A Small Study Evaluating Cortisol Production of Undocumented Immigrant Latino Parents and Their US-born Adolescents

Karen Mejia[a], MPH, CHES
Ezemenari M. Obasi, PhD
Joseph G. Grzywacz, PhD
Daphne C. Hernandez, PhD, MSEd, FAAHB, FSBM[*]

Abstract

While cortisol production has been studied in parent-child dyads, research has not specifically examined cortisol production of US-born adolescents and their undocumented immigrant Latino parents, despite the elevated stress associated with mixed status. The purpose of the small study was to 1) assess the cortisol production of undocumented immigrant parent-US-born adolescent dyads and 2) examine the cortisol production of the dyads identified as being at heightened risk for immigrant and economic stress. A community-based strategy was used to locate and recruit self-identifying undocumented immigrant, Latino parents and their US-born adolescents (12-16 years) in the Houston-area (September 2019-January 2020). Each participant within the dyad self-reported on immigration and economic stress, socio-demographic characteristics, and parents self-reported on their immigration documentation status. Each participant within the dyad also provided four saliva samples collected at-home during designated time points within the same day. Paired t-test were conducted to compare cortisol production at each of the four time-points among undocumented parent-US-born adolescent dyads and among mixed-status dyads whose parents reported elevated immigration and economic stress. Nineteen mixed-status dyads participated (adolescents: 63% male; average age 13.68 years; parents: 96% female; average age 41.95 years; primarily from Mexico). Cortisol production comparisons within mixed-status dyads did not differ at any of the four time points (i.e. cortisol production appeared to be the same) [$t_1(18)=1.54$, $p=0.14$; $t_2(18)=-1.32$, $p=0.20$; $t_3(18)=-0.43$, $p=0.67$; $t_4(18)=-1.65$, $p=0.12$]. Among mixed-status dyads whose parents reported elevated immigrant-related stress [$t_1(10)=1.15$, $p=0.28$; $t_2(10)=-0.85$, $p=0.42$; $t_3(10)=-1.31$, $p=0.22$; $t_4(10)=-1.46$, $p=0.18$] and economic stress [$t_1(10)=0.17$, $p=0.87$; $t_2(10)=0.12$, $p=0.91$; $t_3(10)=-0.25$, $p=0.80$; $t_4(18)=-0.19$, $p=0.85$], cortisol production did not differ at any of the four time points. The shared environment among mixed-status families appears to be co-activating adolescent-parent physiology, contributing to similar cortisol production. The constant level of stress may shape *all* members of the family similarly, regardless of documentation status.

Keywords: community-based recruitment, cortisol synchrony, Hispanics, stress, physiological synchrony, undocumented status

*Corresponding author may be reached at: daphne.hernandez@uth.tmc.edu; Tel: 713-500-2052

Introduction

Most Latino children in the US (52%) are second generation: US-born to foreign-born parent(s), most commonly from Mexico. Over 3.2 million second-generation Latino children are threatened by deportation policies because they have at least one parent that is unauthorized to work or reside in the US (i.e., "mixed-status" family) (Fry &

Passel, 2009). Despite their legal status, income-eligible US-born children in low-income mixed-status families are less likely to receive public assistance, which has been associated with improved health outcomes (Gundersen & Ziliak, 2015; Miller & Morrissey, 2021; Schanzenbach, 2023). This creates a distinct economic stressor with potential indirect health-related effects. Thus, there is a climate of fear and chronic stress related to immigration and economics within families that have an undocumented parent (i.e., legal residents who work and reside in the US). These challenges fuel behavioral and mental health disparities (Martinez et al., 2009).

The majority of research on Latino immigrant families rarely measures the documentation status of individuals within families due to legal concerns (Suárez-Orozco et al., 2011). This poses a fundamental barrier to understanding mental and behavioral health disparities that Latino adolescents have stemming from living with an undocumented immigrant parent. Instead, largely to protect their research participants from forced disclosure of status, investigators typically use proxy measures of documentation status (e.g., concern about deportation) (Cavazos-Rehg et al., 2007). The absence of research using direct assessments of documentation status impedes the ability to determine the structural burden of stressor exposure. This oversight is particularly pernicious in light of Latino children being the fastest-growing child immigrant population (Fry & Passel, 2009).

