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Assessing Biobehavioral Effects of Exposure to Traumatic Events in Palestinian Children

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Abstract

Background: A growing body of work suggests that exposure of children to the trauma of war threatens their physical and psychological development. Children exposed to such childhood adversity have an increased risk of developing mental health problems, including posttraumatic stress disorder (PTSD), emotional and behavioral problems, and psychobiological ailments. Methods: This pilot study used a descriptive cross-sectional design to explore the relationships among traumatic event exposure, child stress, and biological stress markers (salivary cortisol and salivary alpha-amylase) measured in a sample of 37 West Bank Palestinian children aged 10-12 years. Results: Findings revealed moderate correlations between perceived child stress scores and higher levels of traumatic exposure, higher awakening cortisol level, and greater variation in diurnal cortisol levels. Further, 32% of the sample demonstrated a reversed ***s****AA diurnal pattern. Conclusion: In our study sample, children who reported higher exposure to violent traumatic events appeared to have higher perceived stress, and possibly were experiencing disruption in their normal physiologic stress response. With identification of more valid and reliable screening instruments, it may be possible to provide earlier identification of at-risk children, and direct interventions to help mitigate the impact of exposure to traumatic war events in this vulnerable population.*

Keywords*:* *Child trauma, perceived stress, salivary cortisol, salivary alpha-amylase, Palestine.*

Introduction

A growing body of work suggests the exposure of children to the trauma of war threatens their physical and psychological development. Children exposed to such childhood adversity have an increased risk of developing mental health problems, posttraumatic stress disorder (PTSD), emotional and behavioral problems (Singer & Hodge, 2010; Massad et al., 2011), and psychobiological ailments (Elzinga et al., 2008; El Zein & Ammar, 2011).

Violent political conflicts and war are widely spread across the world where civilians particularly children, may become victims of its ramifications. According to Shann (2010), the direct effects of war are that war kills approximately 200,000 children, and disables 500,000 every year. Studies on refugee children from 60 war zones have shown high rates of probable posttraumatic stress disorder (PTSD) (30.4%), generalized anxiety (26.8%), somatization (26.8%), traumatic grief (21.4%), and general behavioral problems (21.4%) (Betancourt et al., 2012). The physical and psychological consequences of PTSD and related disorders in children have been found to lead to higher health care utilization and medication use; a variety of mental health problems**,** such as depression, anxiety disorders, anger, hyperarousal symptoms, substance abuse, social isolation; altered neuroendocrine function; and brain changes (Carrion, Weems, & Reiss, 2007; Creamer et al., 2006).

One population facing the trauma of war for several generations is children living within the context of conflicts in the Middle East. Since 1948, Palestinian children living in West Bank and Gaza Strip have been exposed to war, political resistance, civil disturbance, and paramilitary conflict. Thus, health professionals in Palestine have raised concerns about the long-term physical and psychosocial health consequences Palestinian children may experience as they develop. These concerns are supported by the current high rate of PTSD symptomatology and associated psychiatric morbidity in these children. Prior studies on Palestinian children revealed the increased risk of psychiatric, emotional, and behavioral disorders (Altawil et al., 2008; Basak, 2012); however, effects of traumatic exposure on the child’s neurophysiology have not been examined. A previous longitudinal study on posttraumatic stress reactions found 40.6% of Palestinian children suffer moderate to severe PTSD (Thabet et al., 2009).

These issues have important relevance for health care professionals caring for children exposed to the trauma of violent events, and who may be experiencing stress-related alterations in their health. Further, this study may have important application for researchers seeking to more fully explore the biobehavioral responses in children exposed to traumatic violent events. In this paper**,** we describe findings from a feasibility study that aimed to examine the relationship of reported exposure to traumatic events and biobehavioral outcomes in a group of children living in Ain Beit Elma Camp, Nablus district, Palestine.

