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CAPITALISM, CONTRACEPTION AND CHEMICALS: A MEDICAL ANTHROPOLOGICAL
ANALYSIS OF THE PREMATURE SEXUAL DEVELOPMENT EPIDEMIC IN PUERTO RICAN
FEMALES

By

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Bachelor of Arts, University of Iowa, Iowa City, Iowa, 2008

Thesis

presented in partial fulfillment of the requirements
for the degree of

Master of Arts
in Anthropology

The University of Montana
Missoula, MT

May 2012

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Table of Contents

An Investigation of Etiologies: The Biosocial Exploration of Premature Sexual Development in Puerto Rico	iv
Employing a Comprehensive Literature Review as a Method for Researching the Social Context of a Pediatric Health Epidemic	1
Designing and Implementing a Anthropological Analysis of Mixed-Methods Literature	8
Medical Anthropology and the Significance of Studying the Social Context of Health.....	11
Operation Americanization: Political and Economic Developments of the American Regime and Their Effect on Puerto Rican Culture	17
Social Contraception: Women's Role in the Formal Economy and Shifts in Reproductive Practice	26
An Epidemic Without Etiologies: Precocious Puberty and Premature Thelarche as a Consequence of Institutional Change	37
Analyzing the Precocious Puberty and Premature Thelarche Epidemic Within Existing Medical Anthropological Framework	63
Turning Theory into Practice: Applications of Medical Anthropology in the Study of the Precocious Puberty and Premature Thelarche Epidemic	75
The Importance of Using Medical Anthropology to Identify the Social Context of the Precocious Puberty and Premature Thelarche Epidemic	83
References	92

An Investigation of Etiologies: The Biosocial Exploration of Premature Sexual Development in Puerto Rico

Chairperson: Dr. Kimber Haddix McKay

Objective: The purpose of this study was to argue for an anthropological approach in the investigation of the world's highest recorded prevalence of precocious puberty and premature thelarche that occurred in Puerto Rico in the late 1970s. After 30 years of biomedical research, definite etiologies of this epidemic remain unknown; prompting for a more dynamic, biosocial approach in studying this pediatric health phenomenon.

Methods: This research began with a literature review of mixed-methods data. Literature sources were segmented by qualitative and quantitative methods. Each source was read and had corresponding handwritten notes that were converted into an electronic format using Microsoft Word. Codes were created to classify the literature into three overarching categories that complemented the research aims: capitalism, women's shifting social roles and precocious puberty and premature thelarche. These three main topics were further organized into sub-sections, which led to the identification of appropriate theoretical frameworks that shaped the thesis' argument.

Conclusions: The relationship between political and economic institutional developments and their effects on females in Puerto Rico are hypothesized to be the ultimate culprit of the precocious puberty and premature thelarche epidemic. The onset of the American Regime in 1898 introduced corporate capitalist culture to the insular population. Consequently, social changes such as the adoption of materialism, rapid industrial development and a substantial increase in female social autonomy occurred. Fetal origins theory's key concept of maternal to fetal transmission is applied to this argument to hypothesize that the compounding effects of women's liberation, their increased engagement in the formal economy, and the toxic byproducts of industrial waste practices caused an increased incidence of precocious puberty and premature thelarche in the pediatric population.

Future Directions: Hypotheses derived from this literature review indicate the need for a holistic and multidisciplinary approach to understanding the ultimate etiologies of this epidemic. Anthropological methods, which are both holistic and multidisciplinary, should follow-up the social considerations of existing research through an analysis of the biosocial interface and local social context of this pediatric health issue (Colon et al. 2000). Future research methods should include surveys, semi-structured interviews, participant observation, medical records, focus groups, and bivariate and multivariate statistical analyses.

Employing a Comprehensive Literature Review as a Method for Researching the Social Context of a Pediatric Health Epidemic

Puerto Rico has the highest recorded prevalence of precocious puberty and premature thelarche in global history. In 1979, 8 out of every 1,000 female children were diagnosed with this pediatric health issue that is characterized by premature sexual development. Overall, precocious puberty affects at most 1 in 5,000 children (Cesario and Hughes 2007) with Puerto Rico's rate being 40 times this global average. According to Colon et al. (2001:1) Puerto Rico's morbidity rates were 18 times greater than the 2nd highest recorded incidence that occurred in Olmsted County, Minnesota in the early 1980s. The literature indicates that precocious puberty is 10 times more common in girls so this thesis focuses on the literature concerning the prevalence in females though it also occurs in males. Numerous causes of abnormal sexual development have been identified but there is no research that indicates why this unique pediatric condition has had such a high occurrence in this island population. In the absence of defined etiologies, this thesis argues that this anthropological interdisciplinary literature review may reveal social conditions that have contributed to the precocious puberty and premature thelarche epidemic that began in Puerto Rico in the late 1970s.

Epidemic is a broadly defined term that is fraught with emotion, used to communicate a sense of risk which can stimulate various reactions based on the context in which it is used. The definition of the term *epidemic* is esoteric as its implications vary within its' epidemiological, administrative and legal connotations; all of which can differ significantly from how this term is used in the popular public literature (Green et al. 2002). Epidemiologists use the most basic definition of this term, indicating that an *epidemic* is "the occurrence in a community or region, of cases of an illness, specified health behavior, or other health-related events clearly in excess of

normal expectancy... and the time period in which cases occur are specified precisely” (2002:3). Green et al. (2002) state that this term can be applied to a wide variety of human conditions but that it is essential to use additional, descriptive terminology to effectively communicate the degree of risk that the epidemic presents (i.e. mild/moderate/severe in terms of clinical concern). It is also important when using the term *epidemic* to indicate the reason for the use of the term, which can be either descriptive or used to identify the defined risk of a specific health condition (2002:5).

Based on the literature review provided by Green et al. 2002, it seems appropriate that the term *epidemic* is used to describe the increase in premature sexual development in Puerto Rican females. The precocious puberty and premature thelarche epidemic was first classified as such in the epidemiological literature, indicating that it was an alarmingly high increase in diagnoses of this health condition that was identified by pediatric endocrinologists beginning in 1979 (Colon et al. 2000). The rate of diagnoses was the highest in the world and includes a temporal component indicating when the epidemic was first identified. What remains unclear is how this information was used in the popular public literature and how the use of this label *epidemic*, influenced the public response and disease processes of this condition.

The primary aim of this thesis is to argue that an anthropological study of the precocious puberty and premature thelarche epidemic in Puerto Rico should include a holistic and interdisciplinary approach that begins with a literature review of both qualitative and quantitative studies. In this paper, qualitative information is used to explain why the quantitative literature has been insufficient in providing definite etiologies. Highlighting the social etiologies of this health issue will prompt researchers to think about innovative methods to include in their future studies. Within this aim, it is argued that this particular epidemic lacks causal explanations after

30 years of quantitative studies because researchers have neglected to consider how cultural shifts and behavioral changes have enabled this health issue to proliferate.

The second aim of this paper is to explain how formal employment, family planning campaigns and the adoption of materialism are important behavioral changes that may be useful in describing the relationship between consumption patterns, teratogen exposure and premature sexual development in Puerto Rico. Analyzing these relationships, I argue that both qualitative and quantitative methods are essential to conducting a holistic anthropological analysis of the precocious puberty and premature thelarche epidemic. Focusing specifically on Puerto Rico, the third aim of this thesis is to define certain female behaviors that contributed to the epidemic proportions of this pediatric health issue. This hypothetical relationship between female consumption practices and pediatric health is explained through the analysis of this literature review.

Medical anthropological research can complement existing and future quantitative research through a holistic analysis of social change and health and through the development of social etiological hypotheses that associate behavioral patterns with health outcomes. The “Medical Anthropology and the Significance of Studying the Social Context of Health” section uses examples from this academic sub-discipline to explain how the social context of health needs to be understood as an integrated biological and social process. This paper attempts to provide a biosocial explanation of the premature sexual development epidemic in Puerto Rico through a synthesis of the literature in the “Operation Americanization: Political and Economic Developments of the American Regime and Their Effect on Puerto Rican Culture”, “Social Contraception: Women's Role in the Formal Economy and Shifts in Reproductive Practice” and “An Epidemic Without Etiologies: Precocious Puberty and Premature Thelarche as a

Consequence of Institutional Change” sections. The strategic breakdown of this argument creates a hypothesis for how cultural shifts occur in response to institutional developments and how these behavioral changes are pivotal to understanding why certain health conditions affect specific populations at increased rates.

An Investigation of Etiologies: Lacunae in the Quantitative Literature

According to national medical standards, healthy sexual development does not begin before the age of eight (Witchel and Plant 2009). Precocious puberty is diagnosed based on the presence of secondary sex characteristics and menses, while premature thelarche is identified by the increase in unilateral or bilateral breast tissue (De Vries et al. 2010). Premature thelarche is a potential precursor of precocious puberty but can also occur in isolated cases. Both of these reproductive health abnormalities occur before eight and can range in severity from benign to austere. Severe physical manifestations of these conditions include the permanent display of secondary sex characteristics and fusion of the growth plates causing drastically stunted adult stature (Eriksson 2005:1096). Long-term reproductive health effects of precocious puberty and premature thelarche remain unstudied.

Quantitative studies have been unable to identify etiologies of this pediatric reproductive health issue in Puerto Rico but generally, researchers have included social determinants of health such as body mass index (BMI), race, genetics, international adoption and food consumption patterns in their hypotheses (Kalpowitz and Kemp 2010; WebMD 2012; Partsch and Sippell 2001). These social determinants indicate that there is likely to be a relationship between human behavior and premature sexual development, but they do not follow up these claims with any consideration of social structural effects that may be contributing to the existence of these correlations. Analyzing the quantitative (biomedicine, epidemiology, ecology and public health)

and qualitative (history, political science, psychology and anthropology) literature, it is proposed that a mixed-methods (qualitative and quantitative) approach is essential to understanding why the precocious puberty and premature thelarche epidemic occurred.

Medical anthropological research typically includes both anthropological methods and approaches from the aforementioned qualitatively based disciplines. Synopses of three medical anthropological studies are used in this thesis to demonstrate how viable and dynamic frameworks of anthropological research are used to locate ultimate causes of illness and disease. These case studies presage a later discussion that details how existing frameworks can be applied to the hypotheses generated from this literature review on the precocious puberty and premature thelarche epidemic in Puerto Rico. This analysis will include previously considered ideas about the social conditions of this pediatric health issue and explore other social features of Puerto Rican culture that may be contributing to the social course of early sexual development. Identifying a relationship between social change and health reinforces the idea that an interdisciplinary approach is essential to studying complex health phenomena and that underlying etiologies can be revealed through the application of anthropological methodologies.

Historians and other qualitative researchers describe how rapid, large-scale social changes have transpired since the epoch of the American Regime in 1898. Beginning with the industrial development period between 1940 and 1970 known as *Operación Manos a la Obra* (Operation Bootstrap), the “Operation Americanization: Political and Economic Developments of the American Regime and Their Effect on Puerto Rican Culture” section explains how the Americanization of social institutions has had a significant impact on Puerto Rican culture. Several political and economic movements took place during this era to promote the island’s candidacy for independence (Hanson 1960:8). However, these rapid industrial efforts failed to

produce a stable economy and caused Puerto Rico to be increasingly dependent on federal funds and American industries (Wagenheim 1975). The framework of political ecology describes how institutional developments alter how a population interacts with the greater environment and that this relationship can be measured through a population's health profile (Faber and Grossman 2000). Social and ecological theories support the argument that capitalism and the development of a materialistic culture in Puerto Rico initiated behavioral changes that may be correlated to the heightened incidence of precocious puberty and premature thelarche.

Narrowing this argument, the "Social Contraception: Women's Role in the Formal Economy and Shifts in Reproductive Practice" section explains how gender roles shifted in response to these institutional developments. Political and economic transitions initiated the commodification of the home-based needlework industry after World War I, which provided women with increased access to formal employment opportunities. Despite the success of the needlework industry, the burden of poverty and unemployment that were believed to be keeping Puerto Rico from attaining independence did not improve. Political authorities realized that increasing employment opportunities for women did not relieve the social pathologies caused by overpopulation and a weak economy. In response, they developed strategies to control population growth by regulating women's fertility. Reproductive health campaigns consisted of federally funded sterilization procedures and subsequently the first large-scale clinical trials of oral contraception where the pills had approximately 100 times more estrogen and progestin compounds than modern birth control pills (Ortho Tri-Cyclen Lo 1998). Engagement in the formal economy increased women's desire to regulate their fertility (Hanson 1960) and consequently, this led to women's use of high-dose oral contraceptives that may have increased their likelihood of having prenatal hormonal disruption (Junod and Marks 2002). The

frameworks of medical and political ecology are applied to this discussion to detail how women's shifting social roles initiated the development of female reproductive autonomy (McLeod 2009; Purdy 2006). This new form of empowerment may have led to behavioral changes that underlie the social etiologies of the precocious puberty and premature thelarche epidemic.

The "An Epidemic Without Etiologies: Precocious Puberty and Premature Thelarche as a Consequence of Institutional Change" section describes the physiological constituents of this reproductive health issue, the ambiguities in the current research and adopts the theoretical frameworks of the epidemiological transition to explain how these biological changes might relate to the aforementioned social etiologies. Furthering this argument, fetal origins theory delineates the impact of industrialization on health to explain effects at the micro, individual level. Maternal to fetal transmission is an important concept in this framework and is used in this section to develop social etiologies that can explain how materialism influences consumption practices and how these behaviors may be affecting pediatric health.

Tangible applications of a medical anthropological approach are outlined in the "Analyzing the Precocious Puberty and Premature Thelarche Epidemic Within Existing Medical Anthropological Frameworks" and in the "Turning Theory into Practice: Applications of Medical Anthropology in the Study of the Precocious Puberty and Premature Thelarche Epidemic" sections. Concepts from the three primary components of this literature review are collectively considered in a proposed research design. Fieldwork begins with two surveys, one for the general population and one for medical professional community. Each set of surveys will be distributed to approximately five Puerto Rican urban centers in hopes that a large number of respondents would provide an insightful and diverse data set by hopefully identifying specific communities

or individuals within these cities who have been increasingly afflicted by this pediatric health issue. After collecting responses, the two most informative cities will be included in an ethnographic study. Research methods will include semi-structured interviews, participant observations and a review of medical records. Questions and directions for this study are detailed in the “Turning Theory into Practice: Applications of Medical Anthropology in the Study of the Precocious Puberty and Premature Thelarche Epidemic” section which includes a discussion of potential research methods. These future applications highlight the significance of medical anthropology’s role in studying the social context of a complex health phenomenon.

Designing an Anthropological Analysis of Mixed-Methods Literature Review

Like all forms of research, investigating the social conditions of a pediatric health issue through a literature review required a significant amount of organization. This research began with a review of mixed-methods data, which included books, encyclopedias, and journal articles that were all obtained from the University of Montana library’s online catalog and interlibrary loan system. The selection criteria of the literature began with a general approach: to identify all literature sources on Puerto Rico and precocious puberty and premature thelarche. Once I obtained an exhaustive set of literature, I reviewed abstracts and table of contents to determine if the source was applicable to my research aims.

The chosen literature sources were segmented in to two groups: qualitative and quantitative methods. After identifying a preliminary set of literature, each resource was read and had corresponding handwritten notes that were converted into an electronic format using Microsoft Word. Codes were created to classify the literature into three overarching categories that complemented the research aims: political and economic developments, women’s shifting

social position and precocious puberty and premature thelarche. These three main topics were further organized into sub-sections, which led to the identification of appropriate theoretical frameworks that shaped the thesis' argument (*see* Figure1). Additional literature sources were included in this review as relevant articles were identified through references cited sections of the preliminary resources and additional research. Literature cited in the medical anthropological frameworks and future directions sections of this paper was considered separate from the sources that led to the development of these three initial categories and is was primarily used to outline and reinforce the presented argument.

Figure 1 visually displays the methodological outline of the argument and should be read from left to right as indicated by the direction of the connecting arrows. The first box indicates that this thesis is a literature review of mixed-methods approaches that has been conducted within the context of medical anthropology to hypothesize about the biosocial context of the premature sexual development epidemic in Puerto Rico. Using this approach in the literature review allowed for the creation of the three main themes that were mentioned previously in this section. Sub-themes are identified under each of these main categories that are linked using the theoretical frameworks of political ecology, epidemiological transition, medical ecology and fetal origins theory. These connections are identified with the use of thick arrows. The two long, curving arrows that encompass each of the three main concepts and the theoretical frameworks are used to demonstrate that hypotheses generated from this literature review of mixed-methods data has provided a foundation for future research where these ideas about the biosocial interface of precocious puberty and premature thelarche can be tested during fieldwork in Puerto Rico.

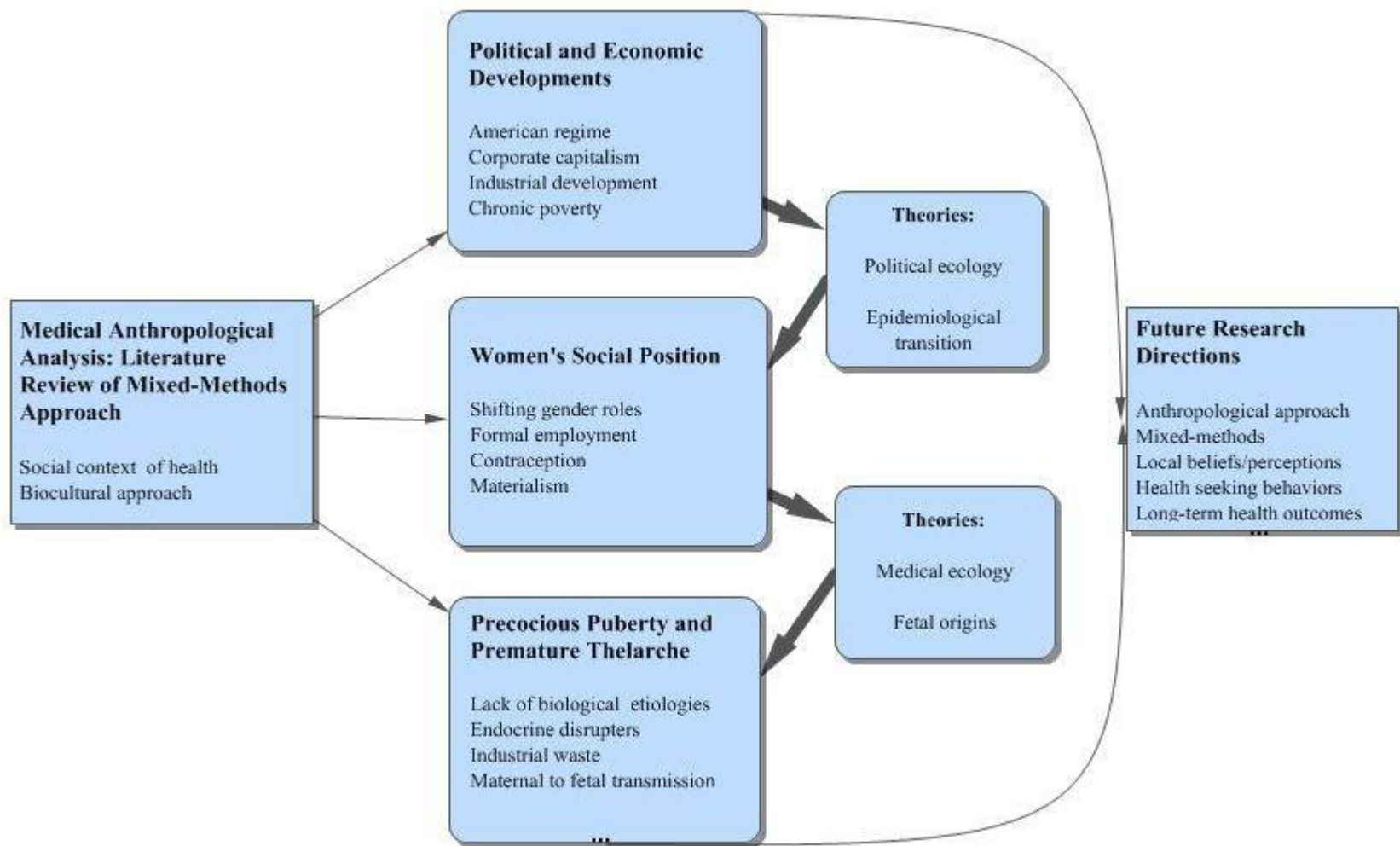


Figure 1. A visual outline of the thesis' argument. It should be read from left to right as indicated by the arrows. This outline is used to demonstrate how a medical anthropological approach is essential to understanding the biosocial context of the precocious puberty and premature thelarche epidemic that began in Puerto Rico over thirty years ago and proposes how hypothesis generated from this literature review of qualitative and quantitative data can be applied in future research.