Understanding how the structural stressors affect undocumented immigrant Latino families requires models that capture the physiological impact of shared experiences. The bio-behavioral synchrony model offers such a framework, suggesting that shared experiences create physiological synchrony within families (Feldman, 2012). Cortisol synchrony reflects the coordination of cortisol between individuals, such that a parent's heightened stress response is mirrored in their child's response at the same time point. (Fleck et al., 2023) and vice versa (Pratt et al., 2017). Mother-adolescent cortisol synchrony has been observed to be stronger among families that report higher levels of engagement, monitoring, and supervision (Papp et al., 2009). Yet, cortisol synchrony can also be stronger among parent-child dyads that experience elevated negative stress, conflict/aggression, or emotions (Gordis et al., 2010; Papp et al., 2009; Williams et al., 2013). Thus, a shared environment with shared interactions can contribute to cortisol synchrony within families. The shared environment and corresponding interactions may contribute to persistent cortisol levels that influence the development of poor health, including the development of depression (LeMoult et al., 2015) and anxiety (Adam et al., 2010; Schiefelbein & Susman, 2006).

A limitation of the studies cited above is none of them concentrated on the cortisol synchrony of US-born adolescents and their undocumented immigrant Latino parents. Mixed-status households may have a consistent structure-level of vigilance and concern that contributes to a high level of stress (e.g., a parent may not come home if there is an ICE raid at work). This constant level of stress may shape all members of the family, not just the undocumented parent. Specifically, elevated stress levels could influence the physiological functioning of both the undocumented parent *and* the US-born adolescent. The bio-behavioral synchrony model (Feldman, 2012) provides a framework for evaluating whether a structural stressor (i.e. undocumented status) operates at the individual-level (i.e. affected only the undocumented parent) or at the family-level (e.g., affecting both parent and adolescent). This can be assessed by examining cortisol production in

undocumented immigrant parent-US-born adolescent dyads. Given that undocumented status is linked to ongoing immigrant and economic stress, it is important to assess cortisol production of mixed-status dyads who are at greater risk for experiencing such chronic stress. Thus, the aims of this study are to 1) assess the cortisol production of undocumented immigrant parent-US-born adolescent dyads and 2) examine the cortisol production of the dyads identified as being at heightened risk for immigrant and economic stress. Given the structural stressor of undocumented status and the shared family environment and interactions, it is hypothesized that undocumented immigrant parents and their US-born adolescents will exhibit similar cortisol production. This similarity would suggest the presence of cortisol synchrony within the dyad.

Methods

Recruitment, eligibility, and study compensation

A community-based strategy was used to locate and recruit potential study-eligible participants. Specifically, recruitment occurred at a Houston-area church and health fairs with a high Latino immigrant representation, and through the use of snowballing techniques. If adults expressed interest, a bilingual undergraduate research assistant (URA) would write their phone number and email to be screened for eligibility by the Principal Investigator (PI) or a bilingual URA later.

Eligibility criteria for the study included self- identifying Latino immigrant parents who had a US-born adolescent between the ages of 12 and 16 years of age. The family also needed to have an active telephone number and a functional refrigerator-freezer in the household. Immigrant parents must have also expressed experiencing economic hardship as indicated by a 2-item screener focused on the sufficiency of household earnings meeting basic needs over the past 12 months [i.e., 1) During the past 12 months, how much difficulty have you had paying your bills? (A great deal of difficulty, quite a bit of difficulty, some difficulty, rarely any difficulty, or never a difficulty. Affirmative responses (*some, quite a bit,* and *a great deal of difficulty*) were categorized as experiencing economic hardship). 2) Generally, at the end of each month, did you end up with..? (Not enough to make ends meet, barely enough, enough to make ends meet, or more than enough to make ends meet). Individuals that responded with *not enough to make ends meet* or *barely enough* were categorized as experiencing economic hardship)]. Exclusion criteria for participation included the use of nicotine-related products and females (adolescents or parents) who self-identified as pregnant or using oral contraceptives because of their physiological consequences for cortisol assessment (Lovallo, 2006; Schreiber et al., 2006). Due to research budgetary constraints, families with more than one study-eligible adolescent were advised to pick the oldest adolescent.

Each member of the dyad was compensated $30 grocery gift card for completing the survey and a $40 (i.e. $10/saliva sample) gift card for the saliva collection (i.e. up to $70 per participant; $140 per dyad). Gift cards were to a national discounted department and grocery store. The study was approved by (blinded for review) Institutional Review Board, and data analyses was approved by the (blinded for review) Institutional Review Board.