The neurophysiologic response to psychological stress involves activation of the sympathetic nervous system (SNS) and hypothalamic–pituitary-adrenal (HPA) axis. The acute activation of the HPA axis and SNS response to stress are considered protective and adaptational processes; however, long-term up-regulation of these systems which produce high levels of circulating glucocorticoids and catecholamine's can be physiologically damaging and may lead to a variety of pathologic conditions (McEwen & Seeman, 2006). Under normal functioning of the HPA axis, diurnal patterns of cortisol release follow a predictable course with cortisol levels peaking within 30-45 minutes after awakening followed by a steady decline through the day, reaching its nadir just prior to sleep (Kelly et al., 2008).

Chronic exposure to psychosocial stressors can cause prolonged activation of the HPA axis. This prolonged HPA activation is associated with lower morning cortisol levels and elevated afternoon cortisol levels, resulting in less circadian variation ("flatter" diurnal slope) and greater daily output of cortisol (Danese & McEwen, 2012). A normal, steeper cortisol diurnal pattern is associated with better health outcomes while "flatter" slopes of cortisol are associated with poorer health outcomes (Saxbe, 2008). In children, flatter cortisol diurnal patterns are linked with a variety of problematic health outcomes, including coping difficulty, decline in school performance, and physical disorders, such as asthma (Gunnar & Vazquez, 2001). Van der Vegt, Van der Ende , Kirschbaum, Verhulst, and Tiemeier, (2009) found severe maltreatment early in life was related to lower cortisol levels and a flatter cortisol slope while less severe early maltreatment was associated with higher levels of cortisol and a steeper diurnal decline.

In the last two decades, investigators have begun to explore the impact of chronic stress on the sympathetic nervous system. Blood pressure and heart rate increase related to chronic elevation of the SNS activity can promote atherosclerosis, and have been associated with increased cancer mortality (Seeman et al., 2010). Development of an assay measuring alpha-amylase in saliva

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enabled researchers to use this as a valid and reliable surrogate biomarker for the SNS response (Almela et al., 2011; Kivlighan & Granger, 2006). The release of catecholamines from the adrenal medulla into the blood results in an increased discharge of alpha-amylase in saliva (sAA) via stimulation of beta-adrenergic receptors in salivary glands, thus allowing sAA to serve as a useful noninvasive indirect measure of SNS activation (Granger et al., 2007; Nater & Rohleder, 2009). Like cortisol, sAA normally follows a predictable diurnal pattern; however, the trajectory is directly opposite that of cortisol. Levels of sAA are lowest approximately 30 minutes after awakening and increase steadily throughout the day with the highest levels occurring in the evening (Kelly et al., 2008; Rohleder et al., 2004). In Figure 1, Adam, Hoyt, and Granger, (2011) provide a useful illustration of normal diurnal patterns of salivary secretion of cortisol and alpha-amylase patterns in a community population of adolescents.

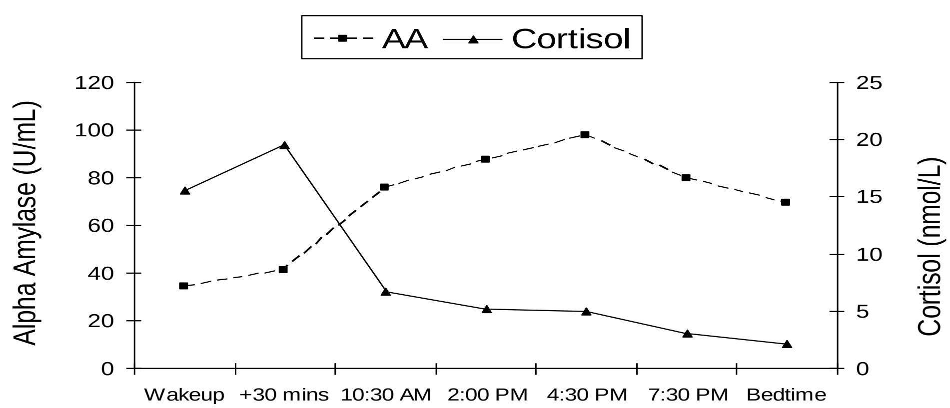

Figure 1: Example of Average Diurnal Patterns of Salivary Alpha Amylase (AA) and Salivary Cortisol Across the Day in a Sample of Late Adolescents (Adam, 2006). Cortisol Data are Described in Adam (2006).