Medical Anthropology and the Significance of Studying the Social Context of Health

Medical anthropology is a sub-field of biocultural anthropology that has both applied and theoretical implications. Practitioners of this sub-field use traditional ethnographic research methods and specialized interdisciplinary techniques to comprehensively understand the experience of health, illness and health inequalities within specific cultural contexts. Biosocial, ecological and political-economic models of health are important theoretical frameworks that medical anthropologists use to research the origins of health and illness from a biological, cultural and social perspective. These assorted research methods are used to bridge the biological and social experiences of human life, health and illness. This kind of data can also be used to improve public policy, health statuses and services world-wide (Singer and Baer 2007; Sargent and Johnson 1996). Carolyn Sargent and Thomas M. Johnson (1996) predict that this sub-field's use of interdisciplinary and diverse research methods has the potential to generate conceptual advances that will benefit the discipline of anthropology as a whole (1996:xx).

Medical anthropology has been informally in practice since American anthropology's official inception by Franz Boas in the late 1800's. Boas was influenced by renowned pathologist Rudolf Virchow who was instrumental in creating formal anthropological studies in Berlin and an important figure in the early development of medical anthropology (Singer and Baer 2007:15). Virchow was a pioneer of social medicine due to his interests in the "ways in which the distribution of health and disease mirror the distribution of wealth and power in society" (Singer and Baer 2007:15). In 1898, one of the first medical anthropological studies was conducted by British researchers W.H.R. Rivers, Dr. C.G. Seligman and Alfred Haddon. Together they researched indigenous Australian peoples and in their data included information about traditional healing practices and beliefs. Rivers used this information to correct the popular

notion in the Western world that non-Western and preliterate societies only practiced useless and strange customs by arguing that they had coherent structures of cultural beliefs and disease etiologies (2007:13).

Medical anthropology has a deep history in anthropology but it was not officially recognized as a field until the World War II era. The institutionalization of anthropology improved job opportunities for professionals in the field across the in the United States. During this time an increasing number of anthropologists were becoming involved in development work and were also being hired to work in medical schools and clinical settings as teachers, researchers, administrators and sometimes clinicians (Singer and Baer 2007:16). By the 1950s, anthropologists were involved in improving the delivery of biomedical care in both technologically advanced and undeveloped nations. However, some of anthropology's involvement in World War II and post-World War II projects has been criticized as being highly unethical, tainting the perception of anthropological research. Despite these conflicts, this sub-disciplines involvement in resolving international health problems continues to be recognized in the modern era at collegiate and professional levels (2007:16-17).

Over the course of the last 40 years, medical anthropology has expanded with organized associations found in several other nations. This sub-field also continues to diversify in terms of work and its impact on international health related issues (2007:17). Influential works from medical anthropologists Nancy Scheper-Hughes, Arthur Kleinman, and Paul Farmer are summarized in this section to demonstrate how the unique yet practical methods of this sub-field are imperative to understanding health as the interface between the biological and social experience. This biosocial framework of health and illness is a core feature of medical anthropology that is essential to successfully conducting comprehensive health-related research

projects and public health programs. Medical anthropology's evolution since the World War II has contributed to the sub-fields critical role in understanding health in the modern era.

Examples of this work include ethnographic research conducted on schizophrenia in rural Ireland, epilepsy in China, and the human immunodeficiency virus (HIV)/acquired immune deficiency syndrome (AIDS) and tuberculosis (TB) in Haiti.

Nancy Scheper-Hughes's ethnography of mental illness in Ireland (2001) describes social etiologies of the escalating schizophrenia diagnoses in the village of Ballybran in the rural Dingle Peninsula of Ireland that took place during the 1970s. Perplexed by the association between ethnicity and mental illness, the Irish medical community was unable to identify etiologies through isolated genetic, biochemical or environmental research. Scheper-Hughes uses ethnographic research methods and a variety of projective psychological tests to study this population in both communal and clinical settings. Her research concludes with a broad cultural diagnosis of social stresses that may have contributed to this mental illness epidemic in rural Ireland (Scheper-Hughes 2001:60).

Scheper-Hughes applies both social and psychological orientations to study the historical circumstances and economic determinants that served as symbols of beliefs, values and behavior in rural Ireland (2001:61). Her research indicated that young and middle-aged bachelor farmers were increasingly susceptible to schizophrenic diagnoses. Participant observation and interviews with mothers, children and patients in the district mental hospital enabled Scheper-Hughes to hypothesize about several social and cultural features of Ballybran that were contributing to these increased psychiatric hospitalization rates in this specific group of young men.

Collectively these projective psychological testing and the ethnographic research methods identified social constructions of schizophrenia in this rural Irish community. Scheper-Hughes

adopts these constructs to explain how the social and physical conflicts created by structural change influenced perceptions of normality. In turn, these local views influenced beliefs about the behavior of a healthy versus a pathological body. Beliefs about sexuality and gender in rural Ireland stemmed from an amalgamation of progressive and traditional cultures that led to an increased amount of schizophrenia diagnoses and psychiatric hospitalizations, particularly in young and middle aged bachelor farmers (2001).

Nancy Scheper-Hughes's ethnography recapitulates concepts that were presented in medical anthropologist Arthur Kleinman et al.'s (1995) collaborative research on the *social course* of epilepsy in interior China. The term *social course* is described by Kleinman as the continuous socio-somatic interaction between biological and social processes that leads to the development of a local ontology of illness (1995:1321). Kleinman worked with epilepsy experts to research how stigma and social theory are essential to understanding the collective experience of this condition in China, specifically in low-income areas where the prevalence is reportedly greater (1995:1319). Post-study analyses explore how this chronic condition is reflective of both the biological condition itself and China's greater social institutions. Anthropological methods were able to identify how the experience of this chronic illness was constructed within resource poor settings and the lay protective strategies that were developed in response to institutional ostracism.

Kleinman developed a qualitative analysis of patient interview data to explain the *social course* that lied beneath quantitative figures of patient compliance and epilepsy treatment. He argues that patient and family accounts need to be understood within the local context where social conditions may be reflective of the greater society's world- view (1995:1325). Numerous interpersonal issues were present in each of the patient accounts indicating that there was a lack

of homogeneity within these sample populations. Using social theory to organize the interview analyses, Kleinman was able to deduce that illness in these provinces was experienced on a familial level and that epilepsy has drastic effects on socialization. Institutional stigma of chronic disease and disability in China has the potential to delegitimize family morals and exacerbate the condition of the family's preexisting burdens that can ultimately result in a form of "social death" (1995:1328).

Kleinman et al. argues that the social course of epilepsy needs to be studied within local contexts so that prognosis and health seeking behaviors can be better understood, especially in disenfranchised communities (1995). Medical anthropologist and physician Paul Farmer is well known for his work in the impoverished country of Haiti where he is the medical director of the *Clinique Bon Sauveur* of Partners In Health. Farmer expands on Kleinman's claim, stating, "large scale social forces, such as racism, sexism, political violence, poverty and other social inequalities, are rooted in historical and economic processes and sculpt the distribution and outcome of HIV/AIDS and TB" (Castro and Farmer 2003:S20). In Haiti, HIV/AIDS and TB are the leading causes of death in young and middle aged adults (Castro and Famer 2003:S23). Farmer and Castro (2003) provide three patient histories to support their argument that public health policy needs to realign their focus to the social context of infection in order to improve equity plans and access to other health care resources (2003:S23).

Structural violence is a term that was created by Famer to describe the social conditions that "predisposes the human body to pathogenic vulnerability by shaping the risk of infection and subsequent disease reactivation" (Castro and Farmer 2003:S23). Access to treatment and the increasing outcome gap between the incidence and prevalence of infectious disease are also determined by *structural violence*. Farmer and Castro (2003) use the histories of three patients,

two of patients diagnosed HIV/AIDS and one diagnosed with multi-drug resistant TB (MDR-TB), who received treatment at the *Clinique Bon Sauver* to describe the effects of *structural violence* in Haiti. These patient accounts depict the relationship between social hardship and infectious disease and are used to describe how large-scale social forces are embodied by the poor (2003).

Farmer and Castro (2003) describe how these patient accounts are descriptive of the lives of most of the Haitian poor. *Structural violence* creates social circumstances in which the poor have limited access to resources and medical care. Structural issues are not only the ultimate cause of infectious diseases such as HIV/AIDS and TB, but they also contribute to the spreading of these diseases. Farmer counters cost-effective arguments of free health care claiming that these beliefs empower *structural violence* and further contribute to the health outcome gap (2003). He concludes by stating that it is the responsibility of public health, medicine and the biosciences to understand the social context of infectious disease. This information can be used to improve equity plans and eliminate disparities such as poverty that have created this socioeconomic context of HIV/AIDS and TB (2003).

In a later section, these frameworks will be used to analyze the social context of the premature sexual development epidemic in Puerto Rico. Each of these studies provides a unique framework for researching and holistically understanding social etiologies of specific diseases. Schizophrenia, epilepsy, HIV/AIDS and TB are health conditions that bear little biological similarity to premature sexual development. However, Nancy Scheper-Hughes, Arthur Kleinman and Paul Farmer agree that regardless of the pathology, it is the local social context in which disease, health and illness are best understood. As medical anthropologists they emphasize how institutionalized social and economic forces contribute to local beliefs that can ultimately affect a

population's perceptions and experiences of health. The next section will describe how institutional shifts that have occurred in Puerto Rico since the onset of the American Regime in 1898 has caused behavioral changes that may be responsible for the increasing rates of premature sexual development in the female pediatric population.

Operation Americanization: Political and Economic Developments of the American Regime and Their Effect on Puerto Rican Culture

Since the beginning of the American Regime in 1898, Puerto Rico's political and economic institutions have drastically transformed. These macro social changes have influenced the relationship between politics, economics, and culture. In this section, I argue that by analyzing specific institutional developments, researchers may be able to identify social etiologies of the precocious puberty and premature thelarche epidemic. The theoretical framework of political ecology is used to explain how these institutional shifts have contributed to this epidemic through the adoption of American corporate capitalist culture, a shift that has heavily influenced local consumption practices (Lewis 1963; Lewis 1965; Hanson 1960; Wagenheim 1975; Carr 1984).

On December 10, 1898 the "Treaty of Paris" was signed confirming Spain's transfer of Puerto Rico, Cuba, Guam and the Philippines to the plenary authority of the United States. Initially, Puerto Ricans were content with the new occupation and considered themselves fortunate to be living under a more liberal and progressive regime (Jones 1916). Unfortunately, the early years of American military rule resulted in poor political leadership and social disruption. Jones (1916) concludes that friction in early years of the American Regime was due to cultural differences, language barriers and economic instability.

The United States recognized Puerto Rico's political and economic potential but struggled to organize and regulate a population of nearly one million people who already had a “defined” social structure and a high rate of poverty. In the early 20th century social Darwinism dominated the logic of the United States’ authorities who believed that Puerto Rico was racially and culturally inferior. Federal authorities rationalized that their colonial authority over Puerto Rico was necessary in order to protect its politically and socially inadequate inhabitants (Ayala and Bernabe 2007:31).

In April of 1900, The Foraker Act (Organic Act) was passed by President McKinley in order to establish a civilian government in Puerto Rico that would abide to the federal laws of the United States (White1938). In conjunction with these political developments, Puerto Rico's economic structure also shifted by replacing rudimentary rural capitalism with American industrial high-finance capitalism. Proletarianization was initiated with the modernization of the sugar industry and left many agricultural workers unemployed for more than six months of the year in a period known as *el tiempo muerto* (dead time). Women and children supplemented family income through odd jobs and needlework. Despite the hardships faced by the lumpen-proletariat, Puerto Rico accepted United States citizenship in 1917 with the passing of the Jones-Shafroth Act. American citizenship did not improve living conditions for most Puerto Ricans, but it did enable the United States federal government to accumulate more bodies to defend the United States in World War I (Hanson 1960).

After World War I, Puerto Rico absorbed the demands of the European needlework industry. The relocation of embroidery manufacturing in the early 1900’s was due to the war-related turbulence in the Atlantic Ocean. Now a previously household art form in Puerto Rico was being capitalized by Europe and the United States (Ayala and Bernabe 2007:47).

Wagenheim (1975:107) describes how over 40,000 women in Puerto Rico used the formal needlework industry to supplement family incomes while their husbands and other family members engaged in seasonal sugar cane cutting labor. Needlework shops varied in size from small, 2 to 3 person household businesses, to large shops that employed hundreds of female workers. Puerto Rican women also managed larger shops that typically paid higher wages, were easier to unionize and conducive to employee regulation. Women in managerial positions at these shops conducted enterprises of large volume in their own names however; they did not control the embroidery market. Instead, buyers in New York selected the materials for production and shipped them to Puerto Rico for processing. Despite these power dynamics, the formalization of the needlework industry shifted women's social roles by providing them with a sense of economic autonomy. This institutional development also marks the beginning of significant changes in the economy as the success of needlework exports increased the desire for capitalistic relations on the island and between Puerto Rico and the United States (Wagenheim 1975).

Early industries in Puerto Rico focused on sources of wealth that resulted in fast and simple returns. Ayala and Bernabe (2007:47) describe this time period as an era of massive expansion and success in the needlework industry. Between 1920 and 1930, 60,000 Puerto Rican women produced embroidery for the United States and European market, with needlework becoming the second most profitable industry to the sugar economy. Women's intentions to foster family incomes also made them prime candidates in other industrial employment opportunities that developed in Puerto Rico over the next few decades. Family dynamics shifted as women were integrated into the workforce. Men began traveling to find agricultural labor and the number of female-headed households increased. These social shifts that were caused by

women's participation in formal employment altered some of the most important cultural features of Puerto Rican life such as beliefs about family size, personal relationships, and reproduction (Ayala and Bernabe 2007:142). Later in this paper, it is argued that some of these cultural changes occurred as a consequence of rapid industrialization. The history of institutional developments and its effect on formal female employment practices creates a foundation for identifying social etiologies of the precocious puberty and premature thelarche epidemic.

As the Puerto Rican economy shifted and the agricultural market declined, families vacated from the rural, interior areas to urban, coastal cities in an effort to find jobs and to "modernize". With little resources, many families settled in city slums and struggled to gain economic opportunities. Their inability to find work is attributed to the fact that many of these migrants had an agriculturally specialized skill-set and little formal education. By the end of the 1920s the living and economic conditions in Puerto Rico had degraded substantially in both urban and rural areas. Carr (1984) describes the urban housing conditions during the economic depression of the 1930s as "appalling living conditions....60 percent of whom were living six to a room" (Carr 1984:57). In addition to poor housing conditions, Puerto Ricans were also experiencing declines in health and employment. Early public health campaigns helped to decrease the infant mortality rate, the death rate and deaths due to infectious disease. However, the demographic improvements on the island were not sustainable and eventually worsened social conditions by contributing to the rapidly expanding population size (Ayala and Bernabe 2007:103).

Sugar and needlework industries were successful through the Great Depression but the unemployment rate and population size continued and eventually all capital ceased from coming to the island (Wagenheim 1975:8; Carr 1984). The Puerto Rican government urged the United

States to provide them with more economic resources to remedy these social pathologies. The American government was reluctant to entrust the island with more industrial labor because of populations' reputation as having lazy and idle people with little motivation to promote their own economic well being (White 1938). In the early 1930s President Franklin D. Roosevelt and First Lady Eleanor Roosevelt were the first American political authorities to recognize the inward causes of this "lazy and idle" proletariat. These social pathologies existed not because the people were simply unmotivated; rather it was poverty and the effects of an unstable economy that were destroying the character of the Puerto Rican worker (Carr 1984).

President Roosevelt realized that the social ailments of Puerto Rico were caused by severe economic disparities. Puerto Rico was victim to a *laissez-faire* economy that caused widespread misery and led to the highest unemployment rates in history. Rural life consisted of underfed women and sickly men who typically had several children. Most of these families had little food and had minimal opportunities to acquire more (Carr 1984). Poverty and misery continued to increase because Puerto Rico was attempting to survive on an artificial economy that was not growing at the same rate as the population (Wagenheim 1975:8).

After several development failures initiated by President Roosevelt in the 1930s, the 1940s began a new era of economic transition (Wagenheim 1975). In 1941, Luis Muñoz Marín was elected the 4th President of the Senate of Puerto Rico. Muñoz Marín planned to rejuvenate traditional Puerto Rican identity by starting with a series of political and economic shifts that were intended to prepare the island for independence. The *Partido Popular Democrático* (Popular Democratic Party, Muñoz Marín's political party) welcomed the opportunity for American-sponsored industrial development in an effort to reconstitute Puerto Rican society. More economic opportunities were welcomed in hopes that it would alleviate of

food shortages, decrease both the poverty and unemployment rates and strengthen the island's candidacy for political independence (Hanson 1960:8).

In 1947, Muñoz Marín introduced *Operación Manos a la Obra* (Operation Bootstrap, later known as the “Commonwealth Model”) to persuade the Puerto Rican people that the implementation of American industries would result in financial security and social improvements (Ayala and Bernabe 2007:153). This new economic policy encouraged American industries to relocate to Puerto Rico. Here, American industries were able to operate in a foreign business environment that offered many benefits: tax holidays, a large body of low-wage laborers and the opportunity to keep their business in the United States market (2007:189). Parallel to this development, the needlework industry was relocating to more economically desperate areas of Asia where embroidery could be produced for much cheaper wages. Regardless of their loss of the formal needlework industry, women were seen as high-quality candidates for the new industrial jobs because of their low education levels, minimal wage standards and their eagerness to work (Carr 1984).