Data collection procedures

Data collection among the parent-adolescent dyads occurred on weekends from September of 2019 to January 2020. Data collection involved two components. The first component involved separate interviewer-

administered survey questionnaires with the immigrant parent and the US-born adolescent of the dyad. Multiple dyads were scheduled simultaneously to complete their surveys. As a result, several URAs were present, with 1-2 URAs assigned to work with each dyad. For dyads that were recruited from the church, survey completion occurred in the church pews (n=5). Survey completion for dyads that were recruited from health fairs or through snowballing techniques occurred at the PI's on-campus university lab (n=14). Bilingual URAs sent eligible parents an email, text, and/or phone call the day before data collection as a reminder. Members of each dyad were consented separately by URAs in the language they preferred. After consenting the participants, URAs conducted interviewed-administered surveys with each of the participants. Interviewed-administered surveys help to reduce survey completion barriers due to low literacy and unfamiliarity with taking surveys. This type of methodology has been successful when conducting research with low-income Hispanic adults (Hernandez, 2016; Hernandez et al., 2016; Hodgman et al., 2021; Reesor et al., 2018).

The second data collection component was saliva sampling of both members of the dyad. Once the surveys were completed, each participant was provided a "Saliva Collection Kit." Using the materials in the saliva collection kit, a URA and the PI explained how saliva samples would be collected through a YouTube video demonstration recorded in English and Spanish, followed by a live demonstration. The saliva collection kit also included written instructions in English and Spanish, along with the link to the YouTube video demonstration and a data collection diary. Similar to prior work conducted by the research team (Obasi et al., 2017), participants were instructed to provide 4 saliva samples at specific time intervals: (1) wakeup – before getting out of bed, (2) 30 min post wakeup and prior to brushing teeth, (3) 60 min post wakeup, and (4) bedtime. All samples were to be obtained via passive drool (UCI Institute for Interdisciplinary Salivary Bioscience Research, 2021), wherein participants were provided a straw that transported saliva from the participant's mouth into 2 mL vials. All vials in the kit were pre-printed with the individual and family identification numbers, and clear numbers (i.e., 1-4) to correspond with the four data collection time intervals. Each participant was also asked to record in a data collection diary (i.e. "time diaries") the time they the woke-up, the time each of the four samples was obtained, and the time they went to bed. Data collection compliance was achieved if samples from parent and adolescent were collected within the time window of ±10 min of the specified time in the diary. After completion, participants were asked to freeze the saliva samples in the provided kit.

Dyads were asked to schedule the saliva data collection on the same day, and a day considered "typical" for both dyad members. While this data collection component occurred at home, having a scheduled day enabled the bilingual URAs to call participants the day prior to starting the saliva collection process to review the protocol and emphasize the importance of collecting saliva on the same day. Then, within 48 hours of completing saliva collection, a URA would schedule a day and time to retrieve the saliva samples and collect time diaries from participants' homes. Samples were transported to an on-campus laboratory in sealed coolers filled with freezer bricks to prevent a freeze-thaw cycle. All samples were logged into the secured database using individual and family identification numbers. All samples were stored in an ultra-cold laboratory freezer (-30°C) prior to being assayed for cortisol by a graduate RA (Obasi et al., 2015).

Measures

Participant socio-demographic characteristics.

Parents and adolescents each self-reported their age, gender, and education (adolescents: 5th grade, 6th-8th grade, 9th-11th grade; parents: less than high school, high school, and more than high school). In addition, parents reported their immigration status (documented vs. undocumented), marital status (married vs. single), employment status (full-time, part-time, not employed), annual household income (< $15,000; $15,000-29,999; $30,000-$44,999; $45,000-$59,999; $60,000-$74,999; $75,000-$99,999), country of birth (Mexico vs. Latin/South America), years in US, and number of children.

Immigration stress.

The Hispanic Stress Inventory 2 (HSI-2) was used to assess self-reported immigration-related stress through a 9-item subscale for the parent. The subscale includes items on the stressors related to healthcare, employment, deportation, and stigma experienced due to legal status (e.g., "Because of the lack of legal documentation, I could not get quality health care," "Since I did not have legal documentation, I was overworked at my job.") Items were scored on a five-point Likert scale from 1= *Not at all worried* to 5= *Extremely worried* and summed with higher scores indicating greater experiences of immigrant-related stress (Cervantes et al., 2016) (alpha = 0.84 for the current study). Seven items from the family immigration stress subscale of the Hispanic Stress Inventory-Adolescent (HSI-A) were used to assess family stressors that adolescents reported, such as, employment and migration, based on parent's legal status (e.g., "Family had problems finding work after migrating"). The scale was scored on a five-point Likert scale from 1= *Not at all worried* to 5= *Extremely worried*, and the items were summed with higher scores suggesting greater experiences of family immigrant-related stress (Cervantes et al., 2012) (alpha = 0.81 for the current study).

