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NUTR 677/ April 20, 2018

"If someone were asked to design an environment that would be as tough as possible on family systems, it would probably look a lot like the military" (1).

SPECIFIC AIMS- Measuring growth indicators in military children.

Military families are a unique community within the United States population. The military creates a "culture", in the anthropological sense, radically different from civilian America (1). Undefined by race, religion, ethnicity, language or location, the culture of military families carries its own social identity (1).

Children of military personnel are exposed to a variety of stressors attributed to the career of their parents. Of the roughly 1.9 million children in military families, more than 60% are between six and eighteen years of age (2). Military families will always find life extremely challenging, constantly encountering the unexpected. Even in peacetime, families are constantly under pressure to live a very rigorous and demanding way of life (1). In addition to these difficulties, the military carries significant stigma around seeking military care and therapists cannot protect their client's confidentiality (1).

Healthy growth in children can often be understood through maturation and adaptations seen in the body. Variability in environmental factors can play a large role in the development of a child. Pediatric behaviors, and growth outcomes are likely influenced by changes in physical and psychological stress following difficult circumstances such as parental deployment, strict physical assessments and base relocation during early adolescence (3). Stress in children has been historically linked to environmental factors and its relationship to poor outcomes in cognitive function affecting the ability to plan, pay attention and control impulses and emotions (4). Children of military families are especially vulnerable, as they are under constant stress (3). To our knowledge, this is the first time research has been conducted

to better understand growth trends among military children. Psychosocial morbidity has been associated with deployment (5), and mental health of adolescents of military families is a constant worry but little research exists around the implications of these stressors on physical growth and maturation.

The overarching goal of this study is to understand the implications of stressful circumstances on growth and maturation indicators in children of military families.

AIM 1: To understand if growth is restricted in children attempting to cope with stressors.

We will conduct monthly measurements of BMI, heart rate variability, and cortisol levels to assess stress levels and growth changes in a sample of n= 300 adolescents to better understand why it occurs, if it varies by stressor, and what its implications are on growth indicators.

Hypothesis: We hypothesize that through unique stressors such as frequent transitions to different bases, deployment of a parent and having disordered eating behaviors, children of military families will show signs of altered growth. This will be tracked by comparing growth in military children to CDC growth charts.

AIM 2: To understand if precocious puberty occurs as a result of altered growth patterns due to stressors.

We will conduct a series of Tanner stages in a sample of n=300 adolescents to better understand if precocious puberty is a result of stress manifestation. We will assess when puberty starts, as well as its duration.

Hypothesis: We hypothesize that altered growth, as a result of unique stressors, will predict altered maturation trends.

AIM 3: To understand if obesity trends in the military children are related to disordered eating patterns in military parents.

We will conduct a series of questionnaires in n=300 adolescents in order to screen for disordered eating among children, and to better understand if these disordered eating patterns are related to dietary habits of parents enlisted in the military. We will also assess whether these patterns include similar military behaviors such as strict physical activity and constant weigh-ins.

Hypothesis: We hypothesize that there will be increased obesity trends in military children that are exposed to a variety of stressors, that affect their growth.

SIGNIFICANCE

IIA1. Why is it critical to understand stressors in military families

Historically, the military was composed of mainly single men, so the demand for exclusive and undivided loyalty to the military, was rarely questioned (5). With the creation of an all-volunteer force, this changed (5). The military's high demands on families pressure military families to cope with normal issues, such as child care or parental concerns, in a specific way. Military families carry the rank of their spouse or parent and are encouraged to conform to the guidelines of behavior (5). Adolescents in military families must adapt to stress from normative development (puberty, formation of peer relationships, parent/child relationships, increasing academic demands), in addition to unique stressors of military culture. Research indicates that military-connected youths worldwide are at significantly higher risk for suicidality (6). Youth with military association are more likely to have suicidal idealization, suicidal plans, suicidal attempts and suicidal attempts requiring medical care (6).

Relocation is a constant stressor in military families as moves usually occur every three years, or more frequently in higher ranking officials. On average, military children move three times more often than

their peers, experiencing change and transition at a much faster pace. Due to the inability to establish stability before a new transition is planned, social and emotional growth of military children may be challenged (2). Military children are often adapting to new schools, and may be enrolled in public schools that are unfamiliar with military culture, leading to alienation from faculty and students, and often inability to establish peer relationships (2). Numerous moves can also cause parents to feel physically and emotionally exhausted, leaving children to cope with stress on their own (2). Several studies report that parental stress, in a military family, directly affects a child's ability to cope with stressful situations while increasing likelihood of conflicts between parents and children (2). These conditions can further exacerbate a child's difficult transition time (2).

Among military families, children with a deployed parent self-report higher levels of depression than those without a deployed parent, while parents self-reported that children with a deployed parent are at higher risk of psychosocial morbidity (3). Deployments can range in duration from six to nine months, but can often last longer, putting children at risk for extended periods of time.