Operación Manos a la Obra was an incredible short-term success that created a century's worth of economic progress in just one decade (Wagenheim 1975:109). This era of industrial development quickly transitioned Puerto Rico into a North American automobile centered way of life. At its peak in the mid-1950s, there were 500 new factories that employed more than 45,000 Puerto Ricans. This successful period of time during *Operación Manos a la Obra* is often referred to as the “Golden Era”. The majority of those employed were females from the 60,000 families that had previously been displaced by the migrating needlework industry. Despite its outward success, this economic development program only increased the total employment rate

by 2% after absorbing unemployed persons from the declining agricultural and needlework industries (Carr 1984:104).

A global recession caused the “Golden Era” the decline in the early 1960s. This economic deficit devastation was followed by several years of social unrest as unemployment began to increase in the coastal areas and spread to the interior (Ayala and Bernabe 2007:267). At this time, federal funds for the economically disadvantaged reached an all-time high. Between 1970 and 1990, a large portion of federal funds was accounted for through the distribution food stamps and other basic needs programs. Within these two decades the amount of federal aid used in Puerto Rico for food stamps increased from 500 million to six billion annually (Wagenheim: 1975).

Economic strife in the 1970s and 1980s reinstated all Puerto Rico’s social disparities from the 1930s (2007:269). Insular authorities responded to this financial crisis by adopting a sophisticated form of capital-intensive industries that included petrochemicals, pharmaceuticals, and electronics. These elite American industries relocated to Puerto Rico because of the economic advantages offered by the Internal Revenue Code: Section 936. Enacted in 1976, Section 936 was created to provide American corporations with exemption from paying federal income tax on profits earned through Puerto Rican manufacturing subsidiaries. Unfortunately, the strategic planning of Section 936 did not account for the thousands of jobs lost in the decline of *Operación Manos a la Obra*. This industrial shift also decreased the economy’s capacity to absorb the mass amount of laborers who were migrating from rural, interior regions of the island. Social pathologies continued to worsen as Puerto Rico's economy failed to provide financial opportunities for all the people that were displaced during these political and economic fall-outs (Wagenheim 1975).

Political Ecology: Structural Determinants of Health

Poverty has been a chronic social pathology in Puerto Rico since the beginning of the American Regime that not only affects one's financial capacity but also impacts their health and health-seeking behaviors. Political ecology can be applied in this situation to explain how social institutions influence health. This framework hypothesizes a connection between these major political and economic movements with the shifts in Puerto Rican social praxis. Understanding this relationship may help researchers identify how these social developments affect health. The adoption of American corporate capitalist culture in Puerto Rico disrupted the traditional Puerto Rican family structure, introduced women to industrial labor and left men to migrate elsewhere for economic opportunities. The information provided in this section explains the political and economic basis of behavioral changes in women that may be underlying social etiologies of the precocious puberty and premature thelarche epidemic. Political ecology refines this argument by elaborating on the relationship between the social developments of American capitalism and their influence on health (Hardiman and Mukta 2000; Robbins 2003; Stonich 1998).

The monopolization of the sugar market, the commercialization of needlework and the introduction of American industries after World War I are the earliest documented indicators that Puerto Rico was adopting a capitalist social structure. Since then, the insular population has become fixated on consumerism and economic individualism that have greatly impacted consumer behaviors. The development of capitalism caused a cultural shift towards materialism where Puerto Rican laborers are subjected to the production-consumption bind in order to maintain their social position. Operating within a capitalistic structure, Puerto Rican's (specifically women) used consumption practices to symbolize upward social mobility and to

separate themselves from the conditions of poverty and unemployment that are representative of a past era where they had little financial or social autonomy.

The qualitative literature can only provide clues about the shifts in female consumer behaviors that contributed to the precocious puberty and premature thelarche epidemic. Women's time was now being stretched between family and formal employment causing an increase in the consumption of modern convenience items, especially dietary products such as canned *sofrito* and TV dinners (Wagenheim 1975:189). In addition to consumption practices, women were gaining a sense of reproductive autonomy (McLeod 2009). In the next section, hypotheses about family planning methods and their relationship to the modern materialistic lifestyle will be introduced.

The onset of *Operación Manos a la Obra*, the acculturation of American capitalist culture and the shift in consumption practices are the foundational features of this medical anthropological analysis that suggests that the precocious puberty and premature thelarche occurred at an epidemic rate of 8 out of 1,000 girls per year (Colon et al. 2000) because shifts in Puerto Rico's social structure. By analyzing the effects of the large-scale institutional developments, researchers can speculate about why and how specific social and behavioral shifts occurred and how they are underlying etiologies of disease and illness. What cannot be determined with this information is the type of consumer items that contributed to this phenomenon. The “Social Contraception: Women's Role in the Formal Economy and Shifts in Reproductive Practice” section narrows this discussion about social change in Puerto Rico and provides quantitative data to explain how specific social practices may be involved in the endocrine abnormalities of the Puerto Rican population.

Social Contraception: Women's Role in the Formal Economy and Shifts in Reproductive Practice

The institutional transitions of *Operación Manos a la Obra* initiated a shift in family planning programs the primary goal of which was to lower the island's fertility rate and slow population growth. Women's participation in these programs can be correlated to a shift in their social position as they now have increased opportunities in formal employment and a desire to sustain their new consumption-centered way of life (Ayala and Bernabe 2007:180). Feminist literature indicates that these family planning campaigns were coercive, but lack official evidence supporting this claim (Briggs 2002). The success of contraceptive programs in Puerto Rico had a significant impact on fertility but early oral contraceptives may have also contributed to hormonal disruptions in women's bodies that may have caused the precocious puberty and premature thelarche epidemic.

Political and economic institutions in Puerto Rico adopted methods of social control to improve the chronic social pathologies of poverty, unemployment and overpopulation. Political ecological research supports the hypothesis that institutional shifts underlie behavioral changes that have contributed to this reproductive health epidemic (Zsembik and Peek 1994; Faber and Grossman 2000; Robbins 2003). Theories of medical ecology also contribute to a discussion about how the government's remedies for the Puerto Rico's social pathologies may be affecting the population's biological capacity to produce healthy bodies (Foucault 1980; Porter and Jones 1998). Medical and political ecology connect institutional developments to shifts in women's reproductive and general consumption practices. Biological theories of premature sexual development that are discussed in the next section explain how chemicals, such as plasticizers and synthetic-estrogen are omnipresent in modern industrial societies and that their increased

presence on the island may be contributing to health issues such as premature sexual development. Identifying potential correlations between institutional development and specific social shifts may unveil underlying structural and behavioral etiologies of the precocious puberty and premature thelarche epidemic in Puerto Rico.

Prior to the American regime, European Catholicism dominated the concept of gender roles in Puerto Rican society by promoting the need for a strong social barrier between the sexes. Female behavior was centered on maintaining virginal purity until marriage (Lewis 1963:265). Females were believed to be intellectually inferior to males because they were considered to be mentally disabled and morally weak. Men would use their physically and emotionally authoritative social power to correct female behavior and to dictate women's degree of social freedom. Women rarely went in public without their husband and often did not participate in extracurricular activities such as drinking and dancing, outside of their domestic space (Mintz 1960). Premarital sex was a social taboo for females and was reprimanded with serious consequences by one's family. Wives and mothers were known as "*madre sufrida*" (suffered or suffering mother) because they lived as a slave to their husbands and were forced to ignore their husband's frequent and numerous extra-marital relationships (Wagenheim 1975:194). This Catholic-influenced gender dichotomy began to wane during World War I as women became a critical component of the Puerto Rican economy. Women's empowerment in the formal economy caused an increase in female autonomy both publicly and privately. Shifting gender roles was catalyzed by the onset of the American regime and the introduction of capitalist culture (Ayala and Bernabe 2007; Hanson 1960; Lewis 1963; Wagenheim 1975; Carr 1984; White 1938).

The American Regime initiated capitalist developments that motivated Puerto Rican women to liberate themselves from the restrictions of the traditional Roman Catholic gender

system. The first documented increase in women's social autonomy began with the women's suffrage movement in the late 1920s and 1930s. By 1932, literate women were granted the right to vote and 4 years later, all women were eligible to participate in elections (Ayala and Bernabe 2007:69) Economically, women were transitioning from their domestic duties to formal employment in the needlework industry (2007:68). The needlework industry successfully expanded between the 1910s to the 1930s due to the success of production. Puerto Rican women's social and behavioral circumstances of economic deprivation, eagerness to engage in wage labor, docile personalities and strong work ethic also contributed to this industry's economic success (Carr 1984:202).

Women's social empowerment gradually displaced men from their traditional roles as principal family providers. Shifts in economic institutions caused men, husbands, partners and sons to migrate to employment opportunities elsewhere, typically off the island. The migration of male labor resulted in an increase in the number of matrifocal, single-parent households (Lewis 1965:XXVII). Divorce and contraception also became legal in Puerto Rico within the first 60 years of the American Regime. These additional social developments continued to liberate women and influence their perception of family. Women began to prefer the American "nuclear family" size over the larger family sizes that were symbolic of the chronic poverty, suffering and subordination Puerto Rican females experienced during the Spanish regime (Lewis 1965). Smaller family sizes were also desirable because they allowed women to maintain their formal employment positions and enabled them to financially provide for their family.

Women's engagement in formal economy softened the gender divide but did not significantly improve the social pathologies that were characteristic of Puerto Rican life (Hanson 1960:192). The unexpected dissolution of early industries led the insular government to blame

the rapid population growth for the island's economic disparities. Family planning programs were developed in the 1920s with the creation of the *Birth Control League* (Ayala and Bernabe 2007:207). By 1937, maternal and child health clinics were commonly found in low-wage neighborhoods, slums areas and in the industrial facilities that had a substantial amount of female employees (White 1938). When the population size reached 2 million in 1940, the Puerto Rican government realized that more aggressive measures needed to be taken to control the population's fertility rates in order to improve economic conditions (Briggs 2002).

Over the next two decades, Puerto Rico instituted a family planning program called *La Operación*; a sterilization program that was funded by the United States government to enhance family planning services and effectively decrease the fertility rate. A similar, yet arguably more coercive program was implemented in the United States by the U.S. Agency for International Development, the Rockefeller Foundation, and the Ford Foundation and was specifically targeted at Native American and Black women (Carpio 2004; Price and Darity 2010). In Puerto Rico, this procedure became the primary method of contraception for women in low socio-economic groups because it was typically free and very reliable (Briggs 2002). Targeting this campaign towards women in low-wage neighborhoods appears to be coercive but the feminist literature states otherwise sadly admitting that most women who engaged in this procedure found it to be a positive experience (Briggs 2002). In a sample of 271 women who were sterilized between 1920 and 1950, over 70% of them state that they would undergo the procedure again (2002). By 1960, 35% of the female population had undergone *La Operación*. Analysts claim that by the mid-1960s hospitals and clinics were experiencing substantial social and financial pressure from American and Puerto Rican grassroots organizations to end this campaign (Schoen 2005). As a

result, these facilities abandoned sterilization programs before the end of the decade (Briggs 2002).

Puerto Rican women were receptive to the sterilization programs because of their engagement in structured employment, their increasing responsibilities in their family life and their desire to maintain and empower themselves through these opportunities to attain reproductive autonomy (Briggs 2002; McLeod 2009; Purdy 2006). However, younger women expressed their concern about permanently eliminating their ability to reproduce and began to demand alternatives to the sterilization programs (Zsembik and Chuck 1994). In 1955, Gregory Pincus (an American biologist who co-invented the oral contraceptive pill) visited Puerto Rico. Here, Pincus identified an ideal location to conduct large-scale human trials for the newly developed birth control pill *Enovid*. Pincus acknowledged that the densely populated island was struggling to improve its chronic state of poverty and that there were no laws against the use of birth control. Puerto Rico appeared to be a great opportunity for Pincus and colleagues to test the new oral contraception. Soon after his visit, Pincus and fellow researchers began to develop partnerships with the 67 birth control clinics that were already in operation so they could accumulate participants for the clinical trials (Junod and Marks 2002).

In April of 1956, the first clinical trial of *Enovid* known as the “Searles Trials” was launched in *El Fangito*, a slum area in *Río Piedras*, Puerto Rico. A high dose, 10 mg pill was administered to the women in this study to ensure the oral contraceptive would not result in pregnancy. After the first year of the clinical trial, *Enovid* proved to be 100 % effective, but not without serious side effects such as nausea, ataxia, headaches, stomach pain and vomiting. Pincus and his partner and co-inventor John Rock classified these symptoms as psychosomatic.

In addition, three out of 132 women in this clinical trial passed away during the course of the study but these deaths were never investigated (Junod and Marks 2002).

Similar to sterilization, oral contraceptives were also eagerly received by Puerto Rican women (Ayala and Bernabe 2007). This new method of birth control was targeted toward the same population as the sterilization campaigns: women of low socio-economic status and those engaged in capitalist wage labor. As a result *La Operación* and the *Enovid* clinical trials had a measurable impact on fertility and population growth. The number of children ages 5 to 9 only increased 3% between 1960 and 1970, and children ages 1 to 4 decreased by 10% (Wagenheim 1975:173). The Center for Disease Control's *Vital Statistics of the United States* indicates that from 1947 to 1966 the crude birth rate dropped from 42.7 births per 1,000 women per year to 27.6 births per 1,000 women per year. This data also reports that within these 19 years, total live births decreased from 91,305 to 73,630 (Center for Disease Control's *United States Vital Statistics 1947 -1966*). Puerto Rico was included in the United States birth registry in 1943 but it is difficult to locate data that indicates how family planning campaigns impacted the population's total fertility because the demographic literature does not provide total fertility rates (TFR) for Puerto Rico until 1960. However, the available data does indicate that the fertility rate dropped between 1960 and 1970 from 4.7 to 3.1, respectively (The World Bank 1960-1970). Political authorities saw the uncontrolled population growth as a threat to the success of the industrialization era of *Operación Manos a la Obra*, but even the success of the family planning campaigns did not improve economic instability (Briggs 2002). Birth control campaigns were embraced by Puerto Rican women touting the added benefits that contraception provided women with the capacity to plan their future, control reproduction and participate in consumption practices that were symbolic of upward social mobility.

The health threats of early oral contraceptives were due to the high, experimental doses of the pill. Progestin and estrogen are the two essential hormone products in birth control pills that effectively prevent pregnancy. Modern oral contraception contains 0.180 -0.250 mg of a progestational compound and 0.025 mg of estrogenic compound (ORTHO TRI-CYCLEN® Lo 1998). During the large-scale clinical trials of *Enovid* in Puerto Rico in 1956, women were taking birth control pills that had 10 mg of progestin. Simple calculations indicate that the first oral contraceptive had hormonal doses nearly 100 times greater than the birth control pills that are used today. The severity of the reported side effects with the early 10 mg pills was considered to be psychosomatic and atypical by most physicians who participated in these trials, but these physical complaints were also responsible for the high dropout rates in the initial and subsequent clinical trials (Junod and Marks 2002). Junod and Marks (2002) report: “At least 20 percent of the women taking the drug in Puerto Rico and 66 percent of those on trials in Los Angeles discontinued *Enovid* on account of such side effects” (2002:143). These reports were casually dismissed and in 1959 the Food and Drug Administration’s (FDA) approved the 10 mg pill in the United States for limited use for women with menstrual irregularities (2002).

By 1960, the FDA approved *Enovid* for contraceptive use. Prior to expanding these clinical trials overseas, the British Family Planning Association (BFPA) demanded that more evidence be shown that *Enovid* was safe and effective. Most importantly, the BFPA did not want to test a drug that could cause carcinogenic or teratogenic effects or that could negatively affect fertility (Junod and Marks 2002). The secondary goal of the BFPA’s was to use these research demands to push for studies that would identify the lowest effective doses of progestin and estrogen that would prevent pregnancy. Unable to easily expand their market in Britain, United States researchers were funded to conduct additional clinical trials for 5 mg *Enovid*. The

resulting benefits of this research were numerous. By decreasing the amount of progestin and estrogen, lower dose pills had reduced side effects and also lowered production costs. Research efforts increased between 1960 and 1970 as health concerns associated with the pill became public. The birth control pill was now being correlated with the sudden passing of young women who died from venal thrombosis (blood clots). After a detailed review of the methodologies used in the early clinical trials in Puerto Rico, health officials themselves began to question the safety of the pill. Despite these public concerns, oral contraception was never removed from the market (2002).

Today there are a few recognized health effects on women who used birth control pills but the carcinogenic and teratogenic effects of oral contraception remains understudied. Early research indicates that there are no major teratogenic effects that occur as a result of oral contraception use but that the severity of effects may depend on the time of embryonic exposure and the types of progestin compounds used (Nora and Nora 1974; Stacey 2009). It is unclear as to exactly when lower hormone oral contraceptives replaced the 10 mg pills, but today doses are significantly less and reported to be 99.9 percent effective (Junod and Marks 2002:160). The clinical trials of *Enovid* exposed women to high doses of estrogen and it is possible that this influx of hormones may have contributed to the precocious puberty and premature thelarche epidemic. Regardless of its unknown threats to health, the quantitative data indicates that birth control mechanisms were effective in reducing fertility in Puerto Rico. This success is attributed to the institutional development strategies of the 1940s that increased women's social autonomy which lead to their desire to participate in birth control programs.

Existing research suggests that certain groups of women were targeted for fertility control between the mid-1940s to the mid-1960s (Briggs 2002; Garcia 2004; Schoen 2005; Zsembik and

Chuck 1994; Junod and Marks 2002). Women who were targeted for these birth control campaigns were typically of the low socio-economic working class; however there is no data indicating a relationship between class and the incidence of precocious puberty and premature thelarche. Future research should include socioeconomic status as a social marker to understanding the relationship between class, female reproductive behavior and pediatric health. Using class and reproductive autonomy as measures for pediatric health outcomes may be useful for identifying patterns of disease prevalence in certain populations. This information can guide researchers in identifying social indicators of pediatric health conditions like premature sexual development and use this information to identify, reduce and possibly eliminate ultimate etiologies.

Disease alters the relationship of a population and its environment by engaging biological mechanisms, challenging cultural beliefs and reforming the conditions in which it survives. Medical ecologists have identified a relationship between biology, culture, and the environment; identifying adaptive changes in a population as important features of understanding disease in a biocultural context. According to JE Gordon (1958) adaptation is used to explain how disease and illness develop, thrive and decline in a given population. Political ecology focuses on how social institutions are involved in the underlying etiologies disease (Faber and Grossman 2000). The synthesis of medical and political ecology frameworks has resulted in a multifarious argument of this pediatric reproductive health epidemic that includes the analysis of both macro and micro social culprits.