Economic stress.

Parents responded to 16 items describing financial hardships as a way to measure economic stress (e.g., "…borrowed money to help pay bills"). Affirmative responses were summed with high scores suggesting greater experiences with economic stress (Conger et al., 1994) (alpha = 0.70 for the current study). Family economic stress was also assessed by adolescents with a 12-item HSI-A subscale. This subscale assessed the financial burden experienced by the family (e.g., "Family struggled paying bills") on a five-point Likert scale from 1= *Not at all worried* to 5= *Extremely worried* summed with higher scores suggesting greater experiences of financial burden (Cervantes et al., 2012) (alpha = 0.90 for the current study).

Saliva samples assayed for cortisol.

Samples were thawed, and centrifuged at 3,000 rpm for 10 minutes, and the clear top phase of the sample was pipetted into appropriate test wells. Cortisol was measured using an Enzyme Immunoassay specifically designed for use with saliva (Salimetrics, n.d.). The test used 25 µl of saliva (per singlet determination) and has a minimum detection limit of 0.007 µg/dl. Average intra-and inter-assay coefficient of variations are 4.13% and 8.89%, respectively. All samples were tested in duplicate; samples from the same participant dyads were assayed on the same plate within the same run. Duplicate test values that vary by more than 7% error were subject to repeat testing with reagents from the same lot. The use of validated kits to assay cortisol and testing in duplicates contributes to the scientific rigor and reproducibility. Similar procedures were

Table 1.
Characteristics of Mixed-Status Dyads (N=19), Mean (SD), or %

Characteristics	Undocumented Parents	US-born Adolescents
Age	41.95 (4.95)	13.68 (1.73)
Gender		
Male	5%	63%
Female	95%	37%
Marital Status		
Married	74%	-
Single	26%	-
Education		
5th grade	-	6%
6th-8th grade	-	47%
9th- 11th grade	-	47%
Less than High School	47%	-
High School Diploma	32%	-
More than High School	21%	-
Employment		
Full-Time	21%	-
Part-time	26%	-
Not employed	53%	-
Income		
Less than 15,000	21%	-
$15,000-$29,999	37%	-
$30,000-$44,999	37%	-
$45,000-$59,999	5%	-
$60,000-$74,999	0%	-
$75,000-$99,999	0%	-
Country of Birth		
United States	-	100%
Mexico	84%	-
Latin/ South America	16%	-
Years in US	19.11 (5.28)	-
# of Children in Household	3.16 (1.46)	-
Immigrant Stress	27.84 (7.95)	14.05 (5.45)
Economic Stress	7.00 (2.83)	21.00 (8.31)

previously used by the research team (Obasi et al., 2015; Obasi et al., 2017).

Data analysis

Paired t-tests were used to compare cortisol production at each of the four time-points: 1) among undocumented parent-US-born adolescent dyads and 2) among dyads who parents reported elevated immigration and economic stress.

Results

Only six parents reported they were documented immigrants. Due to the small sample size, we only report the findings from the 19 mixed-status families (Table 1). Parents were on average 41.95 (SD = 4.95)

Table 2.
Cortisol sample comparisons within mixed-status dyads (n=19), cortisol averages (M) and standard deviations (SD) for each time point.

	Undocumented Parents		US-born Adolescents	
Sample	**M**	**SD**	**M**	**SD**
1	0.35	0.23	0.27	0.12
2	0.34	0.14	0.43	0.28
3	0.20	0.11	0.22	0.12
4	0.08	0.04	0.10	0.06

Note: Cortisol values are reported as µg/dl.

years old and had lived in the US for 19.11 (SD = 5.28) years. Most of the parents were female (95%), married (74%), had less than a high school education (47%), unemployed (53%), 58% made ≤ $29,999, and primarily from Mexico (84%). Adolescents residing in mixed-status families were on average 13.68 (SD = 1.73) years and 63% male.

Comparisons of cortisol production levels among US-born adolescents and their undocumented parents did not differ at any of the four-time points [$t_1(18)=1.54$, $p=0.14$; $t_2(18)=-1.32$, $p=0.20$; $t_3(18)=-0.43$, $p=0.67$; $t_4(18)=-1.65$, $p=0.12$] (Table 2).

