Framework in Global Health

Global Health Scholars Program

February 2009 Fellowship Recipient

Proposal Title:

"Child Energetics in American Samoa"

[3 of 4]

Application for the Brown University Framework in Global Health Scholarship

Title:
Child Energetics in American Samoa

Dates of Study Period:
Mid-June to Mid-August, 2009
8-10 Weeks

Location:
American Samoa

Brown Faculty Mentor:
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I have been interested in Professor McGarvey's work on obesity and diabetes in Samoans since I first heard his lecture in my introduction to public health course. Following up on my inkling toward global health, I took Professor McGarvey's class (Burden of Disease in Developing Countries) last fall, which further whetted my interest to study health problems in the developing world. After the course, I discussed with Professor McGarvey the idea of working on his research project in American Samoa in summer 2009. Considering my background as a pre-medical community health concentrator and my intentions to become a primary care physician, we both agreed that the child energetic project would be a great fit.

Objective and Specific Aims:

More than 70 percent of boys and 80 percent of girls aged 15-17 years in American Samoa are overweight or obese (1,2). Even in the United States, the overweight prevalence in children and adolescents has increased significantly over the last twenty years (3,4). Yet, despite the widespread rise in childhood obesity around the world, the causal behaviors leading to rapid weight gain among children and adolescents are very poorly understood (5,6).

These causal and behavioral factors can begin to be uncovered by measuring energy expenditure, physical activity levels, and dietary intake among children. There exist very specific and accurate techniques for measuring all three of these factors. Energy expenditure can be measured using the doubly-labeled water (DLW) method, physical activity using activity monitors, and dietary intake using a 24-hour recall. However, the ability to carry out these measurements on American Samoan children aged 8-13 is unknown. Thus, the long-term goal of a longitudinal randomized study of children must be preceded by a smaller pilot study to assure the effectiveness of the proposed data collection methods.

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We plan to carry out this pilot test over a two-three month period. During this time, we will measure energy expenditure and activity levels of 30-40 American Samoan children aged 8-13. In addition, we will collect blood pressure, BMI, and anthropometric measurements from each of the pilot study participants. Beyond collecting a small sample of cross-sectional data, the pilot study will determine the feasibility of carrying out the energetic procedures (DLW, activity monitor, and 24-hour dietary recall) on young, Samoan children.

We propose the following specific aims:

1. To determine the feasibility of using the DLW and activity monitor methods to measure energy expenditure and levels of physical activity in American Samoan children. By obtaining these measurements in a pilot sample, we will demonstrate the viability of these data collection techniques for a larger, longitudinal study involving a much higher sample size.

2. To measure the energy expenditure (EE) and physical activity (PA) level of N=30-40 American Samoan youth. EE will be measured using the doubly-labeled water (DLW) technique, and patterns and types of physical activity will be determined using electronic activity monitors. The data obtained will provide useful insight into the behavioral causes of overweight and obesity among American Samoan children.

3. To measure dietary intake of American Samoan children using a 24-hour recall method. We will be able to use this information to examine patterns of dietary habits among our sample of American Samoan youth.

4. To compare childhood activity levels, energy expenditure, and dietary patterns with levels of adiposity and CVD risk factors. We expect that lower activity levels and higher intake of fatty foods will be associated with higher BMI and blood pressure.

Background and Significance:

Overweight/Obesity in American Samoa:

Adult BMI levels in the Samoas have risen dramatically in the last thirty years. Representative data from the 1990's shows an 80 percent prevalence of obesity (BMI≥30 kg/m^2) among American Samoan men and 90 percent among women. (2)

This rapid increase in levels of obesity demonstrates the extreme nutrition transition occurring in American Samoa as well as other parts of the developing world. This transition is driven by a shift towards a more sedentary lifestyle, modernization, and a higher intake of fatty foods. The recent spike in obesity rates in American Samoa suggest that it is currently in the midst of the transition phase. For this reason, conducting research and implementing behavioral interventions to prevent obesity are both extremely important.

Professor McGarvey's prior research in the Samoas has provided statistical estimates of overweight and obesity among American Samoan children. Approximately 70 percent of boys and over 80 percent of girls ages 15-17 years are overweight or obese. In both boys and girls, average BMI increases steadily with age, from 6-8 through 15-17 years of age, suggesting that overall overweight and obesity prevalence could be decreased by targeting behavioral interventions at children. (2)

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Our research is aimed at looking the causal behaviors that lead to these high levels of childhood obesity in American Samoa.

Childhood Obesity and CVD Risk Factors:

Adolescent obesity is associated with multiple health risks and serves as a strong indicator for adult health, including diabetes (7). Overweight children and adolescents are much more likely than their non-overweight peers to have two or more CVD risk factors (8), and studies have shown strong correlations between blood pressure and BMI (9,10).

As a result of these findings, we plan to obtain blood pressure measurements for each of our participants. This will allow us to analytically look at patterns of adiposity related to blood pressure as well as energy expenditure and physical activity.