Medical ecology defines a significant link between the “Operation Americanization: Political and Economic Developments of the American Regime and Their Effect on Puerto Rican Culture” and the “Social Contraception: Women's Role in the Formal Economy and Shifts in

Reproductive Practice” sections. Political ecology is used to outline how social institutions regulated female behavior by the strategic targeting and implementation of the family planning campaigns. In this context, medical ecology highlights that women's individual behaviors reflect how macro institutional shifts have influenced women’s reproductive choices. This ecological angle indicates that the increase in birth control practices is a form of “adaptation” that occurred because of the development agenda of Puerto Rico’s political and economic institutions. During the Luis Muñoz Marín era, Puerto Rico was striving for political independence from the United States by demonstrating that the island had a reliable and sustainable economic infrastructure. Rapid population growth and the increasing number of people affected by the dissolution of the agricultural industry superseded the employment capacity of the new industrial economy. The solution to improving this situation was to quickly and effectively decrease population growth through the regulation of the female social body and their reproductive behaviors. Regulatory mechanisms were embraced by women because of their new social positions in a capitalistic society that focused on a materialistic sense of individual gain and subjected them to a consumption-production bind.

Political ecology assumes that social status controls the disease’s level of transmission between individuals and their given environment (Hardiman and Mukta 2000). The biological capacity of reproducing-aged women shifted in the late 1940s through the promotion of birth control practices, sterilization and oral contraception. These forms of physical adaptations were successful in Puerto Rico because females were acculturated into the materialistic system of American capitalist culture. Women also used birth control mechanisms to preserve their autonomy that was gained through formal employment opportunities. Socio-economic status, consumption practices and employment collectively contributed to the alteration of women’s

biology so they could engage in Puerto Rico's developing society. This social explanation in combination with the small amount of data on the effects of high-dose hormone pills on prenatal development indicate that it may be possible that these biosocial developments contributed to Puerto Rico's epidemic rate of precocious puberty and premature thelarche diagnoses.

Medical anthropology's dynamic and interdisciplinary research methods enable the information in the literature to be hypothetically synthesized and used to create theories about how the macro social context, the historical, political and economic movements that occurred during the first century of the American Regime, contributed to this epidemic. The development strategies employed in Puerto Rico impacted female social behavior through the effective implementation of family planning programs and birth control procedures. This shift in reproductive practices was supported by political and economic institutions and served as an adaptive mechanism that targeted specific groups of women in order to improve upon the social pathologies of poverty and over population. The quantitative data indicates that measures taken to regulate female reproductive behavior were successful in decreasing fertility. However, the success of early oral contraception may also have contributed to increased precocious puberty and premature thelarche diagnoses due to hormonal disruptions that could be caused by the high experimental dosages of progestin and estrogen. Future research directions should include an exploration of how Puerto Ricans understand the relationship between health and these specific social developments that were initiated during the American Regime. This information may enable researchers to develop lay explanatory models of the precocious puberty and premature thelarche epidemic. These models could validate or inform the hypothetical social context of this condition that was created based on this literature review.

An Epidemic Without Etiologies: Precocious Puberty and Premature Thelarche as a Consequence of Institutional Change

This section synthesizes the current theories of premature sexual development and highlights their inadequacies through the application of fetal origins theory. This framework is used to explain how the social context of health is influenced by macro institutional shifts. These structural developments may have caused micro levels of human behavioral change that ultimately resulted in this pediatric reproductive health epidemic. According to Selma Feldman Witchel and Tony M. Plant (2009) there is a consensus among quantitative researchers that hormonal imbalances cause precocious puberty and premature thelarche. However, the data does not indicate what specific endocrine disruptors result in these health conditions. Researchers suggest precocious puberty may be a precursor to premature thelarche but this specific relationship is not well understood (2009). A few studies provide a discussion about the social implications of their data but this information has not been applied specifically to the incidences in the Puerto Rican population (Bhatt 2000; Biro et al. 2009; Sáenz de Rodriguez et al. 1985; Comas 1982; Tiwary 1998). The deficient state of the quantitative literature warrants the need for a mixed-methods research design. Here, several studies are presented that may be important to advancing this social etiological argument. After an introduction of the quantitative literature, there is a discussion that hypothesizes about how the “Operation Americanization: Political and Economic Developments of the American Regime and Their Effect on Puerto Rican Culture” and “Social Contraception: Women's Role in the Formal Economy and Shifts in Reproductive Practice” sections can be integrated with theories from the quantitative literature to create a medical anthropological analysis of the precocious puberty and premature thelarche epidemic in Puerto Rico.

Social etiologies proposed in the “Operation Americanization: Political and Economic Developments of the American Regime and Their Effect on Puerto Rican Culture” and “Social Contraception: Women's Role in the Formal Economy and Shifts in Reproductive Practice” sections are justified through the application of fetal origins theory. This framework describes the fetus's capacity to adapt to the intrauterine environment and explains how a woman can predispose her child to teratogens through the placental membrane (Environmental Working Group 2005). One of fetal origin's key concepts, maternal to fetal transmission, is used to argue that women's increased consumption of dangerous chemicals may be having negative effects on pediatric reproductive health.

The physiological mechanisms that control the timing of puberty remain uncertain (Witchel and Plant 2009:395). In females, this physical transition is typically expressed between 8 and 13 years of age (2009:395). Reproductive development is marked by the maturation of the sex organs, the display of secondary sex characteristics, a rapid increase in stature and the onset of menstruation. In order to be diagnosed with precocious puberty or premature thelarche a child must display signs of reproductive development before the age of 8 (2009). Sexual maturation begins with the stimulation of gonadotropin releasing hormones but researchers have been unable to ascertain how this process is initiated and how to determine the speed of its progress. Researcher's inability to identify the physiological details of normal pubertal development complicates studies that aim to understand how premature sexual development occurs.

Premature sexual development is characterized in two ways. The first type is called or central precocious puberty or pseudo puberty, meaning that early maturation is caused by abnormalities, damage or disease to the hypothalamus or the pituitary gland. Ng et al. (2003) claim that central precocious puberty can be identified by the presence of intracranial

abnormalities in an MRI or CT scan. The second type, peripheral precocious puberty, classifies a condition that it is caused by endogenous agents, such as tumors, congenital adrenal hyperplasia and McCune–Albright syndrome; and exogenous sources such as environmental toxins and synthetic hormones (Roman et al. 2004). Central precocious puberty has the potential to be directly observed and confirmed while peripheral causes are more complicated and not well understood. Data on the Puerto Rican epidemic suggests that CT Scans and MRIs provide no indicators that precocious puberty should be classified as central and therefore a discussion concerning this type of premature sexual development is not included here. The hypothesized social etiologies of modern consumer practices and oral contraception presented in previous sections direct this argument to advocate for a peripheral classification by endogenous and exogenous sources.

Premature thelarche's status as a benign, isolated condition or as a precursor to precocious puberty remains under debate. Verrotti et al. (1996) conducted a longitudinal study of 46 females who were diagnosed with premature thelarche in an effort to improve treatment methods for idiopathic precocious puberty. Subjects were separated into two groups: *Group A* consisted of 26 girls who were diagnosed with premature thelarche before their second birthday and *Group B* consisted of 20 girls who showed breast enlargement after their second birthday. At the time of diagnosis, the mean level of the basal follicle-stimulating hormone, FSH (a hormone that promotes the development of gametes) (Papadimitriou et al. 2006), in both groups was 2.1 ± 0.05 mIU/ml, which is significantly higher than the control values of 0.7 ± 0.9 mIU/ml. *These results had a p* value of 0.01, indicating that only 1% of the females in this study had lower FSH levels than the control values. A gonadotropin-releasing hormone test revealed that the FSH response for these groups was significantly higher than the control pre-pubertal values

(12.9 +/- 2.1 vs. 3.9 +/- 2.9 mIU/ml). These results had a p value of 0.001 indicating that only 0.1% of the females have FSH responses below the control group. Follow-up periods varied from 5.1 to 7.8 years and included the same hormone measurements and an evaluation of the secondary sex characteristics. Verrotti et al. (1996) states that despite the similarity in FSH levels, a greater percentage of girls who were diagnosed before the age of two did not show signs of premature thelarche at the follow up study, indicating that the age of onset of thelarche is useful in determining a patient's risk of their condition progressing towards precocious puberty (1996).

Contrary to Verrotti et al. (1996), De Vries et al. (2010) determined that age of onset does not affect a premature thelarche prognosis. In this study, De Vries et al. reviewed 139 medical files of females who were diagnosed with premature thelarche, separating them into three groups: those who were diagnosed at birth, between one month and two years of age, and between two and eight years of age. Clinical and anthropometric characteristics at admission included height standard deviation score, bone age-chronological age ratio, and hormonal values. Each of these measurements were comparable in the three age groups indicating that premature thelarche, despite age of onset, was not a precursor to precocious puberty. The initial measurements and the ten year follow up period also indicated that the incidence of precocious puberty and the other measurable features of premature sexual development were similar for all the females regardless of their age at onset. Currently there are no clinical or laboratory tests available that can predict the risk of premature thelarche's progression to precocious puberty at presentation (De Vries et al. 2010). Verrotti et al. (1996) and De Vries et al. (2010) have different strengths that support their argument. Verrotti et al. (1996) provides personal research data for the control subjects and girls with premature thelarche. De Vries et al. (2010) had the

benefit of conducting a controlled, longitudinal study through the evaluation of medical records. It is difficult to determine which study is more convincing in their argument but future studies should include a combination of patient and medical record data to incorporate the benefits from both of these approaches.

Research on the co-morbid endogenous causes of peripheral precocious puberty is minimal but it does promote the idea that these types of agents may be responsible for the epidemic in Puerto Rico. Physical manifestations of McCune-Albright Syndrome (MAS) include precocious puberty, skeletal dysplasia and the typical skin lesions associated with the syndrome (Roman et. al 2004). Researchers confirmed that MAS is caused by a *GNAS1* genetic mutation. Since precocious puberty occurs in patients with MAS, researchers have tried to provide a genetic explanation for the isolated cases of premature sexual development. Roman et al. (2004) conducted genetic analysis for the *GNAS1* mutation on 23 Chilean females who had chronic fluctuating or exaggerated thelarche and displayed no other symptoms of MAS. Six of the 23 subjects had the genetic mutation of the *GNAS1* gene, which indicates a potential correlation between isolated incidences of precocious puberty and specific genetic mutations (2004). Roman et al.'s figures are significant because the global prevalence of MAS is estimated to be between one out of 100,000 and one out of 1,000,000, indicating that there may be a genetic relationship between MAS and precocious puberty in Puerto Rico (Dumitrescu and Collins 2008).

Similar to the precocious puberty and premature thelarche epidemic in Puerto Rico, in the late 1970s Italian endocrinologists noticed an increasingly high incidence of premature sexual development diagnoses in female school children in Milan (Partsch and Sippell 2001). Country-wide incidences ranged from 30.4 – 393.5 cases out of 100,000 children depending on the region (Massart et al. 2005). According to Cisternino et al. (2000), 74% of precocious

puberty diagnoses in Italy were classified as idiopathic. Iughetti et al. (2005) studied the relationship between the secretion levels of allopregnanolone, a neuroactive steroid that increases during puberty, and the incidence of precocious pubarche, the first appearance of pubic hair. The subjects in this study consisted of four groups, 17 girls with precocious pubarche, 22 girls with precocious puberty, 25 girls with normal puberty who are at the same pubertal stage as the precocious puberty cohort, and 17 pre-pubertal girls. Methods included both adrenocorticotropin hormone (ACTH) and gonadotropin-releasing hormone (GnRH) stimulation tests as well as collecting a basal dehydroepiandrosterone sulfate (DHEAS) reading for each of the subjects. This study resulted in a significance level of 0.05, which means that allopregnanolone levels are significantly lower in the 95% of the precocious pubarche group compared to females with precocious puberty. This study suggests that this neurosteroid could be a biomarker of early pubertal development (2005). It also provides new considerations for future research on premature sexual development and may also be signifying the need for a cross-cultural research project to test Iughetti et al.'s (2005) findings between precocious puberty and allopregnanolone with biomedical theories from the Puerto Rico epidemic.

Before the 1990s, there were only a small amount of studies that related the epidemic of precocious puberty and premature thelarche in Puerto Rico to exogenous hormonal disruptors. Sáenz de Rodriguez et al. (1982) and Comas (1982) argued that food contaminants and additives, such as anabolic steroids used to increase muscle mass in cows and poultry since the beginning of the 1970s, were responsible for the drastic increase in precocious puberty and premature thelarche diagnoses. According to Figure 2 (Comas 1982:1300), diagnostic rates for premature thelarche and precocious puberty in Ponce, Puerto Rico (an urban city on the southern coast of island) increased from approximately 14 per 1,000 females and 8 per 1,000 females respectively

in 1978, to 18 per 1,000 females and 30 per 1,000 females in 1979. While diagnostic rates appear to be declining in 1981, this sudden increase in 1979 remains unexplained and understudied.

Sáenz de Rodriguez, a physician from San Juan, Puerto Rico (the populous capital city on the north-eastern coast) claimed that the epidemic due to the significant levels of estradiol that were found in their analysis of several food specimens. Sáenz de Rodriguez et al. (1985) stated:

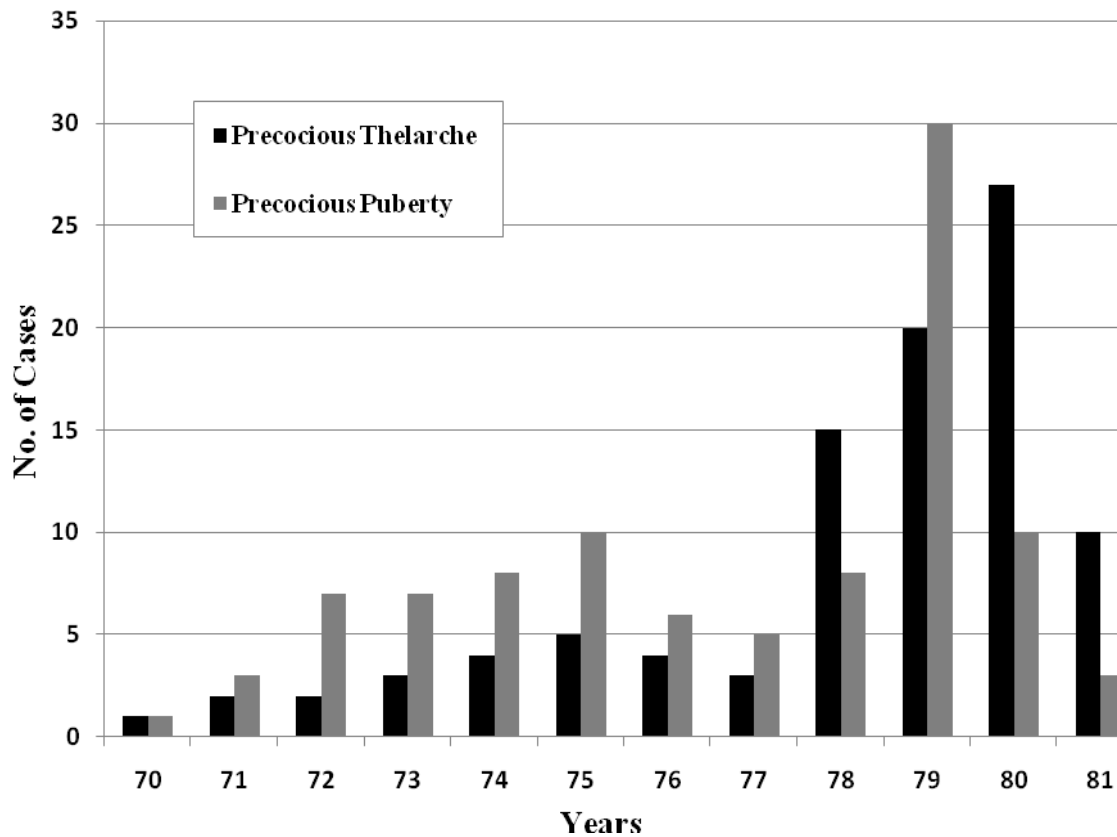


Figure 2. Reformatted table from Comas (1982) showing the increase in cases of precocious puberty and premature thelarche diagnosed by Dr. Comas in Ponce, Puerto Rico from 1970 – 1981.

“We suspect that the early sexual development is caused by exogenous estrogen contamination in the food ingested by the children and by their mothers” (Rodriguez et al. 1985:393). These contrasting statements between Comas and Sáenz de Rodriguez et al. (1985) could indicate that because these physicians’ practices were in different locations on the island incidences varied based on region. However, there is a lack of evidence supporting the relationship between the prevalence of premature sexual development and region. Again, Sáenz de Rodriguez et al. (1985) identified the consumption of meat products as an etiology of early sexual development in addition to their argument that this pediatric health condition began with maternal dietary choices. Based on this data, it is apparent that the concept of fetal origins has existed within the context of premature sexual development since the 1980s. Unfortunately, these theories did not materialize until the late 1990s when researchers began to notice a relationship between other exogenous agents and their effects on health.

Institutionally funded studies from the early 1980s argue against Sáenz de Rodriguez et al. (1982 and 1985) and Comas (1982) etiological theories. Scheid (1985) explains how the United States Department of Agriculture (USDA) and the Puerto Rico Department of Health conducted a series of tests on 800 meat and dairy samples. The data from this study caused the USDA to conclude that there were no abnormal levels of the following suspected chemicals mentioned in the Sáenz de Rodriguez et al. articles: zeranol (legal limit 1 ppb), di-ethylstilboestrol (legal limit 1 ppb), estrone (legal 1 ppb) and estradiol (legal limit 3 ppb) (Ding et al. 2009; Friedman 1984; Scheif 1985; Houston 1985).

The USDA and the Food and Drug Administration (FDA) initiated another large-scale study on di-ethylstilboestrol (a synthetic non-steroidal estrogen) after the Center for Disease Control (CDC) was unable to detect viable etiologies of the epidemic in Puerto Rico in the early

1980s. The FDA focused their study on this synthetic non-steroidal estrogen because “no other compound was pharmacologically active enough to cause a problem of this magnitude” (Crawford 1985). This study concluded that there were no exogenous estrogens in any packaged meat or dairy products (Crawford 1985). According to Schiff and Ravnika (1985) after the aforementioned investigative efforts and their lack of follow up studies, causes of premature sexual development in Puerto Rico remain unclear. Documented abnormalities in hormonal secretion and pituitary function are also absent from this epidemic. Schiff and Ravnika (1985) suspect that an unrelated etiology is responsible for this health issue. As these studies attempted to disprove Sáenz de Rodriguez et al. (1985) and Comas 1982) theories, they created new directions for research by eliminating diet as a potential etiology and shifting the focus on to other common consumer items such as cosmetics, industrial waste and water quality.