Cortisol production comparisons were also conducted among mixed status families where the parent reported elevated immigrant-related stress and economic stress. Elevated stress was determined to be scores above the average reported in Table 1. Cortisol production comparisons between US-born adolescents and undocumented parents among parents with elevated immigrant-related stress did not differ at any of the four time points [$t_1(10)=1.15$, $p=0.28$; $t_2(10)=-0.85$, $p=0.42$; $t_3(10)=-1.31$, $p=0.22$; $t_4(10)=-1.46$, $p=0.18$] (Table 3). Cortisol production comparisons between US-born adolescents and undocumented parents among parents with elevated economic stress did not differ at any of the four time points [$t_1(10)=0.17$, $p=0.87$; $t_2(10)=0.12$, $p=0.91$; $t_3(10)=-0.25$, $p=0.80$; $t_4(18)=-0.19$, $p=0.85$] (Table 3).

Discussion

The purpose of the small study is to assess cortisol production among US-born adolescent-undocumented immigrant Latino parent dyads. The results suggest that undocumented parents and US-born adolescents had similar cortisol production at each of the four time points. Similarly, among households where parents had elevated immigration or economic stress, similar cortisol production was observed at each of the four time points among US-born adolescents and their undocumented immigrant Latino parents. The results suggest that undocumented immigrant parents and US-born adolescents have similar cortisol production and cortisol synchrony *may* be present. This constant level of stress appears to shape all members of the family similarly, and not solely an individual family member. Thus, parental response to stressful environment is mirrored in the adolescent's response and vice versa, like previous work (Fleck et al., 2023; Pratt et al., 2017). With over half of the undocumented parents not being employed, this may have provided more opportunity for shared interactions to occur, contributing to similar physiological processes.

US-born children to undocumented parents experience distinct immigration and economic related stressors. This level of

Table 3.
Cortisol sample comparisons among mixed-status dyads where undocumented parents reported higher than average immigrant stress (n= 11 dyads) and economic stress (n = 11 dyads), cortisol averages (M) and standard deviations (SD) for each time point

	Higher than Average Immigrant Stress				Higher than Average Economic Stress			
	Undocumented Parents		US-born Adolescents		Undocumented Parents		US-born Adolescents	
Sample	**M**	**SD**	**M**	**SD**	**M**	**SD**	**M**	**SD**
1	0.29	0.08	0.24	0.14	0.29	0.08	0.28	0.13
2	0.38	0.12	0.41	0.18	0.34	0.15	0.34	0.21
3	0.18	0.04	0.22	0.12	0.20	0.05	0.21	0.12
4	0.10	0.04	0.12	0.06	0.10	0.04	0.10	0.06

Note: Cortisol values are reported as µg/dl.

stress is constant and not episodic. Thus, future studies focused on how perceived immigration and economic stress impacts the physiology of US-born children and their undocumented immigrant Latino parents may want to consider a biological marker that more accurately reflects *chronic* stress. Hair samples offer the opportunity to measure *chronic* stress over weeks to months compared to saliva that measures *acute* stress. Hair samples require one cut the size of one cm in diameter at the base of the vertex posterior of the head (Russell et al., 2012). The most proximal one cm segment to the scalp is approximately last month's cortisol production and the second most proximal one cm segment is approximately the cortisol production two months prior (Wennig, 2000). For that reason, hair samples are considered a better measure of *chronic* stress over time compared to saliva (Russell et al., 2012). Further, for the study participant, collection of a hair sample compared to multiple collections of saliva throughout the day (and maybe over several days) is less invasive and less labor intensive. Hair samples are also not subjected to physiological daily fluctuations like saliva samples. Unlike saliva samples, hair samples do not require freezing and can be stored at room temperature and are stable for years (Russell et al., 2012).

Limitations

The overall sample size was small, making it difficult to conduct more sophisticated analyses needed to conclude whether cortisol synchrony is present. Further, the low percentage of fathers that participated in the study prevented making distinct cortisol production comparisons between adolescent-mother, adolescent-father dyads, and mother-father dyads. There are also various family dynamics (e.g., parent-adolescent conflict; parent-adolescent involvement) that were not measured. A larger sample that uses hair samples or saliva samples but is followed over multiple time points and includes various measures of family dynamics might provide greater insight into how the family environment influences cortisol synchrony within mixed-status families.