(Reprinted from Biological Psychology, 88, Adam, E. K., Hoyt, L., T., & Granger, D. A., Diurnal alpha amylase patterns in adolescents: Associations with puberty and momentary mood states, 170-173, (2011), with permission from Elsevier).

According to Lynch (2003), there is limited research examining the relationship between exposure to chronic violence and the physiological stress response. Understanding the psychophysiological impact of exposure to traumatic violent events on children has significant relevance for health professionals working with children who are victims of violence, exposed to the traumatic environment of war, or who may live in communities that experience a high prevalence of stressful violent events. Children appearing to cope under stressful circumstance may ultimately begin to evidence negative behavioral and physical outcomes. The purpose of this feasibility study was to explore the relationship of self-reported traumatic event exposure with diurnal patterns of salivary cortisol and sAA secretion in a group of Palestinian children at risk for experiencing traumatic events. We hypnotized that children exposed to severe traumatic stress would demonstrate altered cortisol and sAA diurnal pattern.

Methods

Using a cross-sectional correlational design, we examined the associations of self-reported exposure to traumatic war events, perceived stress, and biologic markers of physiologic stress response in a purposive sample of children living within Ain Beit Elma Camp, Nablus district, Palestine. We obtained approval from the United Nations Relief and Work Agency (UNRWA)/ West Bank to conduct the study in its district schools, as well as IRB approval from the University of San Diego.

Participants

We initially recruited 150 children and their parents to participate in the study. A convenience sample of 48 children were only enrolled whom their parents agreed to the conditions of participation and also met the inclusion and exclusion criteria. Children with ages 10-12 years were selected in order to avoid the potential impact of pubertal physiologic changes on stress hormones results.

Group meetings to provide information about the study were held with children and their parents at Ain Beit Elma Elementary Boys' School for the male participants and at Ain Beit Elma Elementary Girls' School for the female participants. During these group meetings the Principal Investigator explained the purpose of the study, the study procedures, and the process of informed consent. Children were eligible for inclusion in the study if they were: born and raised in Palestine; age 10-12 years; and able to read, write, and speak Arabic. To eliminate any potential source of biomarkers' results contamination, children were excluded from study if they had mouth wounds or gum disease, smoked, or were receiving beta-blockers or beta adrenergic-agonists.

Procedures

Written informed consent from parents and assent from children were obtained prior to data collection. Children completed a brief demographic questionnaire and two instruments to measure level of traumatic exposure and perceived stress. In addition, children were to collect two saliva samples the next day; one upon awakening and one at bedtime. Children and their parents were taught the proper saliva sample collection technique, including timing of collection, storage, and sample delivery; they were provided with all required supplies, as well as a saliva collection instruction sheet. All forms and instruction sheets were translated and back translated into Arabic to ensure cultural and linguistic accuracy.

Measures

We had child participants complete two questionnaires to measure traumatic stress exposure, and level of perceived stress; within 24 hours of completing the self-report instruments. We had parents supervise collection of two saliva samples from the children to measure salivary cortisol and sAA levels.

Level of Traumatic Exposure

The level of traumatic exposure (LTE) was measured by a modified version of the Gaza Traumatic Exposure Checklist (GTEC). Developed by Abu Hein et al., (1993), the original checklist consisted of 17 traumatizing events that a child in the Gaza district might have been exposed to within the past year. The instrument was developed in Arabic for use in school-age children. Previous reported internal consistency reliability of the instrument was 0.90 (Thabet, Abed, & Vostanis, 2004).

Due to the difference in the type of military operations and war violence experienced by Palestinian children in the West Bank as compared to Gaza, the GTEC was modified to include nine additional items. These items were: exposure to direct physical injury; military detainment; experience of being beaten or humiliated; deprivation of food, water, electricity or toileting;

destruction of personal belongings; threats of being killed; exposure to street shooting; arrest and imprisonment; and prevented from attending school. The revised instrument was evaluated by pediatric clinicians for content validity, translated and back translated validity of meaning, and field tested with 75 Palestinian children for reliability prior to use in this study. The internal consistency reliability of the instrument on that pilot was 0.82. The checklist asked about the child's exposure to specific traumatic experiences "in the last several months resulting from the Israeli army incursion to your town."