Since the late 18th century epidemiologists have recognized a strong link between obesity and early puberty (Dunger et al. 2005). Typical associations in the literature include the relationship between low birth weight, rapid post-birth weight gain, increased central fat deposition, insulin resistance, an increased tempo of statural growth, adrenarche and the timing of puberty (Dunger et al. 2005; Garn and Haskell 1959; Morrison et al. 1994; Garn et al. 1983; Adair and Gordon-Larsen 2001). Existing data is yet to identify the precise biological connection between weight gain and these physiological changes, but there is a consensus that several hormonal mechanisms are likely to be involved in this relationship between weight gain, obesity and early pubertal development (Parker 1991; Ong et al. 2002; d’Alleva et al. 2000; Wilson and Suter 2000). While numerous evidence based correlations have been identified, this link is not strongly associated with the epidemic that occurred in Puerto Rico. This absence of data prompts directions for future research that include the evaluation of medical records in order to identify

anthropomorphic measurements such as weight and height in patients diagnosed with precocious puberty and premature thelarche.

Etiologies Based on Race

Since the late 1990s quantitative researchers have arrived at a consensus on two ideas: that physical mechanisms responsible for determining the onset of puberty remain unclear and that metabolic imbalances caused by exogenous sources can result in premature sexual development (Roa et al. 2010; Papadimitriou et al. 2006; Herman-Giddens 1997; Waring and Harris 2005; Crews et al. 2000; Colon et al. 2000; McLachlan et al. 2006; De Vries et al. 2010; Murray et al. 2001; Guzman et al. 2006). The majority of these studies verify that modern consumption practices are involved in the exposure of external agents. However, most of these researchers do not include information on the social and behavioral implications of their data. Instead, they replace social and behavioral data with culturally constructed notions of “race” to indicate that premature sexual development typically occurs in certain groups of people. This explanation caused researchers to temporarily abandon the notion that these conditions were caused by exogenous agents. Some of the literature suggests that African-American females experience puberty earlier than females who identify as white, but few explain how social factors and exogenous agents might attribute to this difference (Herman-Giddens et al. 1997).

Herman-Giddens et al. (1997) suggest that race should be incorporated in the evaluation criteria of pubertal development. This idea resulted from their study on the progression of pubertal development in the United States through an extensive evaluation of clinical records for 17,077 girls. These medical files were organized by the racial categories African- American (9.6%) and White (90.4%). Methods of race identification are unclear, but it can be deduced that racial classification was self reported by the patient or the patient’s family (Herman-Giddens et

al. 1997:506-507). Using the Tanner Scale to evaluate this data, results indicate that African-American females are more likely to develop breasts and have their first menses 1 to 1.5 years earlier than their White counterparts (*see* Figure 3 and Figure 4). Figure 3 indicates that there was a noted difference in breast development between White and African-American females between ages three and eleven with drastic increases beginning around age seven. According to this data, this racial disparity in breast development begins to taper by the age of 11. Study results also identified differences between age and the prevalence of menses in White and African-American girls that is explained in Figure 4. By age 9, 0.2 percent of White and 2.7 percent of African-American females in this sample have a menstrual cycle. This difference continues to increase over the next four years and by age 12 the incidence rate is 35.2 and 62.1, respectively (1997:510).

Tiwary (1998) argues that ingredients in African-American hair care products can explain some of this supposed “racial disparity”. Her study is based on the patient history of $n = 4$ African-American females, ages 14 to 93 months, who were diagnosed with premature thelarche or premature pubarche after their mothers began grooming them with estrogen or placenta-containing hair care products. Tiwary describes estriol (a short acting estrogen) as “biologically active”, meaning that it can bind to immature uterine tissue, vaginal tissue and alter plasma progesterone levels (1998:734). After organic causes were ruled out, patient histories revealed that each of the subjects' mothers used these hair care products on their daughters and they were prescribed to discontinue use. The type of hair care products used, the age when the female started using these hair care products, the age of onset of sexual development after using these hair care products, the total duration of hair care product use and the type of sexual development present at diagnosis varied for each girl (*see* Table 1). One to thirteen months after

the cessation of using estrogen or placenta-containing hair care products pubarche was slowed and breast size was reduced in each of the four girls. Tiwary concludes by warning that natural and synthetic

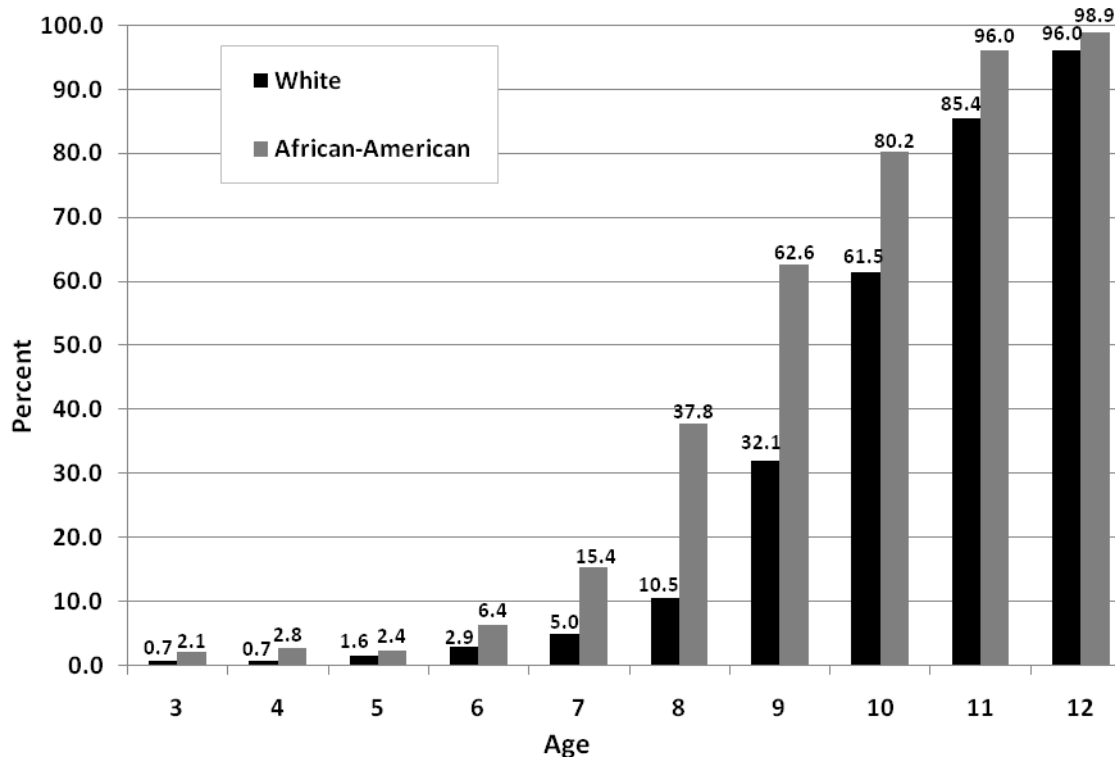


Figure 3. Prevalence of breast development at Tanner stage 2 by age and race (Herman-Giddens et al. 1997:508).

estrogens are used in a variety of dermatological products and that even small amounts can cause disruptions in reproductive development and health (1998:737). In further applications of this study it would be interesting to understand how estrogen- and placenta-containing hair care products are used in the Afro-Caribbean groups in Puerto Rico and if similar forms of cosmetics are used by other females on the island.

Racial classifications are typically based on skin pigmentation which can be measured using methods of spectrophotometry (Gravlee and Dressler 2005:196). Anthropologists Clarence Gravlee and William Dressler (2005) use their study on the relationship between skin pigmentation, self-perceived color and arterial blood pressure in Puerto Rico to describe how the island's complex racial identification system is based on interrelatedness between socio-economic status and skin pigmentation. In Puerto Rico's unique racial classification system, discrimination and racial self-perception are greatly influenced by one's socio-economic position as self-identified darker pigmentations are typically associated with a lower social class and higher arterial blood pressure (2005:197). Understanding the fundamentals of the Puerto Rican race system will be useful in decoding the arbitrary social categories that are used in the medical records. This information may also provide insight about what other underlying social patterns such as socio-economic status might exist in the population of females who were diagnosed with premature sexual development.

Environmental Considerations

The *United States Geological Survey Ground Water Atlas of the United States* provides additional evidence of chemical contamination stating that water availability and ground water quality are principal problems in Puerto Rico. Contaminants come from saltwater intrusions in the limestone aquifers that carry waste from "100 solid-waste disposal sites in Puerto Rico, as well as an unknown number of wells used for the water content on both coasts. The *United States Geological Survey Ground Water Atlas of the United States* indicates that an additional source of exposure to synthetic steroids and estrogenic contaminants could be from industrial waste practices and their effects on water quality. Hunter and Arbona (1995) explain that the island is too small to expand existing dumps and designated hazardous waste areas. As a solution, 30 foot

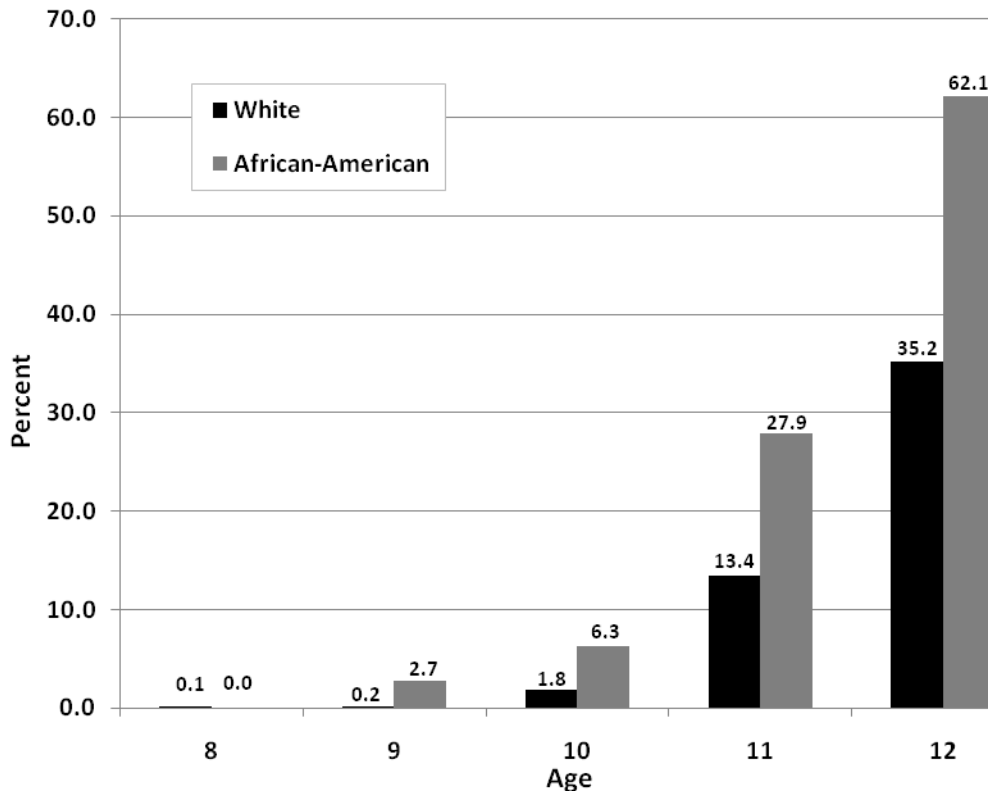


Figure 4.Prevalence of menses by age and race (Herman-Giddens et al. 1997:510).

sink holes have been created so that excess industrial waste can be packed down into them to conserve the space of existing dump sites. Many of these sink holes sites reside near the coastal areas which are in close proximity to the northern and southern limestone aquifers that are a primary source of drinking water for insular inhabitants (*see* Figure 5). During the rainy season, chemicals from these industrial waste products leak in the soil and coastal ground waters, potentially creating an additional source of exposure to threatening synthetic estrogens and steroids (1995). In the Environmental Protection Agency's list of organic chemicals and contaminants, all of the toxins that can cause reproductive health problems are related to waste

products created by chemical industries and commercial farming, both of which have been occurring in Puerto Rico for several decades (EPA 2011).

Hunter and Arbona (1995) report that six out of every ten industrial waste sites in Puerto Rico are in direct proximity to vulnerable aquifers that are used to provide water services to several insular communities. Figure 5 was created to demonstrate the relationship between industrial development, industrial waste practices and their impact on the limestone aquifers that occupy both the northern and southern coasts. This map was developed by integrating concepts from two sources, the first being a map from Hunter and Arbona (1995) that locates the National

THE DURATION OF USE OF HORMONE- OR PLACENTA-CONTAINING HAIR PRODUCTS AND THEIR EFFECTS ON THE DEVELOPMENT OF SEXUAL CHARACTERISTICS					
Patient No.	Contents (estrogen or placenta) of the hair product used	Age when the hair product use was started (months)	Onset of sexual development after the start of use of hair products (months)	Total duration of the product use (months)	Type of sexual development
1	Placenta	10	2	3	Pubic hair
2	Estrogen	12	6	10	Breasts
3	Estrogen	60	24	30	Breasts and pubic hair
4	Placenta and Estrogen	48	12	35	Pubic hair

Table 1. “The Duration of Use of Hormone- Or Placenta-Containing Hair Products And Their Effects On The Development of Sexual Characteristics” in four African-American patients. (Tiwary 1998:735).

Priority List (NPL) [waste] Sites as identified by the Environmental Protection Agency (EPA) and the Environmental Quality Board (EQB) in 1989 and the other being a 2010 map of Pfizer’s

manufacturing plant divestments in Puerto Rico which highlights the majority of the coastal industries which are mostly pharmaceutical, agricultural and construction companies (PharmaBio Source, Inc. 2010; Hunter and Arbona 1995:1342). In Figure 5, the aquifers are outlined in purple and it is easy to recognize a potential relationship between the location of the waste sites (identified as a red hazard sign) and the industries that occupy the entire circumference of the Puerto Rican coast (identified as blue balloons). The literature provides no current maps of industrial waste areas, but it is suspected that the number and size of these dumping sites has increased since 1989. Future research directions should include testing water samples to determine how industrial waste practices may be ultimately contributing to pediatric health abnormalities through the contamination of local water sources.

There is no data available to verify the relationship between Comas and Rodriguez's theories, but it is possible that exposure to toxic chemicals increased due to industrial waste practices their inappropriate disposal of anabolic steroids and estrogenic contaminants. Poor water quality may have compounded the physical effects of steroidal or estrogen exposure that was already occurring in women through consumption of high-dose birth control pills, meat products, medical equipment and cosmetics. Scant literature on the geographical trends of the precocious puberty and premature thelarche epidemic in Puerto Rico makes it difficult to include epidemiological data into Figure 5. However, the patterns that are represented in this map in combination with evidence in the qualitative literature may compensate for this lack of data.

Since the majority of the insular population resides on the urban coasts it could be hypothesized that most early sexual diagnoses would occur in the large coastal populations; however, there is not literature solidifying this speculation. Future research should use Figure 5 to explore the relationship between industrial developments, environmental degradation and the

incidence of precocious puberty and premature thelarche diagnoses. Currently, ecological dynamics of premature sexual development in Puerto Rico can be analyzed using frameworks from the non-human animal data. This majority of this literature reinforces the hypothesis that there are environmental etiologies involved in the precocious puberty and premature thelarche epidemic in Puerto Rico that should be considered in future studies.

Endocrine Disrupting Chemicals (EDCs)

According to the quantitative literature, it is clear that exogenous hormones are involved in the activation of premature reproductive development but researchers struggle to identify what specific hormonal disruptors are involved and whether or not the age at exposure affects its progression. Crews et al. (2000) claim that endocrine disrupting chemicals (EDCs or EDs) are the primary cause of premature sexual development worldwide. The primary endocrine disrupting chemicals of concern are called phthalates. The Environmental Working Group claims that phthalates can disrupt the endocrine system and that they are “nearly ubiquitous in modern society, found in, among other things, toys, food packaging, hoses, raincoats, shower curtains, vinyl flooring, wall coverings, lubricants, adhesives, detergents, nail polish, hair spray and shampoo” (Environmental Working Group 2007). Currently, there is no standard level of toxic phthalate exposure because these chemicals are so widespread and can be detected at high levels in healthy human beings (McLachlan et al. 2006).

Evidence in the Non-human Animal Data

Non-human animal data serves as a microcosm to explain how the phthalates in consumer and industrial waste products can affect reproductive health. Researchers confirm that EDCs can be found in the environment and have been shown to affect the endocrine function of non-human animals and their progeny in natural and laboratory settings (Waring and Harris 2005:2). Calafat

et al. (2004) claims that a major source of EDC exposure in mammals comes from the phthalate di-ethylhexylphthalate (DEHP), which is found in polyvinyl chloride (PVC) plastics. These types of phthalates are also commonly found in medical equipment such as tubing and blood storage bags. DEHP has been shown to negatively affect the reproductive system of both rats and rabbits by decreasing their fertility and affecting estrogen secretion levels.

McLachlan et al. (2006), argue that estrogenic contaminants negatively affect reproductive function and that this evidence can be seen in the animal data. They state:

“Studies have shown that male fish in detergent-contaminated water express female characteristics, turtles are sex-reversed by polychlorinated biphenyls (PCBs), male frogs exposed to a common herbicide form multiple ovaries, pseudohermaphroditic offspring are produced by polar bears, and seals in contaminated water have an excess of uterine fibroids” (2006:63).

High levels of EDC exposure due to modern and industrial waste products can increase the amount of estrogenic effects in the body, causing a variety of reproductive health issues. Pesticides, plasticizers, and other EDCs mentioned in this study mimic phytoestrogens that are found in the natural environment, decreasing androgen (male sex hormones) activity and disrupting the estrogen-to-androgen ratio. McLachlan et al. (2006) hypothesize that environmental toxins will increasingly affect human reproduction as they continue to accumulate and spread across the global environment (2006:63). In the context of precocious puberty and premature thelarche in Puerto Rico, researchers suggest that there is a relationship between the increased exposure to phthalates, which act as anti-androgens and increase the estrogen-to-androgen ratio causing reproductive health issues such as premature breast maturation (2006:67).

Premature Thelarche in the 21st Century

Colon et al. (2000) identified a relationship between elevated plasma levels of phthalic esters and early thelarche in Puerto Rican females. This case-control study included 41 females with premature thelarche ages six months to eight years of age and 35 females with normal pubertal development who were six months to ten years of age. Whole blood was extracted from each of the test subjects and the following phthalate esters were identified in the blood serum samples: dibutyl phthalate (*DBP*), diethyl *phthalate* (*DEP*), benzyl butyl phthalate (*BBP*), dioctyl *phthalate* (*DOP*), Bis (2-ethylhexyl) *phthalate* (*DEHP*), and *Mono*-(2-ethylhexyl) phthalate (*MEHP*). Phthalate esters were detected at significant levels in 68% of the premature thelarche cases. *DEHP*, the plasticizer that is most commonly used in commercial goods, had the highest presence in the blood serum levels with a ratio of average concentrations between (control:case samples) of 70:450 parts per billion (ppb) (2000:898) (*see* Figure 6). Colon et al. discuss the widespread use of *DEHP* in goods that are ingested by children such as plastic packaging on food, waste contaminants in the water, plastic toys, pacifiers and the polyvinyl chloride medical equipment (2000:889). The estimated average daily exposure of *DEHP* in the United States ranges from 0.21 to 2.1 mg/day (David 2000). Colon et al. (2000) argue that the absence of data on the concentration levels of phthalate esters in the general population inhibits this research from being able to confidently state that there is a correlation between EDCs in commercial goods and the increased incidence of precocious puberty and premature thelarche.