Conclusion

This small study suggests that immigration status impacts both undocumented immigrant Latino parents and their US-born adolescent, similarly, indicating that immigration status functions as a family-level stressor. While research on a larger sample size is needed, the shared environment among mixed-status families appears to be co-activating adolescent-parent

physiology, contributing to similar cortisol production. This can have negative, long-term health implications, such as depression and anxiety (Adam et al., 2010; LeMoult et al., 2015; Schiefelbein & Susman, 2006).

Implications for Health Behavior Research

Conducting research on Latino families that include an undocumented parent can be difficult. Below we provide suggestions for conducting health behavior research among Latino families that experience low English literacy, have little experience with participation in research studies, and live in under-resourced communities. Research teams need to have access to bilingual RAs when conducting a study with Latino immigrant families. The ability to communicate in the same language as the participants helps to build rapport and trust. Related, having all recruitment and data collection materials in English and Spanish – consent form, surveys, and written and video instructions for saliva collection – reduces linguistic barriers. For example, the research team first explained the saliva data collection procedures in English, followed by Spanish. All participants also watched a video in their preferred language (either English or Spanish) that demonstrated the necessary steps to collecting saliva. After watching the video there was an in-person demonstration that was performed by the PI. Having the PI, which participants perceive the PI as the "doctora", demonstrate the procedures appeared to reassure the participants that they would not be asked to do something that the PI would not engage in. The multiple forms of instruction (i.e. written and video instruction), along with an in-person demonstration, appeared to make the saliva data collection procedures less daunting and easier to follow.

Also, a research team with a flexible schedule facilitates scheduling participants. Based on this study and other work that focused on a similar population (Hodgman et al., 2021), it is recommended to have a minimum of six bilingual RAs as a part of the research team. Whenever possible, data collection was scheduled to be carried out in the community where recruitment occurred (e.g., church pews). This facilitates research participants attending a location that they trust. The familiarity with the location also helps to ease participants' fear of attending a new place and the associated nuances that can be found to be burdensome (e.g., finding affordable parking, finding the designated building and room). Conducting research in a community center or organization that participants feel comfortable with (rather than on a university campus) is especially important to consider during times of elevated US Immigration and Customs Enforcement raids and associated detention and deportation fears. Consequently, familiarity with a setting selected for data collection positively influences sample size and quality of the data. Further, to lower the burden on participants returning samples to the research team, URAs picked up samples at the participants' house. The distance between participants' homes and the university lab used to assay the saliva was no more than 45 minutes. Thus, having accessible bilingual RAs with flexible schedules and implementing strategies to reduce participant burden (e.g., materials in English and Spanish, in-person demonstrations, and picking up samples from participants' homes) are ways to contribute to the progression of health behavior research.

Discussion Questions

What are recruitment and data collection strategies that can be implemented when there are elevated number of US Immigration and Customs Enforcement raids within the Latino/immigrant communities?

What are recruitment and data collection strategies that can be implemented to increase participation in research studies among Latino immigrant fathers?

Author Contributions: Conceptualization, DCH; Writing – Original Draft, KM, DCH; Writing – Review & Editing, KM, EMO, JGG, DCH; Data Collection, KM, DCH; Data Analyses, EMO, DCH; Funding Acquisition, DCH; Supervision, DCH

Acknowledgments: As a part of the *Health Behavior Research* mentorship issue, we describe the mentoring collaboration that occurred. Dr. Hernandez mentored all undergraduate and graduate research assistants. The first author (Ms. Mejia) completed this research in partial fulfillment of the requirements for a master's degree in public health under the mentorship of Dr. Hernandez. Special thanks to the undergraduate students at the University of Houston who assisted with the project. In addition, the authors thank the church staff for providing the research team with the opportunity to recruit church members and for providing the church on the day of survey data collection. The authors are also extremely grateful to the study participants whose contributions made this study possible.

Funding: This research was supported by the Eunice Kennedy Shriver, National Institute of Child Health & Human Development of the National Institutes of Health, under grant #R03HD098379; the research assistants were supported by the Research and Extension Experiential Learning for Undergraduate (REEU) Program of the National Institute of Food and Agriculture, USDA, under grant # 2017-67032-26021.

Disclosure statement: The authors report there are no competing interests to declare. The funders had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript, or in the decision to publish the results.

References

Adam, E. K., Doane, L. D., Zinbarg, R. E., Mineka, S., Craske, M. G., & Griffith, J. W. (2010). Prospective prediction of major depressive disorder from cortisol awakening responses in adolescence. *Psychoneuroendocrinology*, *35*(6), 921-931. https://doi.org/10.1016/j.psyneuen.2009.12.007

Cavazos-Rehg, P. A., Zayas, L. H., & Spitznagel, E. L. (2007). Legal status, emotional well-being and subjective health status of Latino immigrants. *Journal of the National Medical Association*, *99*(10), 1126-1131.

