

## **A Measurement of Stress Reactivity in Obese Children**

This project will involve 30 children who will be separated in three groups: 1. Central Obesity (measured by waist/hip circumference  $>.75$  and BMI  $>84^{\text{th}}$  percentile and/or body fat  $>31\%$ ) 2. Peripheral Obesity (BMI  $>84^{\text{th}}$  percentile and/or body fat  $>31\%$ ) and 3. Normal weight controls (BMI  $<75^{\text{th}}$  percentile and/or body fat  $<25\%$ ). Cortisol and heart rate variability changes will be recorded at set points throughout the day including a basal rate and before and after three stimuli (food, Stroop test and recreational activity). Results will be analyzed to determine difference in autonomic nervous system and hypothalamic pituitary axis HPA reactions in children with central obesity compared to those that are normal weight. This study offers the opportunity to increase our understanding of how stress can influence the development of central adiposity as it relates to perturbations in cortisol response and eventually affect the design and delivery of prevention and treatment programs.

### **Statement of the Problem**

Central obesity has been directly linked to physical conditions such as adult onset diabetes, and psychological problems such as depression, fatigue, and low self esteem (1). It is becoming increasingly evident that central obesity has distinct characteristics from peripheral obesity and is strongly associated with elevated levels of the stress hormone cortisol (1). It is not known whether these findings apply to children, however. If it is true that central obesity results in higher levels of the stress hormone Cortisol as well as autonomic nervous system dysregulation in children; then clinical indicators could be developed to predict “at risk” children. Prevention and treatment strategies could then be developed accordingly.

### **2. Review of the Literature**

Calling it a public health epidemic the Center for Disease Control (2) has estimated the prevalence of seriously overweight children and adolescents in the United States at 13 percent noting this figure has doubled since the 1970's. Children are likely to remain overweight as adolescents and adults (3) and as a result numerous medical problems eventually emerge (4). Because the efficacy of treatment programs for adults is poor (5), emphasis needs to be placed on children (6).

Heart rate variability (HRV), “oscillations in the interval between consecutive heart beats as well as the oscillations between consecutive instantaneous heart rate” (7), provides a quantitative multidimensional measure of autonomic (sympathetic/parasympathetic) modulation of cardiac function (8,9). HRV is a noninvasive prognostic tool with abnormally low levels serving as a marker of cardiovascular disease (10), SIDS (11), depression (12), sudden cardiac death (13), chemical dependency (14), overall longevity (15,16), anorexia nervosa (17), diabetes

(18), and anxiety/panic (19). In general, healthy individuals demonstrate more HRV (higher levels of parasympathetic involvement) than their unhealthy counterparts (higher levels of sympathetic involvement).

Low levels of parasympathetic activity (PSA) have been associated with obesity (20) and in children with diabetes with poor metabolic control and cardiac autonomic neuropathy (21). These findings and others have prompted researchers to study methods of increasing PSA. Prescribed exercise regimens have produced increases in total heart rate variability in older healthy adults (22) and PSA in children (23). In the latter study PSA decreased when exercise was withdrawn. Moreover, at baseline, total body fat, fat-free mass and subcutaneous abdominal adipose tissue were greater in subjects with low PSA (23).

Cortisol is a hormone that can be used to measure the plasticity of the hypothalamic pituitary axis as high morning and lower afternoon and evening values have been consistently reported (24). Cortisol stimulates fat accumulation and is elevated by perceived and physiological stress. Cortisol is considered an indicator of endocrine, metabolic, and circulatory health with chronic high levels associated with central obesity in adults. Reversal of this process or increasing the differences between morning and evening levels makes the HPA more plastic with less fat accumulation (1). It is not known whether children with central obesity exhibit similar patterns of cortisol release under varying conditions.

In an earlier study we found that physical activity could increase overall heart rate variability and promote autonomic nervous system balance (25). The same study also investigated whether basal cortisol would decrease as a result of the intervention. The study (n=11) found significant decreases in morning cortisol pre ( $m = 8.51 \pm 3.16$ ) and post ( $m = 11.5 \pm 4.02$ )  $p < .05$ . The purpose was to ascertain whether there was a stress reduction benefit to participating in physical activity thereby providing additional support for this type of intervention. While this appears to be the case, there are many confounding variables to consider. Measuring basal a.m. cortisol levels, for instance, reveals some important information but the findings are inconclusive as they do not allow for assessment of cortisol's diurnal rhythm nor do they factor stress-induced changes.