Methods EDC of Transmission

Murray et al. (2001) studied the effects of EDCs on male reproductive health confirming specific genes in humans are sensitive to slight hormonal disruptions and can result in reproductive health issues such as infertility, low sperm concentration, poor sperm quality and

testicular malformation (2001; Latini et al. 2006). Non-human animal data is used to identify the numerous effects that EDCs can have when they are exposed to the fetus *in utero*. Translating these studies to the human population is difficult because maternal doses will vary significantly, leaving the concentration of EDCs that are representative of fetal exposure levels unknown. Clausen et al. (2012) describes how the chemical properties of phthalates allow for a gradual emission of toxins into the air. This effect is compounded at higher temperatures allowing materials made with phthalates to potentially emit over 200 times the normal air concentration of $0.9 \pm 0.1 \mu\text{g}/\text{m}^3$. Puerto Rico's warm Caribbean climate may promote an increased emission of phthalate toxins from materials and waste products contributing to the accumulating affect of EDCs contamination in this insular environment (2012).

Murray et al. (2001) identifies several other confounding variables that can complicate the study of EDCs in the human population. These variables include the numerous chemicals that are termed EDCs, understanding how these chemicals bioaccumulate in the body's lipids, how these lipids are metabolized during pregnancy releasing EDCs from the maternal body into circulation, and the fact that the kinetics of how EDCs transfer across the placenta is poorly understood (2001:80). These obstacles indicate that the level of fetal exposure remains unknown but some studies have highlighted the need for large-bodied animal models so that the details of EDC transmission can be better understood (2001).

Murray et al. (2001), Waring and Harris (2005), McLachlan et al. (2006) and Colon et al. (2000) each use non-human animal data to suggest that there may be a critical period of exposure during embryonic development in which excessive estrogenic activity may disrupt biological systems. This information is also present, though much more hypothetically, in the human literature. Endocrinologists explain that the human fetus develops peripheral endocrine glands

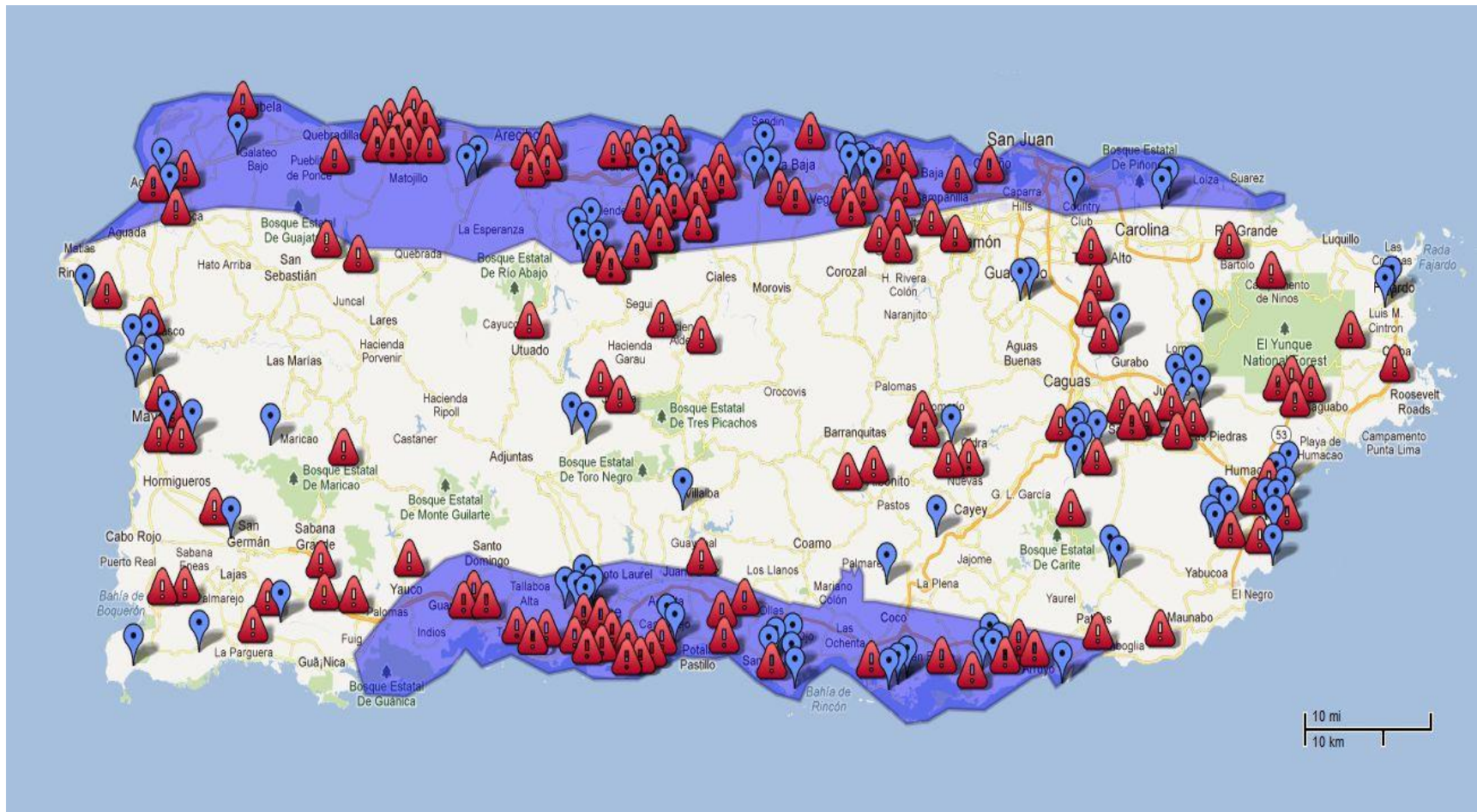


Figure 5. This map was adapted from the 2010 PharmaBio Source Inc: Pfizer Plant Network Consolidation: Puerto Rico Manufacturing Plant Divestments (PharmaBio Source, Inc. 2010) and Hunter and Arbona’s (1995:1342) 1989 map of the high density of dumping sites that were created for industrial waste because of economic development. Concepts from both of these maps were integrated to visually demonstrate the proximity of toxic waste sites to industrial developments and also to show how industrial waste areas are increasingly concentrated near the limestone aquifers that provide drinking water to many insular communities. Industries are symbolized by blue balloons, the dumping sites are marked with red hazard signs, and the limestone aquifers are demarcated by the purple-shaded areas.

(thyroid, pancreas, adrenals and gonads) beginning early in the second month and into the third month using both their own endocrine system and hormones from the placenta and maternal

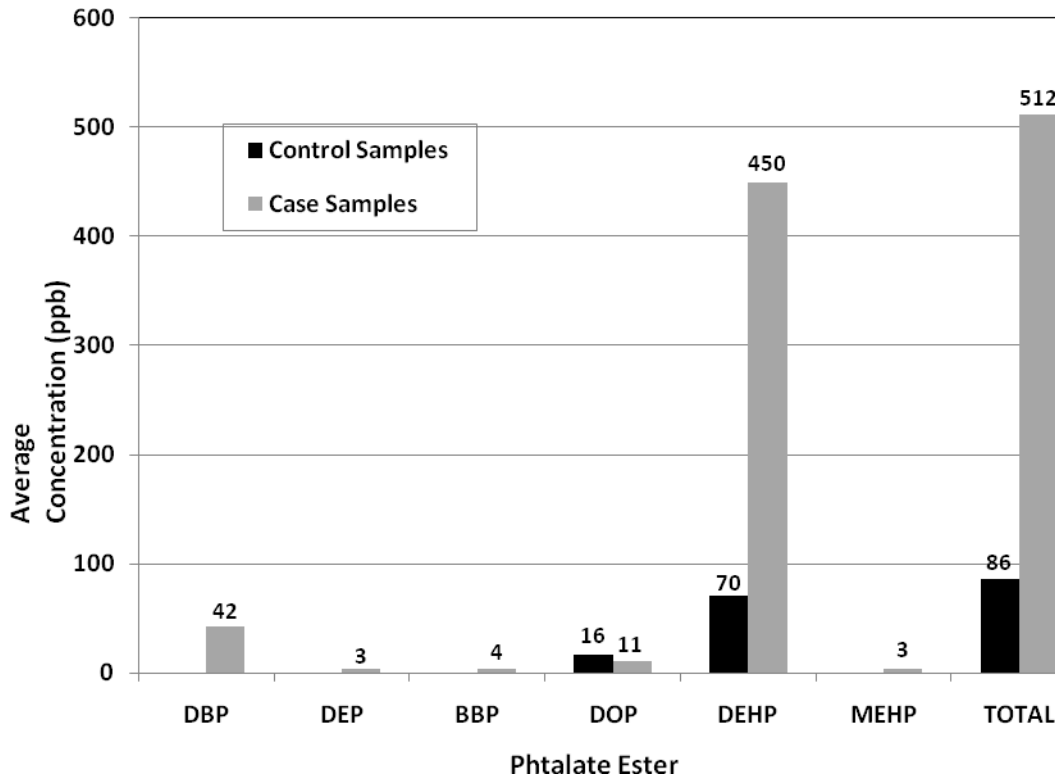


Figure 6. The average concentration (ppb) of DBP, DEP, BBP, DOP, DEHP, and MEHP in 41 thelarche patients and 35 control samples (Colon et al. 2000: 898).

body (Nussey and Whitehead 2001). Several researchers propose the maternal to fetal exposure of EDCs but they have had difficulty identifying a consistent critical period of exposure. The literature on EDCs exposure explains that exposure to multiple EDCs can have both additive and synergistic effects, making it difficult to identify etiologies. Researchers have indicated that EDCs do have a transgenerational, epigenetic effect that can cause reproductive health issues that can be immediate present during childhood or lag until adulthood (Diamanti-Kandarakis et al. 2009).

Fetal Origins Theory and the Puerto Rican Epidemic

Fetal origins theory has dominated the recent biomedical and epidemiological literature as the prevalence of chronic disease persists and few definite etiologies have been discovered. This framework suggests that many, if not all, pediatric (and adult) health outcomes are determined in the nine months of fetal development prior to birth (Pike and Kuzawa 2005). Advocates of this theory describe its biological underpinnings by explaining how plasticity is essential to survival but that its long-term effects are often variable. Pike and Kuzawa (2005:2) claim that “selection is strongest early in life, when pre-reproductive mortality is highest, and responses made by the fetus or infant that boost the chances of surviving this difficult period could be favored by natural selection, irrespective of their late life sequelae”. Developmental plasticity and maternal to fetal transmission are essential components of fetal origins theory. Together these physiological features indicate that negative health outcomes, like premature sexual maturation, could be a consequence of the survival mechanisms the fetus adopts in order to survive in a threatening intrauterine environment (2005). Future research should ask the following question: Could the precocious puberty and premature thelarche epidemic in Puerto Rico have been caused by fetal plasticity in response to the maternal to fetal transmission of EDCs?

How can the information provided in the literature review justify the maternal to fetal transmission framework of this pediatric health condition? The industrial development era was strategically implemented by political and economic authorities to free Puerto Rico from the plenary powers of the United States. Women were affected by the earliest forms of this movement through their increasing opportunities in formal employment and family planning. Though there is no precise evidence indicating that the large scale birth control campaigns of *La*

Operación and the *Searles Trials* were coercive, but it is clear that early oral contraceptives contained dosages of estrogen and progestin that were hazardous to women's health (Briggs 2002). Shifts in the estrogen-to-androgen ratio can affect reproductive health (Junod and Marks 2002) and prior to the development of low dose pills, first trimester exposure to oral contraceptives has been correlated with birth defects involved the vertebrae, anus, heart, trachea, esophagus, kidney and limbs (Pergament et al. 1994). Additional evidence of teratogenacity in the literature indicates the dosage and type of progestin compound used in oral contraception is highly variable but has been related to issues fetal masculinization and feminization (*Encyclopædia Britannica*2012). The “Turning Theory into Practice: Applications of Medical Anthropology in the Study of the Precocious Puberty and Premature Thelarche Epidemic” section includes a discussion about how future studies should analyze the influence that women's social position had on their willingness to participate in family planning campaigns and how these behaviors may have initiated or catalyzed this epidemic through the maternal to fetal transmission due to the effects of estrogenic and androgenic effects that were caused by the high, experimental doses of oral contraceptives.

Hunter and Arbona (1995) argue that cheap and quick economic development has turned Puerto Rico into a gigantic landfill that is slowly contaminating local water sources. The development movements *Operación Manos a la Obra* and Section 936 encouraged United States' industries to relocate to the island by enticing them with tax breaks and lower wages and without considering the effects of industrialization would have on the greater environment (Galvan 2009:13). When the pharmaceutical industry expanded in the early 1980s, Puerto Rico's waste disposal issues worsened as heavy rains caused the increasing number of landfills and sink holes to leak waste into the coastal waters (Hunter and Arbona 1995).

Calafat et al. (2004), Waring and Harris (2005) and McLachlan et al. (2006) claim that phthalates in the environment affect reproductive function in animals, but how they influence human reproduction remains understudied. Due to the increased amount of pharmaceutical and medical industries in Puerto Rico, future studies should test water sources for phthalate contamination and explore how behavioral adaptations have been shaped around the decreasing water quality in order to protect one's health.

Sáenz de Rodriguez et al. (1982 and 1985) and Comas (1982) were the first to identify hormones as an etiology of the precocious puberty and premature thelarche epidemic. During the American Regime, meat and dairy consumption increased drastically as it was no longer symbolic of special occasions or wealth (Carr 1984). This shift in dietary consumption justifies why Sáenz de Rodriguez et al. (1982 and 1985) and Comas (1982) considered the anabolic steroids in meat products to be causing premature sexual development; warning that women and children especially should avoid eating these foods. The FDA and the USDA dispelled these notions with large-scale studies, but had little follow-up data to strengthen their argument (Schiff and Ravnkar 1985). It is difficult to determine retroactively if meat and dairy consumption is an etiology of this epidemic. This research indicates that it is important for researchers to consider how food consumption has shifted during the American Regime in conjunction with other consumer culture practices and how these shifts may be working collectively to affect maternal and pediatric health.

Since the late 1930s, Puerto Rico has become a materialistic society where the acquisition of goods is symbolic of upward social mobility (Hanson 1960:70). The majority of consumer goods such as food, clothing, household goods and cosmetics are imported to the island, with over 50 percent of its imports coming from the United States (Wagenheim 1975:104). Several

studies hypothesize that premature sexual development is caused by specific plasticizers, phthalate esters, which are common ingredients in the import products and their packaging materials (Colon et al. 2000; McLachan et al. 2006). Studies on animals in both natural and laboratory settings indicate that endocrine disrupting chemicals mimic estrogenic behavior and affect reproductive health and that these effects may translate to human populations (McLachlan et al. 2006; Murray et al. 2001; Waring and Harris 2005). Tiwary (1998) explores the effects of placenta-and estrogen- containing hair care products to argue that using these products increased the incidence of premature sexual development in four African-American females and that this pathology should not be restricted to racial considerations; however, researchers should be cautious when using this information as no controls and a small sample size might be associated with weak evidence. Collectively, this data promotes the idea that modern goods are a main culprit in the precocious puberty and premature thelarche epidemic and that the racial differences mentioned in other studies may actually be more reflective of a difference in culturally-based consumption patterns.

Cultural shifts influenced the behavioral patterns of Puerto Rican women (and men) and led their increased consumption of material goods and oral contraception, both of which contain EDCs such as phthalate esters. These disruptors can accumulate in the body's lipids due to long-term use and then metabolize across the placental membrane during gestation. Intrauterine exposure to EDCs may need to occur at a specific time in order to predispose infants and children to precocious puberty and premature thelarche. The outcome of these conditions may be compounded after birth due to the continuous consumption of goods and medical equipment that contains plasticizers therefore potentially perpetuating the cycle of this pediatric reproductive health issue.

Medical anthropology's emphasis on understanding the social context of health from a holistic, interdisciplinary perspective has led to the development of a hypothetical correlation between the onset of political and economic movements like *Operación Manos a la Obra*, the rapid increase in capitalist consumer culture and the precocious puberty and premature thelarche epidemic. This sub-field of anthropology can also be used to guide this research in exploring how the broader social conditions of Puerto Rico underlie this precocious puberty and premature thelarche epidemic. Without synthesizing information from both qualitative and quantitative literature resources, it would have been difficult to understand how consumption patterns influence pediatric health from as early as one's prenatal existence. In the “Analyzing the Precocious Puberty and Premature Thelarche Epidemic Within Existing Medical Anthropological Frameworks” section, additional information from this literature review is discussed using considerations and methods from the medical anthropological research that was presented in the “Medical Anthropology and the Significance of Studying the Social Context of Health” section. Using this anthropological insight, there is a further exploration of how social changes might have influenced consumption patterns and behaviors that may have influenced the course of this reproductive health epidemic in Puerto Rico.

Analyzing the Precocious Puberty and Premature Thelarche Epidemic Within Existing Medical Anthropological Frameworks

Nancy Scheper-Hughes's broad cultural diagnosis of social stresses and schizophrenia diagnoses in rural Ireland included several issues with gender roles, the decline of Catholicism, institutional development and family life. Over 87 percent of people in the Republic of Ireland identify as Catholic (CIA 2011). Similarly, Catholicism is characteristic of Puerto Rican identity

with 85 percent of the population identifying as such (CIA 2011). Scheper-Hughes's analysis of schizophrenia in rural Ireland and its relationship to Catholicism, sexuality and shame provokes a discussion about the role of Catholicism in Puerto Rico and how it may be influencing social beliefs and behaviors that were developed in response to the precocious puberty and premature thelarche epidemic.

Before the 1940s, European Catholicism influenced the construction of gender roles in Puerto Rican society (Lewis 1963). Females were believed to be inferior to males due to the pathological explanation that females suffered from a mental disability and were morally weak (1963:265). Young girls were forced to maintain a virginal status early in life and spent the majority of their childhood and adolescence being harassed and discouraged from premarital sexual relations while male sexuality was openly encouraged and supported from a young age (1963:265-266). The advent of industrialization and the implementation of *Operacion Manos a la Obra* in the late 1940s caused a shift in social power, decreasing the influence of the Catholic Church. Oscar Lewis's 1960s ethnographic study of the urban culture of poverty in a slum outside of San Juan, Puerto Rico, includes information about the liberalization of sexuality for both adults and children. According to Lewis (1965:XXVI) by the 1960s, both males and females engaged in early sexual relations though increased parental restrictions were applied to daughters to protect them from premature relations.