IIA2. Early childhood stressors can result in precocious puberty

Early childhood stress or conflict in the family environment has been associated with early puberty. Precocious puberty has been associated with significant risks for depression, low self-esteem, anxiety, and psychological distress (7). Greater sensitivity and internalization of emotions such as affection, closeness, loyalty, acceptance and social validation can result in early pubertal maturation in times of perceived threat (5). Research shows that girl's heightened stress reactivity, measured by cortisol, can explain the association between early maturation and symptoms of depression and anxiety (9). Specifically, research shows girls that reacted more strongly to father's hostility and peer pressure resulted in early maturity (9). A parent's awkward reaction to their daughter's early sexual maturation may further add to the earlier

development of adolescents (9). Due to the demand of military families to carry the rank of their spouse or parent and are encourage to conform to the guidelines of behavior, peer pressure may be heightened among the military culture (5).

Early menarche was also found in individuals with increased family stress, conflict with their mother in childhood and rejection or detachment from their mother through childhood (7). Father's absence is associated with altered growth and development in both male and female adolescents (8). Furthermore, absence of a father figure can result in precocious puberty (8). In the military, deployment can range in duration from six to nine months, but can often last longer, putting children at risk for extended periods of time (2).

IIA3. Rates of disordered eating have negative health outcomes

High disordered eating patterns are prevalent within military families. Extreme weight loss practices for strict military body and exercise requirements promotes unhealthy dieting among military families (3). High rates of disordered eating among adolescents parallels those rates in military adults (3). Eating disorders and disordered eating patterns are a significant cause of physical and psychosocial morbidity. Negative health outcomes include malnutrition, weakness, low bone density, delayed growth loss of periods and insulin resistance (10).

Research suggests that attempts to avoid certain desired substances results in increased preoccupation with that substance (11). Higher levels of dietary restraint do not effectively promote sustainable weight loss, but rather contribute to weight gain through disinhibited eating behaviors following restraint (12). Disinhibited overeating is a loss of cognitive control, as a result of prior dietary restraint (12). Girls that

are overweight and have mothers that report restricting a daughter's' intake of snack food, are most susceptible to overeating in the absence of hunger (11).

Combat during deployment is highly correlated to new-onset of eating disorders in women (7). Among women who were deployed and reported combat exposure, individuals were 1.78 times more likely to develop new onset of disordered eating and 2.35 times more likely to lose 10% or more of their body weight compared to those who were deployed but not exposed to combat (5). The rates of eating disorders and disordered eating behavior should be considered high risk in military families (3).

Among the civilian population high rates of disordered eating among adolescents have been linked to mothers who had bulimic symptoms, were chronic dieters and had body dissatisfaction (13). Research conducted in a military sample illustrated that twenty six percent of the parents in the population had disordered eating patterns (14). Twenty-one percent of adolescents, from the sample also exhibited disordered eating patterns. These results illustrated significantly higher rates of disordered eating compared to the civilian population (14).

IIA4. Growth Chart Development

Growth charts are used to detect growth faltering or delay. They serve as a preventative tool to protect children from developing negative health outcomes (15). Although a reference chart is used to understand growth among infants, children and adolescents, the aforementioned growth alterations demand the development of another type of growth chart. There is no single growth pattern for adolescents around the world and growth and maturation patterns vary across the world (15).

Healthy growth can often be understood through maturation and adaptations seen in the body. Unhealthy growth can predict later negative health outcomes. Variability in environmental factors can play a large role in the development of a child. Children of military families are especially vulnerable, as they are under constant and unique stressors such as frequent transitions, deployment of a parent and being exposed to abnormal eating behaviors, children of military families will have altered growth (4). Traditional growth curves do not take these exposures into account. Thus, due to the similar stressors among children of military families, a specific growth chart based on those with altered growth, could reframe protective factors for adolescents of military families.

INNOVATION

IIBI. Understanding changes in growth in children of military families.

Our proposal aims to better understand stress among children of military families. This will fill an important gap in the literature. Psychosocial morbidity has been associated with deployment, and mental health of adolescents of military families is a constant worry but little research exists around the implications of these stressors on physical growth and maturation. To our knowledge, this is the first time research has been conducted to better understand growth trends among military children.

IIB2. Population specific growth chart

Our proposal aims to better understand to what extent these growth perturbations are prevalent within the population of military families. This is an important innovation as, to date, despite understanding the unique community of military families, the interaction of psychological and physical occupational stressors has not been investigated. Thus, our proposed research has the potential to identify important intervention periods.

IIB2. Stress relief as a target for intervention

Finally, our proposal aims to investigate the implications of stress on negative health outcomes. A positive relationship between stress and negative growth outcomes, will allow stress as a target for intervention in order to reduce negative health outcomes for military families. This is a novel approach as stress interventions targeting children have not been developed despite the positive outcomes of adult targeted programs.

APPROACH

IICI. Overview

The overarching goal of this study is to assess growth trends in children of military families that will serve as a measure for further development of population specific growth charts and stress interventions. We will conduct both quantitative and qualitative analysis to best understand the study population of n=300 infants and ensure measurement of possible confounders.

IIC2. Sample

Recruitment will take place through the DOD Demographics Report of 2017. Initial assessment of children will be conducted at time of enrollment. All participants will participate in the following data collection, twice monthly. Quantitative data will be taken at local military base hospitals.