Children answered each statement of the checklist with a "yes" or "no" response with a score range of 0 to 26. As an open-ended item, children were also asked to report any other traumatic events they had experienced that were not covered in the instrument. The modified GTEC was used as an unweighted continuous score, and had a Cronbach's alpha coefficient of 0.80.

Perceived Stress

The Perceived Stress Scale developed by Cohen, Kamarck, and Mermelstein (1983), was used to measure child perceived stress. This instrument is a 14-item, 5-level (0 = Never, 1 = Almost never, 2 = Sometimes, 3 = Fairly often, and 4 = Very often) self-report measuring the individual's perceived level of stress during the last month. Total scores range from 0 to 56, with higher scores indicating greater stress. Internal consistency reliability of the items in previous studies ranged between 0.84 and 0.86, and test–retest reliability was 0.85 (Cohen et al., 1983; Roberti, Harrington, & Storch, 2006).

The PSS was developed for use in adults 18 years and older. An Arabic version of the PSS had not been previously developed. Therefore, we adapted the PSS to be linguistically and developmentally appropriate for use in Palestinian children 10-12 years. Two Palestinian grade school English teachers reviewed the instrument and recommended appropriate terminology to make the items more understandable for children in this age group. The Principal Investigator and two other expert reviewers fluent in both English and Palestinian Arabic then translated the instrument into Arabic. This version of the PSS instrument was back–translated into English by two different expert bilingual reviewers. The translated PSS was then tested in West Bank prior to its use in this study, and had an internal consistency reliability of 0.82. In our current study the internal consistency reliability of the PSS was 0.63.

Cortisol and Salivary Alpha Amylase

Children and parents were instructed on the procedure to collect two salivary samples on a single day. One sample was taken within 10 minutes after awakening and a second sample was collected one hour prior to the child's sleep at night. To estimate a diurnal cortisol slope, a minimum of two data points should be included with one sample in the morning (either wakeup or 30-40 min post-awakening), and a sample at bedtime with a slope calculated by subtracting bedtime from wakeup values (Adam & Kumari, 2009). According to Kraemer et al. (2006), two time points (saliva samples at awakening and bedtime) can provide a good estimate for the daily salivary cortisol slope. While Kraemer et al. (2006), suggest serial collections over 2 or 3 days to calculate an aggregate mean for awakening and bedtime cortisol levels, we chose a single day of collection due to limited resources and to reduce participant burden in this feasibility study. Other population-based studies have effectively used the single-day collection approach in reliably measuring salivary cortisol levels (Ashman et al., 2002; Bahijri et. al., 2013; Rosmalen et al., 2005).

Before the saliva collection, participants were not to eat, drink, exercise, or brush their teeth, but could rinse their mouth with tap water. Participants were instructed to chew on the cotton roll provided by the Salimetrics Oral Swab Collection® device for one minute and then refrigerate the samples, using a coded Salimetrics Storage Tube®. Parents were asked to supervise collection of the saliva samples, and to record the date and time of the saliva collection on the labeled collection tube. Saliva samples were then refrigerated until they were brought to school the next day, and collected by the Principal Investigator. The samples were packed in ice in a cryostorage box and immediately transported to the Specialty Laboratory Center (CLC) at Ramallah City, Palestine, for processing.

At the laboratory, salivary samples were frozen at –20°C until they were batch processed. Both cortisol and sAA levels were measured from the same saliva sample. Salivary cortisol samples were assayed using a high sensitivity Salivary Cortisol Enzyme Immunoassay®, manufactured by Salimetrics, State College, PA. The assay had average intra-and inter-assay coefficients of variation of less than 5 percent and 10 percent, respectively.

Participants' samples were assayed for sAA using the kinetic reaction assay kit (Salimetrics, State College, PA) specifically designed for the measurement of salivary sAA activity. The intraassay Coefficient of Variation (CV) for the mean of 30 replicates tests was 2.5-7.5 percent. Inter-assay variation computed for the mean of average duplicates for 16 individual runs was less than 6%. Under the supervision of the main researchers, all salivary samples were destroyed upon the completion of biomarkers' data analysis.

