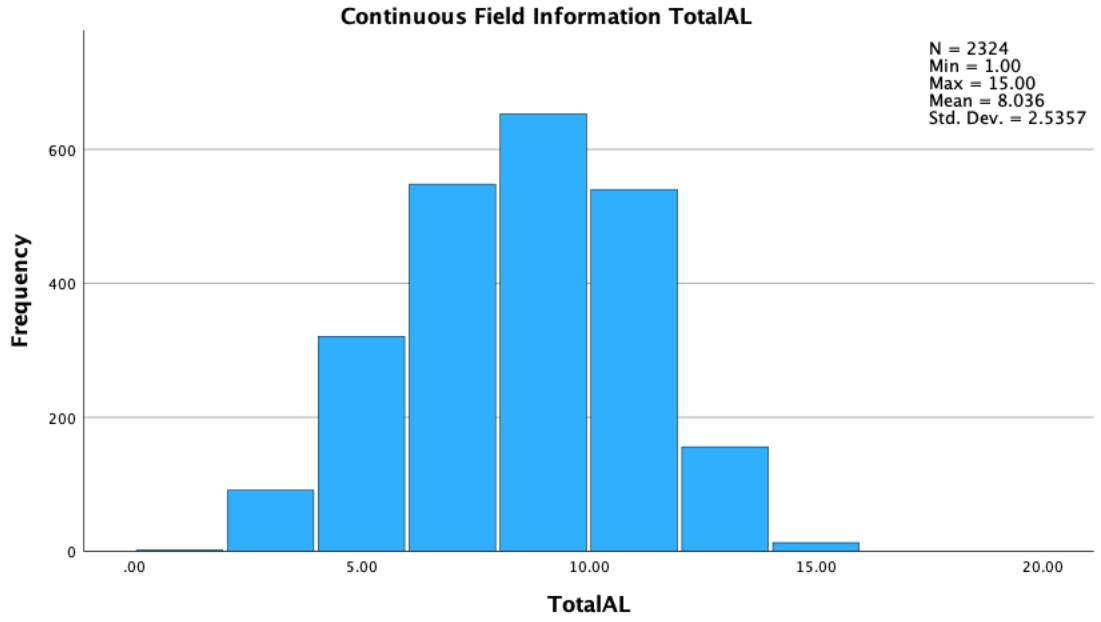


Figure 2: Distribution of inflammatory allostatic load

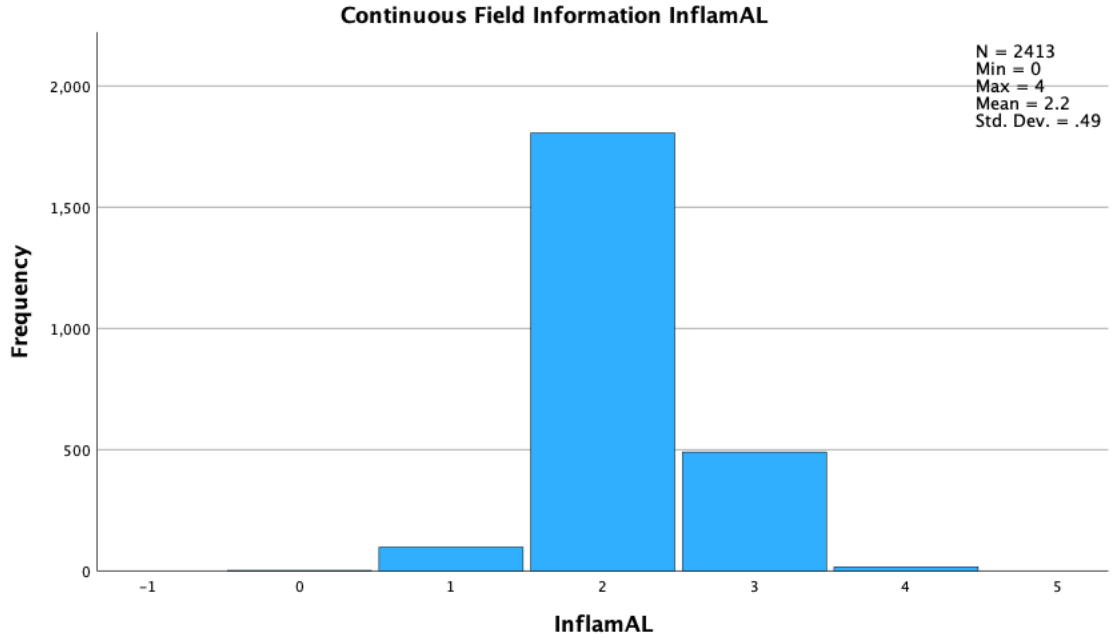