We will conduct twice monthly measurements of BMI, heart rate variability, cortisol levels and Tanner stage assessments beginning at enrolment of three years of age. The sample of n=300 children will be followed until eighteen years of age. This study will be longitudinal as we aim to understand growth and maturation within adolescents, due to their exposure of stress throughout their growth. We will enroll 300 military infants and follow them overtime, ensuring parents are career military individuals. We will

analyze frequent movers vs. non-frequent movers, and frequent deployments vs. non-frequent

deployments in the analysis phase. Among the sample, n=300 we will further understand eating behaviors

and deployment within the families. Combat exposure will be assessed. Recruitment will focus on

ensuring a diverse sample with respect to already understood associations among stress, and different

health outcomes: 1) sex (male and female), 2) race/ethnicity (non-Hispanic white, non-Hispanic Black,

Hispanic and Asian) 3) socioeconomic background.

IIC3. Measures

IIC3a. BMI z-scores. The BMI z-scores are a gold standard measure for understanding growth and

adiposity. Children will be weighed using a Detecto Portable Scale. BMI will be calculated using weight

and height. BMI z-scores will be derived using the age and sex-specific scores that are result of the CDC

growth charts. Due to our aim, we will also record weight and height separate from the BMI z-score to

ensure that growth trends are not disguised by the CDC charts (16).

IIC3b. Electrocardiographic recordings (ECG). An ECG is used to measure heartbeat in individuals.

This measure will be used to understand intervals between heartbeats. Heart rate variability is an

assessment of the autonomic nervous system function. ECG has been validated through interreliablity

tests in athletes (17).

IIC3c. Cortisol levels. Blood draws will be collected to assess the serum level of the hormone cortisol

in the blood. Cortisol levels can indicate issues or changes in function in the adrenal or pituitary glands

(18).

IIC3d. Tanner Stage Assessment.

The Tanner Stage Assessment is a tool that is used to understand pubertal growth/ maturation. Pubertal

maturation can be often described by sequence, timing and tempo. The stages of this measure allow the

categorization of certain changes and sexual characteristics.Analysis of results of Tanner stages shows

that pubertal staging is not influence by age and can serve as a reliable method of assessing puberty (19).

IIC3e. EcSatter Inventory (EcSI). The ecSI is a measure to assess eating competence. The test consists of 16 items and 4 subscales. The subscales are: eating attitudes, food acceptance, internal regulation and contextual skills. This measure has shown internal reliability and has established strong relationships between cognitive or behavior responses (20).

IIC3f. The Diagnostic and Statistical Manual of Mental Disorders (DSM-V). The DSM-V is a widely used diagnostic tool that serves as the gold standard for psychiatric diagnoses. The DSM-V is used to assess eating disorders within the general population (21).

IIC3f. The Center for Epidemiologic Studies Depression Scale (CESDR-10). The CESDR-10 is a widely used measure used to screen for depression in adolescents. The scale has been validated through strong associations and measurements in large population studies (22).

IIC3g. The Generalized Anxiety Disorder-7 scale (GAD-7). The GAD-7 is a self-report questionnaire used to screen for anxiety. The test has proven reliability and consistency, within the US. Increasing scores on the GAD-7 scale are strongly associated with increasing anxiety (23).

Statistical Analysis:

Growth characterizations, hormone levels, measures of disordered eating attitudes and depressive behavior will be compared using overall repeat ANOVA analysis. We are comparing these variables in children that remain on the same base versus those that frequently move. Frequent moves will be defined by moving more than twice in a five year period. We will also look at frequent deployment (upward of 60% of a year) versus no deployment. We will analyze the data to better understand obesity as a result of disordered eating patterns, frequently attributed to stress. Variables that will show significant difference will then be compared by Fisher's test. Linear regression analyses will be used to investigate the

associations between hormone levels and measures and growth. Statistical significance will be defined as a two-tailed P value <0.05.

IID. Study Timeline

This study will be longitudinal, as we aim to understand growth and maturation within adolescents, due to their exposure of stress throughout their growth. Enrollment will begin at three years of age and individuals will be followed til their eighteen years of age.

IIE. Limitations

Limitations for this study will be the ability to fully understand mental health conditions of military adolescents. Perceived stigma around mental health in the military will limit the extent to which individuals are expected to truthfully answer questionnaires regarding depression, disordered eating, eating competency and anxiety. We have accounted for this partly by testing for heart-rate variability, as it is a biological test for stress levels. Furthermore, with a sample size of n=300, our study could face high drop-out rates, or families that leave the military and thus follow-up may be difficult to maintain.

IIF. Future Directions

We anticipate that findings from this research will inform an implementation of population specific growth measures and stress interventions for children of military families, improving positive health outcomes and growth. With a more military population- specific growth chart, clinicians will have the ability to better understand changes in "normal" growth trends as indicators of important periods for stress intervention. Clinical practice will be shifted towards approaching growth from a more holistic point of view, as the relationship and implications of psychological health on physical growth in children will be

better understood. Additionally, these findings will contribute to military-centered health clinics,

hospitals, military family events and overall awareness for military families.

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