Data Analysis

Data analysis was carried out with SPSS version 15.0. Child's age, level of traumatic exposure, perceived stress, salivary cortisol, and sAA levels were treated as continuous variables. Gender was the only categorical variable. Descriptive statistics summarized the sample characteristics and explored the study variables for normality. Independent t-tests were used to test for differences by gender in each of the continuous variables; Pearson correlations were used to describe the bivariate relationships among the continuous variables. The difference between awakening and bedtime salivary cortisol and sAA levels (Time 1 = awakening level minus Time 2 = bedtime level) was computed to estimate the salivary cortisol and sAA diurnal change for each participant, and this difference was treated as a continuous variable.

Results

From an original sample of 48 children enrolled in the study, 37 children had completed study data. Eleven children either had unusable saliva samples or incomplete self-reported instruments. Table 1 summarizes the sample characteristics by gender. Forty percent of the children were boys, and average age in both girls and boys was approximately 11 years. The overall mean level of traumatic experience (LTE) score was high with children reporting an average of 13 traumatic exposures (SD = 4.77) in the previous several months. Girls reported higher trauma event exposures (M = 13.95, SD 5.40) compared to boys (M =11.6, SD 3.36). Boys, however, had slightly higher mean perceived stress scores compared to girls.

Table 1: Descriptive Characteristics of Study Sample by Gender (*N* = 37)

Variable	Boys (*n* = 15)	Girls (*n* = 22)
	M (*SD*)	M (*SD*)
Age in years	10.87 (.83)	11.05 (.84)
Traumatic Event Score	11.6 (3.36)	13.95 (5.40)
Child Stress Score	33.80 (8.42)	31.91 (6.06)
Awakening cortisol level µg/ml	.49 (.32)	.35 (.15)
Bedtime cortisol level µg/ml	.04 (.03)	.01 (.01)
Diurnal cortisol difference µg/ml	.45 (.32)	.34 (.15)
Awakening α-amylase level U/ml	90.46 (49.85)	83.64 (58.93)
Bedtime α-amylase level U/ml	124.27 (66.20)	110.69 (50.23)
Diurnal α-amylase difference U/ml	-33.81 (78.58)	-26.34 (74.09)

M = Mean, *SD* = Standard Deviation

Despite the higher reporting of exposure to traumatic events by girls, boys appeared to have more exposure to severe traumatic events. Forty percent of boys reported witnessing the killing of a family member compared to 18% of girls. Exposure to arrest and imprisoning were experienced by approximately 27% of boys compared to 9% of girls. Table 2 describes the most frequently reported traumatic events by gender.

Both cortisol and sAA levels were higher for boys than girls. While both boys and girls had positive or normal variation in cortisol secretion(i.e., higher morning and lower evening cortisol levels), 32% (12/37) of the sample had a positive sAA diurnal change value (i.e., higher morning and lower evening levels) implying that a significant proportion of the children were experiencing a more abnormal sAA secretion pattern. Figure 2 illustrates these pattern differences in sAA secretion.

Table 2: Most Prevalent Traumatic Events Reported by Gender (N = 37)

Traumatic event	Boys (*n* = 15)	Girls (*n*= 22)
	n (%)	*n* (%)
Hearing about the arrest or kidnapping of someone	15(100)	22(100)
Hearing shelling of the areas close to your town by heavy artillery	14(93)	22(100)
Watching mutilated bodies and wounded people on television	13(87)	22(100)
Hearing the killing of a close relative	12(80)	22(100)
Prevented from going to your school or coming back to your home	10(67)	21(95)
Detained for > two hours by a military barrier	8(53)	20(91)
Witnessing the arrest of a close family member	10(67)	16(73)
Forced detainment at home	8(53)	18(82)
Witnessing neighbor's house being demolished	8(53)	17(77)
Being scared by shooting	9(60)	16(73)
Destruction of your personal belongings due to military action	4(27)	13(59)
Witnessing firing by tanks and heavy artillery at neighboring homes	5(53)	11(50)
Witnessing the killing of a parent or other close family member	6(40)	4(18)
Being arrested or imprisoned	4(27)	2(9)