Cervantes, R. C., Fisher, D. G., Córdova, D., & Napper, L. E. (2012). The Hispanic Stress Inventory--Adolescent Version: A culturally informed psychosocial assessment. *Psychological Assessment*, *24*(1), 187-196. https://doi.org/10.1037/a0025280

Cervantes, R. C., Fisher, D. G., Padilla, A. M., & Napper, L. E. (2016). The Hispanic Stress Inventory Version 2: Improving the assessment of acculturation stress. *Psychological Assessment*, *28*(5), 509-522. https://doi.org/10.1037/pas0000200

Conger, R. D., Ge, X., Elder, G. H., Lorenz, F. O., & Simons, R. L. (1994). Economic stress, coercive family process, and developmental problems of adolescents. *Child Development*, *65*(2), 541-561. https://doi.org/10.2307/1131401

Feldman, R. (2012). Bio-behavioral synchrony: A model for integrating

biological and microsocial behavioral processes in the study of parenting. *Parenting: Science and Practice*, *12*(2-3), 154-164. https://doi.org/10.1080/15295192.2012.683342

Fleck, L., Fuchs, A., Lerch, S., Möhler, E., Koenig, J., Resch, F., & Kaess, M. (2023). Adolescent borderline personality traits and dyadic behavior shape mother-adolescent cortisol synchrony. *Borderline Personality Disorder and Emotion Dysregulation*, *10*(1), 12. https://doi.org/10.1186/s40479-023-00218-z

Fry, R., & Passel, J. S. (2009). *Latino children: A majority are US-born offspring of immigrants*. Pew Research Center. Retrieved April 13, 2025 from https://www.pewresearch.org/hispanic/2009/05/28/latino-children-a-majority-are-us-born-offspring-of-immigrants/#:~:text=A%20majority%20%2852%25%29%20of%20the%20nation%E2%80%99s%2016%20million,America%20and%20South%20America%20that%20began%20around%201980.

Gordis, E. B., Margolin, G., Spies, L. A., Susman, E. J., & Granger, D. A. (2010). Interparental aggression and parent-adolescent salivary alpha amylase symmetry. *Physiology & Behavior*, *100*(3), 225-233. https://doi.org/10.1016/j.physbeh.2010.01.006

Gundersen, C., & Ziliak, J. P. (2015). Food insecurity and health outcomes. *Health Affairs*, *34*(11), 1830-1839. https://doi.org/10.1377/hlthaff.2015.0645

Hernandez, D. C. (2016). Latino mothers' cumulative food insecurity exposure and child body composition. *American Journal of Health Behavior*, *40*(1), 92-99. https://doi.org/105993/AJHB.40.1.10

Hernandez, D. C., Reesor, L., Machuca, I., Chishty, M., & Alonso, Y. (2016). Low-income immigrant Hispanic mothers' concerns and perceptions of their young child's weight. *Public Health Nursing*, *33*(5), 412-420. https://doi.org/10.1111/phn.12252

Hodgman, C. F., LaVoy, E. C., Johnston, C. A., Obasi, E. M., Murillo, R., Yan, S., O'Connor, D. P., McNeill, L. H., Reitzel, L. R., & Hernandez, D. C. (2021). Measuring pro-and anti-inflammatory biomarkers among low-income Hispanic adults: A feasibility and pilot assessment. *Health Behavior Research*, *5*(3). https://doi.org/https://doi.org/10.4148/2572-1836.1143

LeMoult, J., Chen, M. C., Foland-Ross, L. C., Burley, H. W., & Gotlib, I. H. (2015). Concordance of mother-daughter diurnal cortisol production: Understanding the intergenerational transmission of risk for depression. *Biological Psychology*, *108*, 98-104. https://doi.org/10.1016/j.biopsycho.2015.03.019

Lovallo, W. R. (2006). Cortisol secretion patterns in addiction and addiction risk. *International Journal of Psychophysiology*, *59*(3), 195-202. https://doi.org/10.1016/j.ijpsycho.2005.10.007

Martinez, C. R., McClure, H. H., & Eddy, J. M. (2009). Language brokering contexts and behavioral and emotional adjustment among Latino parents and adolescents. *The Journal of Early Adolescence*, *29*(1), 71-98. https://doi.org/10.1177/0272431608324477