When the precocious puberty and premature thelarche epidemic was first acknowledged in the late 1970s, Catholic beliefs about gender and sexuality had liberalized but not changed. Roman Catholicism remains the predominate religion in Puerto Rico. However, in modern times Catholicism has become a symbol of traditional culture rather than a non-secular practice (Galvan 2009; Carr 1984; Lewis 1965). Future research needs to include a consideration how

residual Catholic beliefs about gender and sexuality have influenced the course of this epidemic. Questions to consider include the following: How do the physical and social changes associated with premature sexual development cause feelings of shame that stem from Catholic beliefs about femininity and purity? If modern ideas about shame, gender and sexuality are rooted in Catholicism, how is health-seeking behaviors shaped around these socially ingrained ideas? Despite the declining rate of formal participation, Catholic ideologies may still be influencing perceptions of shame, gender and sexuality. These beliefs may have influenced how this pediatric condition is diagnosed and treated. It may also be important to consider how religious perceptions have affected the diagnosis of associated social and physical outcomes of premature sexual development.

Psychological testing was also used to study the underlying social etiologies of schizophrenia in rural Ireland. The results of these tests revealed that it was the culture of sex rather than the culture of mental illness that caused schizophrenia diagnosis trends (Scheper-Hughes 2001). Traditional Catholic beliefs heavily influenced this culture of sex as these ideas permeated nearly every aspect of Irish existence. This magnitude of religious influence may also be useful in identifying the psychosocial underpinnings of the premature sexual development epidemic in Puerto Rico. The psychology literature on early female sexual development describes how girls who mature significantly earlier than their peers may feel isolated, confused and depressed and that these feelings can linger into adolescence and adulthood (Mendel et al. 2007). A psychological framework could determine what local beliefs influence body image and feelings of shame that become a part of the disease process. Scheper-Hughes's ethnographic research has guided this discussion to explore deeper social considerations of the precocious puberty and premature thelarche epidemic. Her utilization of both psychological and

anthropological methods has served as a template to researching how in the context of early sexual development, perceptions of gender, sexuality, body image and feelings of shame may be influenced by institutional beliefs that are significant to Puerto Rican identity.

Scheper-Hughes's (2001) research on schizophrenia in rural Ireland introduced ideas about how to study the precocious puberty and premature thelarche epidemic from a local perspective. Arthur Kleinman et al.'s (1995) study on epilepsy in interior China also supports this view by discussing how the *social course* of a disease is determined by local contexts that are generated from larger worldviews. The *social course* of epilepsy describes how this pathology affects the patient, their family and their ancestors. This framework describes some lay strategies that are used by close relatives to protect the family's honor and how these protection methods may be representative of China's macro institutional beliefs about disease and disability. Using this concept of the *social course*, researchers can study the biosocial experience of the precocious puberty and premature thelarche epidemic to explain how health seeking behaviors and family dynamics may actually be reflective of macro institutional beliefs.

Like epilepsy, precocious puberty and premature thelarche are visible pathologies indicating that a *social course* of premature sexual development might exist. Females who are diagnosed with early sexual development are at risk of being negatively affected by both the biological and social constituents of this pathology. The *social course* of a precocious puberty or premature thelarche diagnosis could occur through feelings of shame, poor socialization, poor body image and premature sexual relations; all of which could be influenced by familial and greater social reactions to this condition. Precisely how these biocultural outcomes affect these females will vary based on the influence of the local context. Catholicism may have had an influence on the *social course* of this health issue in some regions of the island, but it may also

be absent from other local beliefs about this health issue. Kleinman et al. (1995) strongly suggests that future studies need to evaluate the effects of the *social course* in low-socioeconomic areas. Socioeconomic considerations stimulate other ideas about how this pediatric health epidemic may be influenced not only by underlying religious beliefs and but also by cultural values specific to those of a specific social class.

According to the a report from the 2009 and 2010 U.S. Census data, Puerto Rico's rate of people living in poverty is 45 percent which is significantly higher than the United States rate of 15.3 percent (U.S. Census Bureau 2010). Despite these drastically high levels of poverty, Puerto Rico is a materialistic society where the acquisition of goods, especially those that enhance personal appearance, is a sign of upward social mobility. Oscar Lewis's ethnographic data on low-income Puerto Ricans indicates that these families spend an incredible amount of their income on clothing. This consumption practice is believed to lessen feelings of inferiority in the lower class as they imitate the appearance of the middle and upper class (1965:XXXVII).

While materialism may not be characteristic of all Puerto Rican communities, it would be interesting for researchers to consider how precocious puberty and premature thelarche may affect social practices in different economic classes. If premature sexual development predominately affects people of the lower-socioeconomic class, how do family members socialize this child knowing their pathology is representative of conditions of poverty? In the middle and upper classes where the practice and influence of Catholicism is reportedly greater, how are girls with precocious puberty and premature thelarche socialized? Epileptic patients in Kleinman et al.'s (1995) study typically withdrew from Western treatment because of the risk associated with feelings of shame that were channeled from the greater community. Researchers should think about how the concept of social stigma is similar or different in the context of

precocious puberty and premature thelarche and what are the motives for seeking alternative treatment options?

Evaluating the relationship between socioeconomics and the precocious puberty and premature thelarche epidemic it is apparent that numerous macro social institutions could be involved in the development and course of this pediatric health issue. Paul Farmer's use of the term *structural violence* indicates how large scale social forces determine who gets sick, who has access to treatment and who keeps getting sick (Castro & Farmer 2003; Farmer 2003). This concept could help explain how local contexts in Puerto Rico may be reflective of local world views and that these perspectives are derived from a capitalistic system where consumption is symbolic of upward social mobility and pathology indicates social decay. Farmer's use of *structural violence* pertains primarily to infectious diseases. In this discussion, *structural violence* has been adapted to hypothesize about the effect of macro social institutions have on women's behavior and how this relationship may be contributing to pediatric health issues such as precocious puberty and premature thelarche.

Structural conditions of a society have a significant impact on the development and sustenance of folk illness theories and lay treatment regimens. In Puerto Rico, inhabitants have a variety of local explanatory models of illness, disease, and health most of which can be understood within the frameworks of the "Hot-Cold" syndrome and *Nervios* (Guaranaccia 1993; Guaranaccia et al. 2003; Baer et al. 2003). *Susto* is also a common folk illness that occurs in Hispanic and Latin-based populations; however it does not exist in Puerto Rican society (Weller et al. 2002). In the future applications section of this paper, these folk illness theories will be used to shape discussions about health, illness, and disease in focus groups to determine how

local explanatory models of health have influenced the precocious puberty and premature thelarche epidemic.

The humoral pathology that is known as the “Hot-Cold” syndrome has been identified in nearly all Spanish-American countries including Brazil, Haiti, Puerto Rico, Trinidad and Tobago, the American Southwest, and the Philippines and is assumed to have Old-World origins (Foster 1987:355-356). According to Foster (1987) the “Hot-Cold” syndrome is founded on beliefs that are centered on the concept of homogeneity and balance. These humoral values describe health through the regulation of body temperature and by adherence to the principle of opposites in therapies (1987:356). Alan Harwood’s (1971) study on the Hot-Cold Theory of Disease elaborates on the anatomical-perspective of this belief system in Puerto Ricans. Diseases are categorized independent of their physically temperature properties and are culturally defined as hot or cold (*caliente o frio*). Treatments which are usually in the form of foods, medicines, and herbs also have culturally prescribed temperature properties such as hot, cold, or cool (*fresco*) and are used to neutralize the “hot” or “cold” effects of a given illness.

Harwood (1971) provides several examples of how this humoral system exists in the Puerto Rican population. Patients who are diagnosed with a cold will refused to drink fruit juices because both conditions are believed to be “cold” and therefore drinking juice would worsen the illness. Infant rashes are believed to be “hot” so mothers change the baby’s diet from “hot” evaporated milk infused formula to “cool” whole milk. This dietary transition is gradual so mothers dilute the evaporated milk with substances that have cool properties like barley water, magnesium carbonate, and mannitol. However, this dilution method should be restricted to barley water as the later two can actually cause diarrhea in infants. Prenatal care is also

influenced by this dichotomous belief system as women refuse to take “hot” iron supplements during pregnancy.

The culture-bound syndrome known as the “Puerto Rican Syndrome” is an overarching term used to describe the frequency and numerous types of nerve conditions in the Puerto Rican population (Guanaccia et al. 2003). Guanaccia et al. (2003:343) claim that this illness classification was created by military psychiatrists attached to US Army recruiting and training stations in Puerto Rico who believed that “these expressions of distress denoted something uniquely Puerto Rican” (2003:344). As this syndrome became popularized it indicated to the public that there was a defect in Puerto Rican character and has caused Puerto Ricans to identify with specific expressions of distress. This culture bound condition is still informally yet prominently used in psychiatric practices on the island today and is better known by its’ acronym “*pea are ess*” or PRS (2003:344).

Nervios is a condition that can be classified as PRS and is broadly defined “as a culturally approved reaction to overwhelmingly stressful experiences, especially concerning grief, threat, and family conflict” (Baer et al. 2003:317). Nerve conditions are believed to be developed from integration of one’s physical, emotional and social experience that is sensitive to one’s social context (Baer et al. 2003:316). In Puerto Rico, *nervios* can be broadly defined in three ways: “being a nervous person” (*ser nervioso*), “suffering from nerves” (*padecer de los nervios*) and having “nervous attacks” (*ataques de nervios*) (Guanaccia et al. 2003: 348; Baer 2003:317). Etiologies of these conditions include traumatic experiences of suffering typically, during childhood; depression and life problems that are developed in adulthood; and stressful events that primarily occur in the family setting (Baer et al. 2003:317; Guanaccia et al. 2003). Baer et al. (2003:317) indicate that symptoms of these conditions include unusual amounts of crying,

headaches, stomach aches, and increased anger and violence, particularly in men; mental and physical manifestations of depression; and to become hysterical and “out of control”. Popular and lay treatment methods for these *nervios* conditions include the use of herbal teas, the help of family members, priests and ministers, and psychologists and psychiatrists (Baer 2003:317; Guaranaccia et al. 2003).

The cultural appropriateness of these conditions is primarily based on class, gender and education level (Guaranaccia et al. 2003:349). Guaranaccia et al. (2003) describes a scenario in which these social forces influenced the perceived “normality” of a *nervios* condition:

“What may be considered normal in a working class woman in her rural *barrio*—such as, prototypically, having an *ataque de nervios* during her husband’s funeral— may be judged as the sign of impending mental imbalance in a wealthy man from a prominent family in a similar setting of acute grief. Given the particular social expectations determining such a person’s behavior, the dramatic expressiveness of the *ataque* may appear quite outside the normal” (2003:349).

Nervios is sensitive to the social conditions of Puerto Rican society, but similar to other countries such as Mexico and Guatemala, issues of *nervios* appear to increasingly affect women and the socially marginalized (Baer et al. 2003:318). Demographic data indicates that individuals who are classified as women, middle aged (25 – 44), lower class, and lower education levels are more likely to suffer from conditions of *nervios* (2003:346). Future research should continue Harwood’s (1971) work to explore how folk illness theories have influenced female behavior and how they can be related to premature sexual development in Puerto Rico.

Below, I elaborate on the shifting social conditions of women's lives and suggest that changes in behavior and consumption practices may be partially responsible for this pediatric health epidemic. Next, I identify endocrine disrupting chemicals (EDCs) and the maternal to fetal transmission (MTFT) of these toxins as a primary culprit for premature sexual development. Collectively, this literature review indicates that social shifts initiated by economic and political institutions transformed Puerto Rican society in a way that was unsustainable and detrimental to the insular environment. The increased consumption of consumer goods containing EDCs and the economy's effect on the local environment (i.e. industrial waste practices and its effects on drinking water quality) are two ways that women in Puerto Rico are being exposed to teratogens that may be causing prenatal pathogenic vulnerabilities. In this context, *structural violence's* reactivation process of this disease process remains unclear. Future research directions should consider how this pediatric reproductive health issue is reactivated and if the manifestation of other reproductive health issues such as polycystic ovarian syndrome, endometriosis and breast cancer that occur later in life are a result of untreated premature sexual maturation and continual exposure to EDCs (Franceschi et al. 2010; McLachlan et al. 2006; Key et al. 2001).

Access to treatment and positive health outcomes are another component of *structural violence* that warrants consideration in the precocious puberty and premature thelarche epidemic. The current literature provides no demographic information about the individuals who were diagnosed with premature sexual development during the Puerto Rican epidemic. If this condition predominately affects children from low-socioeconomic classes, access to treatment may be minimal due to lack of resources and consequently, long-term reproductive health may be compromised. Children who are from middle to upper-socioeconomic classes may be more likely to receive a diagnosis and have access to treatment but current medical therapies for this

condition have only proved to be minimally effective (Dixon and Ahmed 2007). Limited treatment options (GnRH agonist therapies and the SUPPRELIN[®] LA (histrelin acetate) subcutaneous implant) and scantily documented health outcomes make it difficult to hypothesize about who is affected by precocious puberty and premature thelarche in Puerto Rico (Central Precocious Puberty Support Central 2011). It is possible that *structural violence* caused this pediatric health epidemic and other reproductive health issues. This informational gap justifies the need for a medical anthropologist to research this epidemic in order to identify behaviors and social conditions that caused this health issue to occur at an increased rate. Medical anthropologists can also use this information to determine if premature sexual development is affecting specific populations and how health-seeking behaviors are shaped around the social context of this pathology.

The dynamic and interdisciplinary methods of medical anthropology allow researchers to understand precocious puberty and premature thelarche through the lens of several academic and professional contexts. This paper interrogates endocrinology and reproductive ecology while emphasizing the interconnectedness between our biological selves and the historical, economical, political and ecological factors that influenced this pediatric health epidemic. Providing summaries of medical anthropologists Nancy Scheper-Hughes, Arthur Kleinman and Paul Farmer's research demonstrates similar yet unique ideas about how to comprehensively study health conditions within specific populations. Each of these research synopses advocates for an exploration of the local context to understand how the biological and social being come together to determine health, disease and illness experiences that may ultimately be reflective of institutionalized norms. Integrating concepts from their case studies with hypotheses about the social etiologies of the precocious puberty and premature thelarche epidemic leads to the

identification of several gaps in the literature that call for a greater, more holistic understanding of this health condition.

Biomedical research can also be broadened by medical anthropological research, making this comprehensive perspective on the precocious puberty and premature thelarche epidemic uniquely important for several reasons. The quantitative literature is missing vital information that could help clinicians understand this health condition. Medical anthropological research could help identify where in Puerto Rico this condition occurs, who is affected by premature sexual development and if there are any long-term physical or social consequences. Interviews and participant observations may assist in identifying local beliefs about this condition and how they affect the health seeking behaviors and treatment. This information could stimulate funding opportunities for additional research to further explore what teratogenic features of these affected areas are similar and assist in identifying definite biological etiologies. Providing these local explanatory models of premature sexual development may help researchers explain how this epidemic has progressed since the 1980s and assist them in understanding lay reproductive health concerns and treatment practices. Outlining the compounding social effects that led to modern consumer practices, environmental degradation and increasing endocrine disrupting chemical exposure for medical professionals may encourage them to take a more sustainable and holistic approach to treating precocious puberty and premature thelarche diagnoses.

Medical anthropology has been rapidly evolving and redefining itself as a sub-discipline since the WWII era. The field's interdisciplinary approach has contributed to a deeper understanding of health, illness and disease that extends beyond the superficial conditions of those who are afflicted. Medical anthropology's unique methodology enables researchers to explore diverse pathologies using various methodologies and academic collaborations in their

work. Dynamic yet holistic research methods of medical anthropology will enable researchers to hypothesize about the social etiologies of the precocious puberty and premature thelarche epidemic in Puerto Rico. This sub-field of anthropology emphasizes that it is essential to focus on the social context of health and its relationship to institutional constructs. Acknowledging this relationship can help researchers explain the interconnectedness between the biological and social processes of health and how critical this framework is to providing effective treatment. While a significant amount of work still needs to be done, the potential outcome of this research might improve academic and clinical knowledge and have an impact on pediatric and long-term female reproductive health.

Turning Theory into Practice: Applications of Medical Anthropology in the Study of the Precocious Puberty and Premature Thelarche Epidemic

The proposed applications of this quantitative and qualitative literature review are outlined in this section using a medical anthropological approach to exploring the underlying social conditions of this pediatric health issue. Below is a research agenda for this anthropological analysis. This section proposes questions and research methods that will help me determine how social institutions have influenced consumption practices and how these behaviors may have negatively affected pediatric reproductive development. Also included in this section are some ideas about how future research can incorporate existing quantitative data into their analysis. Colon et al. (2000) provides evidence that early breast development was prominent in Puerto Rico at the turn of the twenty-first century due to the increasing presence of the phthalate ester DEHP in consumer goods. The proposed study constitutes a follow-up to the findings in Colon et al. (2000) and will focus on social variables suggested therein that are

measured using surveys, semi-structured interviews, participant observation, medical records, focus groups, and bivariate and multivariate statistical analyses.

Before providing a methodological outline of this study, I will introduce three objectives that will guide this research. The most important step in gauging the success of this study will be to assess the population's general level of concern with this pediatric health issue. If Puerto Rican's demonstrate a significant degree of concern then the research can transition to address the next aim. The second objective of this study is to inquire about how the professional medical and lay populations understand this health issue from a physiological and social perspective. This aim will include questions about transgenerational effects of EDCS and determine if there are any factors that cause social perceptions to differentiate. Collecting information about how Puerto Rican's perceive this premature sexual development will lead into the last research objective which is to inquire in both the professional medical and lay community about health seeking behaviors of this condition. These objectives may identify a correlation between cultural practices and industrial development and waste site clusters in the map on page 56 with groupings of precocious puberty and premature thelarche diagnoses that have occurred on the island since the height of the epidemic in 1979.

To begin this research, two surveys will be designed in order to identify the general degree of concern about precocious puberty and premature thelarche in a representative sample of the two aforementioned Puerto Rican populations: the lay and medical communities. Survey respondents will be asked if they are interested in participating in future studies and further screening procedures will be used as a follow up to these responses. Multivariate analyses conducted in SPSS will analyze the relationships among the identified social variables with

reference to the information present in the precocious puberty and premature thelarche literature (Bernard 2006:649-695).

Sáenz de Rodriguez et al. (1982 and 1985) and Comas (1982) claim that there was an increased amount of patients with premature sexual development diagnosed at their San Juan and Ponce practices in the 1980s. Colon et al.'s (2000) research was conducted at the San Juan City hospital. The heightened concern in large cities might indicate that this health condition may be increasingly prevalent in urban, coastal areas. Based on the evidence provided by Sáenz de Rodriguez et al. (1982 and 1985) and Comas (1982), the distribution of both surveys will begin in a select community within a large urban city center, such as San Juan and Ponce. In order to create a geographically diverse data set, surveys will also be distributed in three additional cities in Puerto Rico: Mayagüez, Arecibo, and Fajardo. These cities are all heavily populated locations that reside on both the west and east coasts, while Ponce and San Juan occupy northern and southern coasts. Identifying the level of concern in regards to precocious puberty and premature thelarche in these urban centers may provide insight about where this pediatric health issue is concentrated, if it occurred across the island or if it may be more predominate in rural areas.