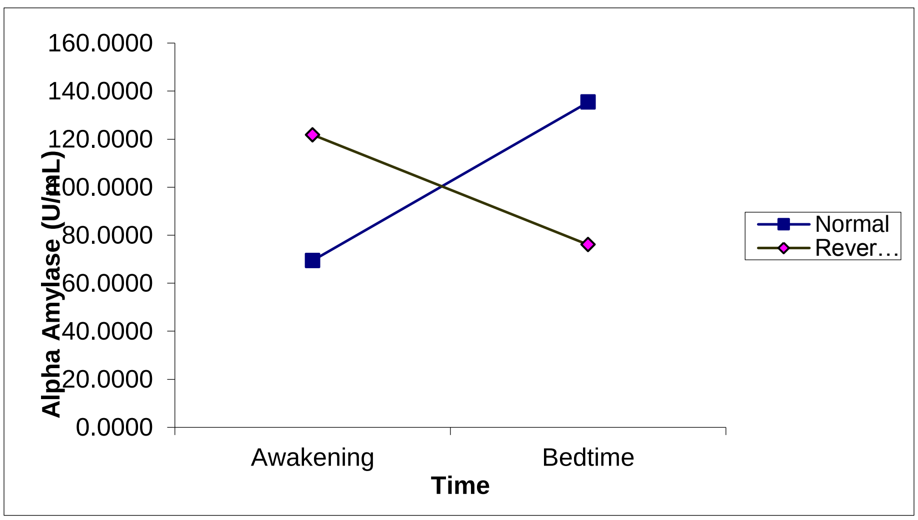

Figure 2: Comparing Salivary Alpha Amylase Levels from Awakening to Bedtime between Children with a Negative Diurnal Slope (Normal Pattern with Higher Bedtime Values) (N=25) and Children with a Positive Diurnal Slope (Reversed Pattern with Higher Awakening Values) (N=12).

Table 3 shows the Pearson correlations of the continuous study variables. Higher child stress was moderately correlated with reported traumatic exposure score (r = .34, p < .05), morning cortisol level (r = .35, p <.05), and cortisol diurnal difference (r =.33, p <.05). The study further found a significant gender difference on evening cortisol (F = 12.7, p = .001) with boys scoring higher than girls. There were no significant associations between sAA levels and the other study variables.

Table 3: Correlation Matrix Comparing Salivary Cortisol and Alpha-Amylase Levels with Child Stress Score and Traumatic Event Score

Variable	1	2	3	4	5	6	7	8
1. Awakening cortisol level	-	.13	.99***	-.01	.21	-.17	.35*	.19
2. Bedtime cortisol level		-	.04	.29	.24	.03	.20	-.17
3. Diurnal cortisol difference			-	-.04	.19	-.17	.33*	.21
4. Awakening alpha-amylase level				-	.09	.66**	.08	-.18
5. Bedtime alpha-amylase level					-	-.69**	.25	-.18
6. Diurnal alpha-amylase difference						-	-.14	.00
7. Child Stress Score							-	.34*
8. Traumatic Event Score								-

Note:* p < .05, **p< .01, p < .001

This study's findings suggest children who report higher traumatic exposure levels experience greater perceived stress. Further, children with higher perceived stress levels appear to have an increased up-regulation of the HPA axis response as indicated by higher levels of awakening cortisol. While not significantly related to other study variables, it is of concern that >30% of the children were experiencing an abnormal diurnal pattern for sAA secretion suggesting an increased sympathetic nervous system activation.