Figure 3: Distribution of cardiovascular allostatic load

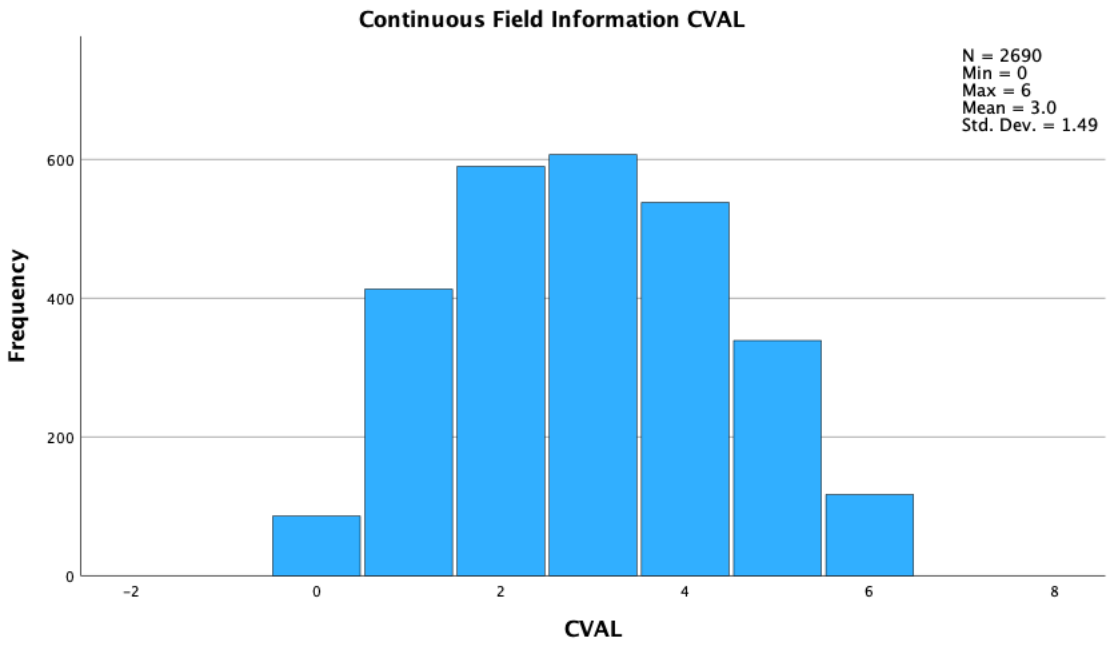


Figure 4: Distribution of metabolic allostatic load