After the survey responses have been collected and analyzed, an ethnographic study will be conducted in the two cities whose inhabitants demonstrate the highest level of overall concern about precocious puberty and premature thelarche. Key informants from both the lay and medical professional groups will be asked to participate in semi-structured interviews with their contact information being extracted from survey responses. In addition to semi-structured interviews for the lay population, research methods will include participant observation to study how premature sexual development affects daily socialization and adult health. Household item assessments will also be used to identify specific sources of phthalates most common in Puerto

Rican homes. Upon approval of the Institutional Review Board and in compliance with ethical medical research, a review of patient cases and medical records from health clinics and hospitals in the two urban centers under study will provide information about age of onset, course of disease, treatment methods, follow-up care and long-term reproductive health concerns (*see* Miller 2008) .

Focus groups will complement the survey and interview data by identifying how Puerto Rican's feel about the precocious puberty and premature thelarche epidemic and how these perceptions affect health seeking behaviors (Bernard 2006:233). Survey respondents who demonstrate a keen interest or strong concern in regards to this health issue, but are not key informants, will be considered applications for these focus groups. Though the details of this process will be refined in the actual study, it seems beneficial to have focus groups that consist of both a dynamic age-set of male and female participants. Their interest in participating in this research may indicate their willingness to disclose information about the social conditions of the epidemic (Bernard 2006:237).

This group of informants can provide researchers with information about how local knowledge concerning about premature sexual development has changed overtime and how these beliefs may have affected the course of this epidemic. Participants can also elaborate on local folk illness theories and explanatory models of health, illness and disease in Puerto Rico. Discussing local health frameworks may stimulate a discussion about the lay diagnostic criteria and treatment methods of premature sexual development if it is classified as either a “hot” or “cold” condition. Understanding how this health issue is diagnosed within this local context may organically lead to a discussion about treatment methods and therapies and how health seeking behaviors are influenced by conflicts between local and biomedical models. Below are potential

topics of inquiry that can be used during an ethnographic study as researchers are conducting interviews and focus groups.

General Population Inquiries

Key informant interviews and focus group discussions in the lay population will provide information about the social context of the precocious puberty and premature thelarche epidemic. Interviewees will respond to these questions from a personal perspective. The first topic of inquiry will focus on general explanatory models (Kleinman 1978) of health followed by a discussion of gender roles and family composition. This information will provide a general layout for how health and illness experiences are constructed in these Puerto Rican communities. Following this phase, key informants and focus group members will be asked about gender roles and their effects on health and health seeking behaviors. Participant responses to these general questions will provide a basis for understanding how beliefs about gender influence the social experience of health in Puerto Rico. This information will be essential to understanding more complex perceptions of health when interviewees and participants are asked more specifically about the precocious puberty and premature thelarche epidemic.

The diagnosis of precocious puberty and premature thelarche, like any pediatric health concern, is most likely to begin at the familial level (Kleinman 1995). Exploring intrafamilial dynamics can help identify how lay diagnoses are formulated and how one's condition may cause disruptions in family structure. Questions about sexuality will shift interviews and focus group discussions from general features of Puerto Rican culture and health to topics specifically concerning the precocious puberty and premature thelarche epidemic. In relation to sexual health, maternal and child health care practices may also be fundamental to understanding this health condition. Questions concerning prenatal care within both the formal and lay settings will

lead to inquiries about fetal origins theory. Informants will be asked to describe how they perceive this framework and if they believe it could be applied to the pediatric health conditions in Puerto Rico. The responses of these questions will be mapped on to the ecological considerations that are demonstrated in Figure 5. This information will be used to identify any existing relationships between the location of residence, social beliefs, the prevalence of environmental degradation and waste and the premature sexual development epidemic. These questions will be followed up with inquiries about lay preventative measures that are used during gestation to promote fetal and pediatric health.

These questions will be complementary to the household items assessments and can be conducted during interviews and participant observations. Inquiries about consumer behavior would include individual waste practices and how participants understand the relationship between health and environmental pollution. In addition, an analysis of individual consumption practices can indicate the prevalence of phthalate esters at the household level. Evaluating household consumption and waste practices in conjunction with household assessments can validate quantitative theories that commercial goods contain phthalic agents and are commonplace locally in Puerto Rican homes and in the greater environment.

After a discussion about household consumption and waste practices, inquiries will begin to focus more specifically on the precocious puberty and premature thelarche epidemic. First, it will be important to reconfirm the interviewees' level of awareness about this pediatric health issue. If so, it would be useful to ask age appropriate participants to provide personal accounts of the height of the epidemic in 1979. Further questions will request that the respondents share their individual opinion about why this epidemic occurred. Lastly, informants will discuss current condition of this health epidemic and if there are certain groups of people who are more

likely to be affected. Creating lay explanatory models of premature sexual development will enable researchers to indicate specific social conditions that may be contributing to this epidemic.

Semi-structured interviews and focus groups will reveal local perspectives of the social etiologies of the precocious puberty and premature thelarche epidemic. This will be achieved through a discussion about general explanatory models of health, gender, family composition, sexuality, maternal and child health care, and through personal accounts of the precocious puberty and premature thelarche epidemic. These proposed research methods in combination with survey data may identify specific underlying features of premature sexual development that are considered common indicators in the quantitative research (i.e. African-American girls are more likely to experience premature sexual development than their white counterparts). This information might also pinpoint certain consumer goods that contain a high amount of phthalates and are prevalent in Puerto Rican households. In addition to a lay perspective, the medical professional beliefs will be explored. This research may happen naturally due to the likelihood that some physicians, epidemiologists and other health workers will respond to the general population survey. Differences in the lay and professional explanatory models will be useful in canvassing how this relationship has affected diagnostic criteria and treatment methods of this disease.

Inquiries for the Medical Community

Semi-structured interviews and a review of relevant medical records will help researchers identify how professional explanatory models of general health and more specifically, precocious puberty and premature thelarche, differ from that of the lay population. These research methods will also aid in the understanding how beliefs and practices in the medical community have

influenced the course of this epidemic. Under the condition that I am granted access to review medical records of premature thelarche and precocious puberty patient cases, they could use this information to document any trends present in the patients' history including the ways in which gender, the length of cases, age at diagnosis, age at recovery, socio-economic background and ethnicity are associated with premature sexual development in Puerto Rico. Regardless of my ability to access these files, physicians will be asked about clinical trends that they noticed in patients at the height of the epidemic. These interviews and medical records should inquire about conditions of co-morbidity in patients who were diagnosed with conditions of premature sexual development and explore the relationship between the high dosage experimental oral contraception and its potential effects on pediatric endocrine function. Physicians will be asked to discuss the frequency of this health issue, if they believe it affects specific populations in Puerto Rico or if this pathology is an island-wide concern. Specific questions will be targeted towards the supposed racial disparities of premature sexual development as medical professionals will be asked to describe how they define the category of "Black", Afro-Caribbean and the like. Physician interviews will investigate the relationship between female behavioral changes, diagnostic processes, treatment seeking behaviors and the epidemic of precocious puberty and premature thelarche in order to identify how this health condition has evolved over the last 30 years.

In an absence of known etiologies and accurate longitudinal studies, physician interviews will include inquires about long-term health effects, etiologies and treatments for premature sexual development. A review of the medical records will follow up these interviews further to support or reject these hypotheses. Physicians will also be asked to describe their knowledge about similar epidemics in Italy and Minnesota and if they believe these geographically

widespread cases have similar etiological underpinnings. Exploring the medical perspective of health outcomes, etiologies and treatment methods, future research may be able to generate some explanations about how clinical practices have influenced the course of this epidemic.

In 1981, medical anthropologist Peter Guarnaccia researched the social and environmental conditions of the asthma epidemic in Puerto Rican children in Hartford, Connecticut. In his research, Guarnaccia identified household and familial conditions that were affecting the asthma rates. These included parasites, cockroaches, dust mites, air pollution, infections, housing problems and family problems (Guarnaccia 1981:13). Guarnaccia's efforts to identify social and behavioral conditions of a pediatric health epidemic have inspired the methods discussed in this section. Future research should include the use of anthropological methods that test social etiological theories provided in this literature review using surveys, semi-structured interviews and participant observation. Identifying and comparing lay and physician explanatory models will enable researchers to formulate social explanations for how this epidemic occurred and what behavioral changes have allowed it to proliferate. Guarnaccia's research validates the importance of anthropological methods in researching health epidemics identifying social conditions at the household level that have a negative effect on pediatric health. This work has been influential in the development of these hypotheses that aim to understand the social conditions of the precocious puberty and premature thelarche epidemic in Puerto Rico.

The Importance of Using Medical Anthropology to Identify the Social Context of the Precocious Puberty and Premature Thelarche Epidemic

Medical anthropology's interdisciplinary framework for researching the social context of health, illness and disease is essential to exposing the underlying and ultimate causal factors of modern medical quandaries. The incidence of precocious puberty and premature thelarche in Puerto Rico is 40 times greater than the global rate and is 18.5 times greater than the second largest epidemic that occurred in Minnesota in the early 1980s (Colon et al. 2000). Female-based studies of this condition were exclusively included in this argument because of the great disparity in sex-related incidences in Puerto Rico (Cesario and Hughes 2007). The quantitative literature indicates that premature sexual development is a complex process that includes both biological and social variables. Deficiencies in the quantitative data indicate the need to focus on the social context of premature sexual development to identify ultimate causalities of this health condition. This paper argues that without a mixed-methods (qualitative and quantitative) approach to the literature review and the future research design, the broader understanding of the precocious puberty and premature thelarche epidemic may remain unknown.

Without definite etiologies, it is difficult to ascertain if there are long-term health risks associated with this pediatric disease. McLachlan et al. (2006) claim that endocrine disrupting chemicals are the primary cause premature sexual development, breast and uterine health issues but the relationship between these pathologies remains unclear. The qualitative literature suggests that in the context of Puerto Rico, this epidemic was ultimately caused by the adoption and influence of American capitalism as a strategy to attaining political and economic autonomy. The first aim of this paper was to advocate for a mixed-methods approach to understanding precocious puberty and premature thelarche in Puerto Rico. After an analysis of themes within both sets of literature, researchers will hopefully be have a better understanding

about how to explore this health issue in future studies. Shifts in female consumption practices and behaviors are a consequence of modern social developments. Without the insight of the quantitative literature this theoretical relationship between behavioral changes and this epidemic may remain unexplored.

This analysis of the quantitative and qualitative literature includes resources from the disciplines of biomedicine, epidemiology, ecology, public health, history, political science, psychology and anthropology. The second aim of this paper is to identify a relationship between behavioral shifts in formal employment, family planning campaigns and the adoption of materialism that may be useful in describing the relationship between consumption patterns, teratogen exposure and premature sexual development in Puerto Rico. The results of this research suggest that a medical anthropology's interdisciplinary approach to this health issue is essential for understanding abnormal reproductive development in Puerto Rican females. This multidisciplinary literature review led to the development of hypothetical social contexts that emphasize the critical impact social institutions have on health and health outcomes.

Puerto Rico's rapid and unsustainable development projects were a result of the social frustrations the insular population felt after century's worth of economic and political suppression (Galvan 2009:46). Operación Manos a la Obra was used as a strategy to boost the economy, strengthen political ties and eventually gain independence from their paternalistic relationship with the United States. This industrial development era created thousands of new jobs but it was not enough to provide employment for all of the displaced agricultural workers. The decline of the agricultural industry and the new post-war economy's improved some aspects of Puerto Rican life but also contributed to the expanding urban slum barrios. This institutional strategy failed to absorb the Puerto Rican labor force and blamed the islands rapidly increasing

population rate for the social pathologies that persisted into the “Golden Era” of Operación Manos a la Obra.

The development of industrialization in Puerto Rico shifted employment practices. Women’s success in the needlework industry made them prime candidates for the new wave of industrial labor and also made it easy to engage them in contraception campaigns which provided women with a sense of reproductive autonomy (McLeod 2009; Purdy 2006). When the success of Operación Manos a la Obra failed to materialize, family planning campaigns were initiated to control fertility rates. The qualitative literature suggests that women complied with contraceptive measures such as sterilization and birth control because they wanted to maintain their new social roles as providers and consumers (Ayala and Bernabe 2007). The framework of political ecology explains how social institutions influenced consumption practices in Puerto Rican women by integrating them into an industrial, capitalist form of wage labor. However, this framework is limited in its scope focusing more on a population scale than on the local perspective which accounts for inter and intra-community differentiation. Future studies should include how macro and micro social developments differentiated within the insular population and how that has affected pediatric health outcomes.

Opportunities in formal employment changed how women perceived themselves publicly and privately. Prior to the capitalization of the needlework industry, women in Puerto Rico were known as “*madre sufrida*” (suffered or suffering mother) and maintained this status throughout their lives with little or no autonomy (Wagenheim 1975:194). Women’s engagement in the formal economy increased their sense of authority at the household level, shifting the Puerto Rican family structure (Wagenheim 1975). Puerto Rican women now preferred nuclear size

families and preferred to consumer modern convenience items, such as TV dinners and canned *sofrito*, to accommodate their new, busy lifestyles outside the household (Wagenheim 1975).

The third aim of this paper was to use this information from this literature review to speculate about specific females behaviors that were contributing to this pediatric health issue. The development of this hypothetical social context of the precocious puberty and premature thelarche epidemic began by using data from both the quantitative and qualitative literature to create a cohesive model that describes how institutional developments influenced the course of this condition. The social context of premature sexual development begins with onset of *Operación Manos a la Obra*, an era of economic development that is characterized by rapid industrial development and the adoption of capitalist consumer culture. The acculturation of American consumption practices and institutional shifts caused women to adapt their social priorities as they were now focused on employment, reproductive autonomy and materialism. These new social behaviors led to the increased accumulation of consumer goods, many which contain toxic endocrine disruptors like phthalate esters and synthetic estrogens.

Shifting family dynamics increased Puerto Rican women's interest in participating in family planning campaigns to control their bodies while simultaneously freeing women from the bind of a domestic lifestyle. Feminists argue that these campaigns were coercive, but the literature does not provide evidence to support this theory. *La Operación* was the first large-scale, federally funded sterilization campaign. Women underwent this procedure because it was effective and socially liberating. However, social pathologies persisted and the chronic state of these conditions made Puerto Rico a prime site for the early clinical trials of oral contraception that used pills that were approximately 100 times stronger than what women use today. Health consequences and teratogenic effects of these early oral contraceptive pills are scanty

documented in the literature. Using the theoretical framework of medical ecology, it is hypothesized that the consumption of these high-dose birth control pills was important not only for regulating reproduction but also so women could comfortably participate in a materialistic lifestyle. Evidence for this argument should begin with a study that includes a review of medical records. This information can be used to identify what percentage of these women who consumed the high-dose oral contraceptives went on to produce offspring that was diagnosed with precocious puberty or premature thelarche further indicating a relationship between consumption practices, hormonal disruptions caused by birth control pills and the precocious puberty and premature thelarche epidemic.

Long-term exposure to these hormones through the increased acquisition of consumer goods and early oral contraceptive pills may be enabling these toxins to accumulate in women's lipids. During gestation these chemicals can be metabolized across the placental membrane. Researchers argue that this degree of intrauterine exposure through maternal to fetal transmission of EDCs may be an explanation for the increased incidence of precocious puberty and premature thelarche in Puerto Rico. In this situation, the fetus is physically adapting to its toxic prenatal environment. The effects of this exposure can be compounded after birth due to the high amount of baby products and medical equipment that contain plasticizers. This relationship between social institutions, female consumption practices, the birth control trials and the maternal to fetal transmission of EDCs might explain how this disease affected this population at the highest rates in global history.

The "An Epidemic Without Etiologies: Precocious Puberty and Premature Thelarche as a Consequence of Institutional Change" section explains the complex and somewhat mysterious biological process of premature sexual development and its relationship to consumer goods.

Researchers' continue to debate about the relationship between precocious puberty and premature thelarche, some indicating that the latter is a precursor of the former, and some arguing that premature thelarche is a separate pathology. The physiological mechanisms for understanding how precocious puberty occurs remain unknown. Precocious puberty can be classified as "central" and is typically considered to be idiopathic. Early sexual development can be also be "peripheral" or pathological in nature, meaning that it has endogenous etiologies, such as tumors, congenital adrenal hyperplasia and McCune–Albright syndrome; and exogenous causes such as the biological effects of exposure to environmental toxins and synthetic hormones (Roman et al. 2004). Existing literature on the social conditions and the incidence of premature sexual maturation in Puerto Rican females indicates that the underlying etiologies of this health issue are most likely peripheral.

Based on the theories in the quantitative literature, endogenous sources of peripheral precocious puberty include specific endocrine disrupting chemicals (EDCs) called phthalate esters. These chemicals are found in numerous consumer goods and have properties that can mimic the properties of estrogen in the human body causing hormonal disruption (McLachlan et al, 2006; Colon et al. 2000). In a sample of San Juan City Hospital patients diagnosed with premature thelarche, Colon et al. (2000) claim that phthalate esters are found at high rates in n = 32 blood serum samples and that these phthalates are found in numerous consumer goods and plastics. The non-human animal data indicates that EDCs from consumer products and industrial waste cause reproductive health abnormalities. Environmental data also claims that Puerto Rico's dumping ground status only increases as the islands industrial waste locations overflow.

Fetal origins theory is used to explain how fetal development is affected by the conditions of the uterine environment that are influenced by the maternal body's exterior ecology

and behaviors. The increase in toxic consumer goods, the use of high estrogen dose birth control pills and the substantial amount of industrial pollution on the island collectively may be affecting maternal and pediatric health. Endocrine disrupting chemicals can pass through the placental membrane during gestation causing the fetus to physically adapt to this toxic environment. However, these adaptations typically do not account for long-term development and may result in negative pediatric health outcomes. This paper argues that in an increasingly toxic environment like Puerto Rico the maternal body is likely to be affected and the adjustments that fetus's makes to survive gestation in may be resulting poor pediatric health outcomes like premature sexual development.

Outlining a future anthropological study put these hypotheses from this literature review into practice and advocates for a medical anthropological approach to studying this pediatric health issue. Evaluating explanatory models of the lay and medical professional populations, researchers may assist analysts in identifying how precocious puberty and premature thelarche is understood in Puerto Rican society from the perspective of the general population and at an institutional level. An explanation of cultural beliefs shaped around this condition might suggest how this epidemic has progressed over the last 30 years and possibly identify the specific consumer practices that are contributing to this health issue. The proposed research project is designed to complement theories in the quantitative literature by using information provided in the qualitative literature to craft questions and methods that can be used in future social science research.

The anthropological methods proposed in this future study include surveys, semi-structured interviews, participant observation, household item assessments and a review of patient cases and medical records. These methods will be complimented with the use of a

multivariate analysis of survey data and the application of quantitative theories. This integrated approach may be able to guide researchers in identifying explanations concerning the social context of this pediatric health issue. Inspired by the work of medical anthropologists Nancy Scheper-Hughes, Arthur Kleinman, Paul Farmer and Peter Guarnaccia, this paper aims to promote the critical need for medical anthropology to identify the social context and ultimate causes of a complex health phenomenon that has an increasing global presence (Biro et al. 2009).

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