Discussion

The purpose of this feasibility study was to explore relationships of exposure to traumatic events, perceived stress, patterns of salivary cortisol, and sAA secretion in a sample of Palestinian children living in an area of chronic political unrest. In this sample of 37 school-age children, salivary cortisol and sAA generally reflected diurnal changes consistent with previous research demonstrating the cortisol diurnal pattern is distinct and opposite from sAA patterns (Granger et al., 2007; Davis & Granger, 2009). The gender differences related to boys having significantly higher evening cortisol levels than girls are in contrast to findings by Rosmalen et al. (2005), who reported that girls had slightly higher evening cortisol levels over boys in a population-based study of 10-12 year old children in the Netherlands; boys in the current study may be experiencing higher HPA activation than girls. One possible explanation for increased HPA activation may be the greater severity of reported traumatic exposures experienced by boys as compared to girls in our sample. The overall higher levels of morning and evening sAA levels in boys compared to girls suggest increased activation of the SNS as well. Nater et al., (2007) found higher sAA levels in their participants with higher chronic stress scores. The observation of a reversed sAA secretion pattern among a significant proportion of the children in our sample implies that studying sAA may be important to consider in future stress-related studies in children.

Children who experience high levels of stress are at increased risk for developing childhood, as well as adult physical, cognitive, psychiatric, behavioral, and psychobiologic disorders (Feng, Shaw, & Silk, 2008; Hasanovic, 2011; Middlebrooks & Audage, 2008; Yehuda et al., 2010). Higher child stress scores in our study were correlated with a higher reported traumatic exposure scores and higher morning cortisol levels. The mean number of traumatic events experiences in our study was 13 exposures compared to 9.7 traumatic exposures in a similar study by Abu Nada, Celestin-Westreich et al., (2010). In their study, 40% of 368 Palestinian adolescents, experienced moderate to severe levels of posttraumatic stress. Lovell, Moss, and Wetherell (2011) found in a study of young adults, those participants with higher perceived stress scores had flatter diurnal cortisol slopes due to higher evening cortisol levels, and more frequent common health complaints than participants with lower perceived stress. However chronic hypocortisolism have been found in individuals with history of trauma, which suggests potential long term and profound effects of childhood trauma on the HPA axis (Hinkelmann et al., 2013).

With increasing world-wide armed conflicts and the potential detrimental effects on vulnerable children, the need for immediate psychosocial interventions becomes pivotal in alleviating the stress and suffering of affected children. According to Calitz (2014) childhood traumatic events may lead to the development of PTSD. Early identification and preventive services to support of children at risk for PTSD are needed.

This study highlights the public health implications for child health resulting from traumatic exposure to war-related events. For field practitioners working with children exposed to traumatic events, particularly in the context of an environment with severe and recurring violence, it is important to consider early identification of children at risk for stress-related health outcomes

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including psychological disturbances and physiological alterations. For example, Theall, Drury, and Shirtcliff (2012), identified that adolescents living in very high-risk neighborhoods had 69% greater odds for experiencing biophysical evidence of psychosocial stress compared to adolescents living in low-risk areas.

Developing effective screening instruments for children at risk for traumatic event exposure can enable public health practitioners to more quickly identify children in need of early psychological intervention and support. For example, a more recently developed scale, the Subjective Threat from Armed Conflict Events (STACE), was used to evaluate exposure to armed conflict and terror events in a large sample of slightly older children (11, 13, and 15 year olds) living in Israel and Palestine (Harel-Fisch et al., 2010). Higher STACE scale scores were significantly associated with greater post-trauma mental symptoms, diminished well-being, and increased risk-taking. The investigators in the STACE study found that parental support had a buffering effect on the impact of stress exposure and child outcomes. A better understanding of the role parents can play in helping children cope with traumatic event exposure is needed. Early identification of at-risk children and timely clinical psychosocial intervention strategies may provide essential protection from significant long-term stress-related health outcomes in this vulnerable population of children. Neurobiological alterations have also been identified among high and low resilient adaptation of caregivers (Ruiz-Robledillo et al., 2014) suggests the importance of studying the psychobiological characteristics of parents and other caregivers caring for traumatized children.