Miller, D. P., & Morrissey, T. W. (2021). SNAP participation and the health and health care utilisation of low-income adults and children. *Public Health Nutrition*, *24*(18), 6543-6554. https://doi.org/10.1017/S1368980021003815

Obasi, E. M., Shirtcliff, E. A., Brody, G. H., MacKillop, J., Pittman, D. M., Cavanagh, L., & Philibert, R. A. (2015). The relationship between alcohol consumption, perceived stress, and CRHR1 genotype on the hypothalamic-pituitary-adrenal axis in rural African Americans. *Frontiers in Psychology*, *6*, 832. https://doi.org/10.3389/fpsyg.2015.00832

Obasi, E. M., Shirtcliff, E. A., Cavanagh, L., Ratliff, K. L., Pittman, D. M., & Brooks, J. J. (2017). Hypothalamic-Pituitary-Adrenal Reactivity to Acute Stress: an investigation into the roles of perceived stress and family resources. *Prevention Science*, *18*(8), 923-931. https://doi.org/10.1007/s11121-017-0759-3

Papp, L. M., Pendry, P., & Adam, E. K. (2009). Mother-adolescent physiological synchrony in naturalistic settings: Within-family cortisol associations and moderators. *Journal of Family Psychology*, *23*(6), 882-894. https://doi.org/10.1037/a0017147

Pratt, M., Apter-Levi, Y., Vakart, A., Kanat-Maymon, Y., Zagoory-Sharon, O., & Feldman, R. (2017). Mother-child adrenocortical synchrony: Moderation by dyadic relational behavior. *Hormones and Behavior*, *89*, 167-175. https://doi.org/10.1016/j.yhbeh.2017.01.003

Reesor, L., Canales, S., Alonso, Y., Kamdar, N. P., & Hernandez, D. C. (2018). Self-reported health predicts Hispanic women's weight perceptions and concerns. *American Journal of Health Behavior* *42*(4), 61-69. https://doi.org/10.5993/ajhb.42.4.6

Russell, E., Koren, G., Rieder, M., & Van Uum, S. (2012). Hair cortisol as a biological marker of chronic stress: Current status, future directions and unanswered questions. *Psychoneuroendocrinology*, *37*(5), 589-601. https://doi.org/10.1016/j.psyneuen.2011.09.009

Salimetrics. (n.d.). *Salivary Cortisol Enzyme Immunoassay Kit*. Salimetircs. Retrieved April 13, 2025 from https://salimetrics.com/wp-content/uploads/2018/03/salivary-cortisol-elisa-kit.pdf

Schanzenbach, D. W. (2023). Understanding SNAP: An overview of recent research. *Food Policy*, *114*, 102397. https://doi.org/10.1016/j.foodpol.2022.102397

Schiefelbein, V. L., & Susman, E. J. (2006). Cortisol levels and longitudinal cortisol change as predictors of anxiety in adolescents. *Journal of Early Adolescence*, *26*(4), 397-413. https://doi.org/10.1177/0272431606291943

Schreiber, J. E., Shirtcliff, E., Van Hulle, C., Lemery-Chalfant, K., Klein, M. H., Kalin, N. H., Essex, M. J., & Goldsmith, H. H. (2006). Environmental influences on family similarity in afternoon cortisol levels: Twin and parent-offspring designs. *Psychoneuroendocrinology*, *31*(9), 1131-1137. https://doi.org/10.1016/j.psyneuen.2006.07.005

Suárez-Orozco, C., Yoshikawa, H., Teranishi, R., & Suárez-Orozco, M. (2011). Growing up in the shadows: The developmental implications of unauthorized status. *Harvard Educational Review*, *81*(3), 438-473.

UCI Institute for Interdisciplinary Salivary Bioscience Research. (2021). *Passive drool collection tutorial*. University of California - Irvine IISBR. Retrieved April 13, 2025 from https://www.youtube.com/watch?v=rJXlesQutzc

Wennig, R. (2000). Potential problems with the interpretation of hair analysis results. *Forensic Science International*, *107*(1-3), 5-12. https://doi.org/10.1016/s0379-0738(99)00146-2

Williams, S. R., Cash, E., Daup, M., Geronimi, E. M., Sephton, S. E., & Woodruff-Borden, J. (2013). Exploring patterns in cortisol synchrony among anxious and nonanxious mother and child dyads: A preliminary study. *Biological Psychology*, *93*(2), 287-295. https://doi.org/10.1016/j.biopsycho.2013.02.015