In order to circumvent this problem Bjorntorp & Rosmond (24) have suggested a methodology of assessing the individual's diurnal slope by collecting multiple samples throughout the day. They argue that most studies have not taken into account central versus peripheral obesity and that both high and low secretion of cortisol is contingent on the functioning of the hypothalamic-pituitary-adrenal gland axis. To gain a clear picture of HPA functions stimuli such as food and perceived stress are suggested (24). By following this method these authors were able to develop a "cortisol profile" of obese adults. Our study will replicate this methodology with children with central and peripheral obesity and compare them with matched controls. Mild stressors will be added to help determine (HPA functioning) stress reactivity.

The following hypotheses are being tested:

- A. Children with central obesity will exhibit a greater increase in cortisol with a food stimulus (Lunch), visual color (Stroop) test and recreational activity than controls.

B. Children with central adiposity will exhibit less heart rate variability and less vagal tone (an overall decrease in sympathetic dominance) after food stimulus (Lunch), visual color (Stroop) test and recreational activity than controls and those with peripheral obesity.

### **Procedures**

There will be 30 children recruited into the study. Children will be separated into 3 groups and participate on different Saturdays. Ten children will serve as matched controls. Children will report to the Human Performance Lab, after an overnight fast, at 7:30 a.m. Physical maturity level will be based on a Tanner Stage of II or less and will be reported by the parent(s) of the child. Skinfolds, waist-to-hip ratios, and BMIs will be assessed. Obesity will be defined as a BMI greater than or equal to the 85<sup>th</sup> percentile or a body fat percentage of greater than or equal to 25.

Central Obesity	WHR > 0.76, %fat >31 and/or BMI > 84 <sup>th</sup> percentile
Controls	Body Fat < 25, and BMI <75 <sup>th</sup> percentile

### **Screening Procedures:**

- 1) Medical history questionnaire
- 2) Body composition analysis using skinfold measurements
- 3) Measurement of weight and height
- 4) Measurement of waist and hip circumference

**Salivary Cortisol Levels (26, 27).** There will be nine samples per participant collected.

- Activities will be conducted in the Human Performance Laboratory and Minges Coliseum.
- Subjects will be given a cotton swab and instructed to chew on it for 45-60 seconds.
- Samples will be obtained in the morning before a standardized breakfast (8 a.m.)
- Samples will also be obtained at 10:00 a.m. prior to the Stroop color test and immediately after its completion, at 11:45 a.m. (before a 12 noon lunch) and then 30, 45, and 60 minutes after eating a standardized lunch. A sample will be taken before and after (1:30-2:30pm) an afternoon recreational activity. The last sample will be taken immediately prior to departure from the lab.

**Heart Rate Variability (HRV)** will be tested using Biocom's HeartScanner 1500 System.

- Two sensors (one right and one left) will be placed underneath a wrist-band. The manufacturer's instruction for data collection will be followed. Ten (10) minute HRV samples will be obtained in the morning before a standardized breakfast (8 a.m.)
- Samples will also be obtained at 8 am prior to 10:00 a.m. prior to the Stroop color test and immediately after its completion, at 11:45 a.m. (before a 12 noon lunch) and 60 minutes after eating a standardized lunch. A sample will be taken before

and after (1:30-2:30pm) a recreational activity involving moderate physical intensity.

- Samples will be collected while children lie in the supine position. This will be done to limit confounding variables e.g. body weight and therefore give a more accurate assessment of changes (23).
- There is minimal risk associated with this procedure.

#### **4. Practical Application of Expected Results**

We anticipate that the results of this study will eventually help practitioners develop interventions specific to the type one type of obesity and therefore increase prevention and treatment effectiveness.

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**Results are being analyzed to determine difference in autonomic nervous system (heart rate variability) and hypothalamic pituitary axis HPA reactions (cortisol) in children with central obesity as compared to those that are normal weight. This study offers an opportunity to increase our understanding of how stress can influence the development of central adiposity as it relates to perturbations in cortisol response and eventually affect the design and delivery of prevention and treatment programs.**

**My role was? Leading activities, data collection, managing the children etc. A sentence or two on what you learned.**

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<sup>1</sup> Shannon, elaborate here a little on the type of food and recreational activity used. Explain the Stroop (stress test as well).