Limitations

There are several important limitations of this study. The cross-sectional design of the study and the small sample size limit our ability to draw generalizable conclusions about traumatic stress exposure in this vulnerable child population. Further research with a larger sample and a longitudinal design is needed to more fully understand the effects of chronic traumatic event exposure on children health outcomes. There may have been other sociodemographic or personal factors that affected the study outcomes such as child’s birth history, attachment to caregivers, and current physical and mental health of the children (Granger et al., 2007). Coincidentally during the study time frame there was a sudden escalation in the Israeli-Palestinian conflict resulting in significant challenges in data collection which may have contributed to some of the loss of study samples (Asia, Georges, & Hunter, 2010). The study was also limited by the lower internal consistency reliability of the PSS; therefore, we may not have been able to reliably estimate the reported level of perceived stress of the child. The PSS has been found to have lower internal consistency reliabilities in multi-ethnic and low-income populations (Watson, Logan, & Tomar, 2008). Further research is required to identify a consistently reliable instrument that measures the important construct of child perceived stress, particularly in a cross-cultural context. Finally, we would recommend capturing saliva samples on at least two consecutive days to ensure a more reliable estimate of prevailing levels of cortisol and sAA, and provide more reliable means of ensuring the participant's delivery of salivary sampling (such as having research personnel pick up the saliva samples from the child's home) to prevent any loss of specimens. In spite of these limitations, this feasibility study demonstrates that studying the biobehavioral outcomes in children living in a conflict zone is worthy despite of all the challenges imposed.

Conclusion

The overall study results reveal Palestinian children in this sample are exposed to numerous traumatic events in their environment as a result of chronic political conflict and terror. The results also identified these children were demonstrating stress-related physiological responses that may lead to long-term health consequences. Chronic traumatic stress in conflict zones can result in alteration of neurohormonal stress biomarkers in vulnerable children. Conducting larger, longitudinal studies of children living in conflict zones may provide an important understanding of situation-specific factors related to child stress and its related health outcomes. With identification of more valid and reliable screening instruments, health care providers may be able to provide earlier identification of at-risk children, and direct interventions to help moderate the impact of exposure to traumatic war events in this vulnerable population.

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تقييم اثار الاحداث الصادمة على التغييرات الفيسيولوجية لدى الأطفال الفلسطينيين

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ملخص

الخلفية: *تشير الدراسات المتزايدة الى أن تعرض الاطفال الى الصدمات الناتجة عن الحروب تهدد التطور البدني والنفسي لديهم. حيث أن تعرض الاطفال لمثل هذه الاحداث تزيد من نسبة اصابتهم بالأمراض النفسية، العقلية والصدمة ما بعد الحرب (PTSD)، اضافة الى مشاكل سلوكية وعاطفية وفسيولوجية.*

الأساليب: *تناولت هذه الدراسة التجريبية العلاقة بين التعرض للصدمة، والضغط النفسي للطفل، وعلامات الإجهاد البيولوجية (الكورتيزول والألفا الأميليز في اللعاب) الذي تم قياسه في عينة تتكون 37 طفل فلسطيني في الضفة الغربية والذين تتراوح أعمارهم بين 10-12 سنة.*

النتائج: *كشفت النتائج عن علاقة متوسطة ايجابية بين الضغط النفسي عند الاطفال وعدد الاحداث الصادمة التي تعرضوا لها، وكذلك ارتفاع في مستوى الكورتيزول عند الاستيقاظ، وزيادة التباين في مستويات الكورتيزول خلال اليوم. وعلاوة على ذلك، أظهرت الدراسة أن 32٪ من العينة اظهروا انعكاسا في المستويات الطبيعية لهرمون الالفا امايليز خلال اليوم.*

الخلاصة: *تبين الدراسة أن الأطفال الذين تعرضوا لأحداث صادمة عنيفة اظهروا مستويات اعلى من القلق النفسي، وكذلك اضطراب في ردود الفعل الفسيولوجية الطبيعية لديهم. إن تطوير واستخدام ادوات القياس البحثية المتخصصة والموثقة تساعد في التشخيص المبكر للأطفال المعرضين لخطر الصدمة، ومن ثم التدخل المباشر في التخفيف من مضاعفات التعرض للأحداث الصادمة خلال الحروب.*

الكلمات الرئيسية: *صدمة الطفل، مفهوم الضغط النفسي، الكورتيزول اللعابي، ألفا الأميليز اللعابي، فلسطين.*