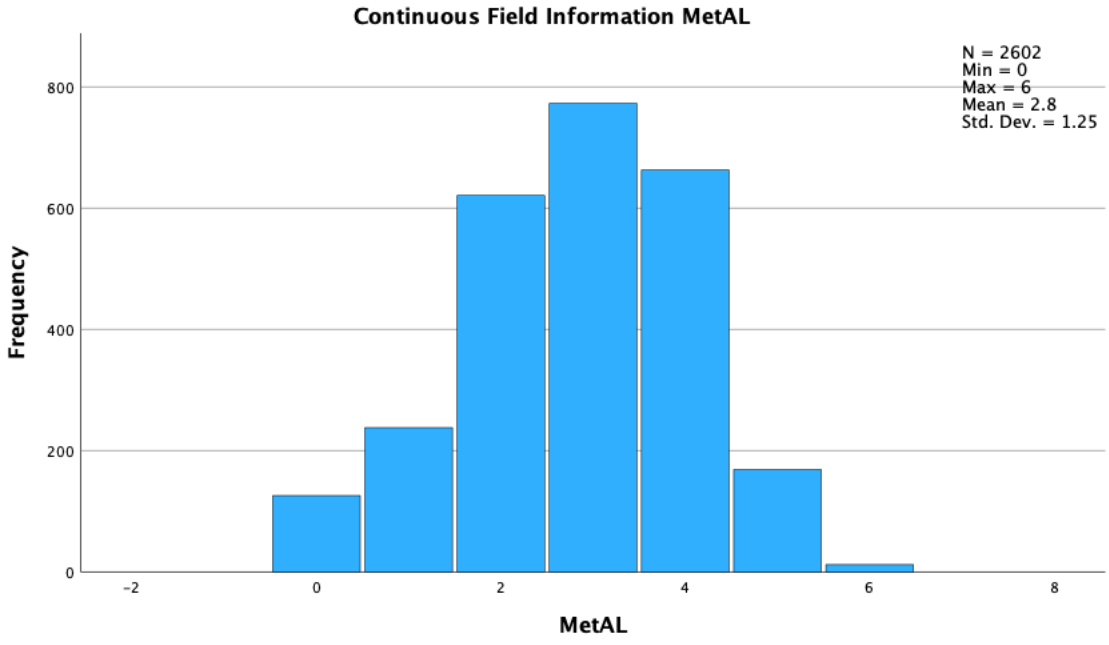


Figure 5: Distribution of enculturation

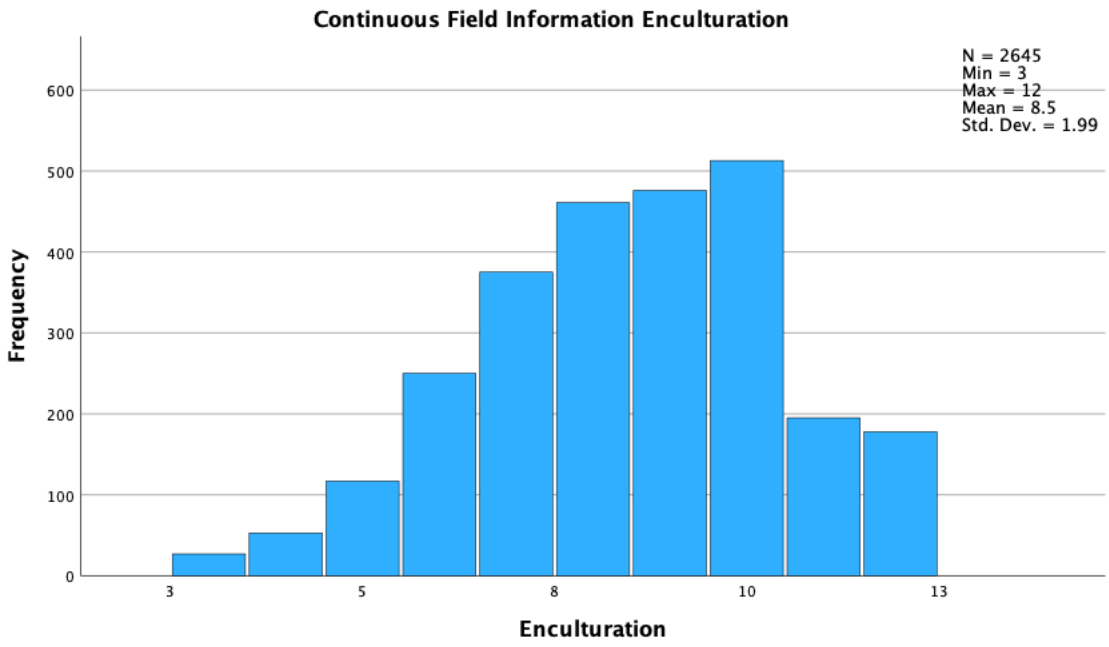


Figure 6: Distribution of acculturation