Physical Activity, Energy Expenditure and Adiposity:

Data relating energy expended in physical activity to adiposity in preadolescent children have been incomplete and inconsistent. While some studies have demonstrated no association (11-17), others have reported an inverse relationship between physical activity levels and adiposity (18-24). The majority of the studies directly comparing physical activity and adiposity have involved very small, non-random samples.

Using a DLW method similar to the one we intend to carry out, Rush et al. found an inverse relationship between physical activity level and percent body fat in boys but not girls (25). However, the small sample size and cross-sectional design of this study limit the implications of this study, and a longitudinal study with a large population of Samoan children would overcome these limitations. The proposed pilot study is a necessary precursor to such a longitudinal study.

Preliminary analysis of physical activity in American Samoan children ages 12-17 years has shown that approximately 50 percent of girls and 33 percent of boys do not spend the recommended ≥ 2.5 hours per week in at least moderate physical activity. Comparing physical activity to adiposity, preliminary analysis also found that participation in farming was significantly associated with lower percent body fat in boys ($p=0.032$).

Diet, Fatty Acids and Adiposity:

High-fat diets have long been at the center of blame for increasing rates of obesity. Studies have found correlations between specific fatty acids and obesity in children and adults (26,27). Very little information exists on the effects of fatty diets on adiposity of children over a period of growth.

Measuring diet provides a real challenge, especially in large-scale studies. Using multiple tools of measurement, including 24-hour recalls, food frequency questionnaires, and biomarkers, would provide the best overall picture and allow for the most specific analysis of dietary intake. However, because we plan only to conduct a small, cross-sectional pilot study, we will only measure dietary intake with a 24-hour recall.

Methods and Data Collection Procedures:

Research Design:

While the ultimate goal of this proposed pilot research is to obtain longitudinal data, we must first establish the feasibility of the measures through a cross-sectional pilot study in a small sample of

children. We will collect one set of data values for each participant using the methods described below. The data will be collected for all participants within the three-month span of the summer of 2009.

Study Sample and Recruitment:

For this pilot study, we will be using a sample of approximately N=40 American Samoan children of ages 8-13 years. Because this project is a pilot study, we will use a convenience sample rather than a randomized one. We will likely recruit children to participate through Dr. McGarvey's connections that he has built up through many years of work in American Samoa. Children will ideally reside in a small number of villages (one or two), so as to make transportation and data collection easier.

Because of this sampling technique, the data on energy expenditure and physical activity will not be generalizable to the entire population of American Samoan youth. However, by obtaining the data we will be able to assess feasibility of these techniques (DLW, activity monitor, 24-hour recall) for a larger, randomized study.

Despite the convenience sample, we will make an effort to achieve age and gender diversity within the sample. We will aim to have equal number of children aged 8-10 years and 11-13 years as well as equal numbers of male and female participants.

Since our research participants will all be children, we will receive consent from parents and assent from the participants themselves. This will be done immediately prior to the administration of the DLW and activity monitor procedures.

Doubly-Labeled Water:

Currently, doubly-labeled water (DLW) is the only technique that directly measures total energy expenditure (EE). Since total EE is the sum of resting EE and energy spent during physical activity (PA), obtaining measurements for total EE and resting EE can provide a good measurement of PA (PA = total EE - resting EE). Resting EE can be measured by indirect calorimetry using metabolic carts. However, due to financial and time constraints, we will estimate this value for each participant using existing equations from other Pacific populations.

Total EE will be measured using the DLW method over a 9-11 day period for each participant. On the first day of clinical examination, a spot urine sample will be taken and each participant will be given an oral dose of DLW (calculated based on weight and estimated total body water). Urine samples will be collected at 1, 3 and 4 hours after DLW administration.

A midpoint urine sample will be collected on day 5 (±1 day), and a final sample will be collected on day 9 (±2 days). All urine samples will be collected and stored at 20°C and labeled with the participant's ID and the date and time of collection. Mass spectrometric analysis of these urine samples will provide a measurement of total EE for each participant. Energy spent on physical activity can then be calculated by subtracting the participant's resting EE.

Activity Monitor:

Past studies have demonstrated the effectiveness of accelerometer-based activity monitors at differentiating levels of activity among children (28-33). These monitors record the intensity, duration and frequency of physical motion. We will administer activity monitors to each participant to provide a second measure of physical activity level.

Each participant will wear the activity monitor for a seven day period, beginning at the same initial examination as the DLW procedure. We will instruct participants to wear the monitor at their waste at all times except while bathing or showering and during sleep if it is uncomfortable. Parents will

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be instructed to remove the monitor after seven days and record the date and time of removal. The monitor will be returned when the participant returns for his or her final urine sample on day 9.

Dietary Intake:

Dietary intake will be measured using a 24-hour recall method. The interview for this recall will be conducted with both the participant and the parent during the initial clinical examination.

Adiposity and blood pressure:

Adiposity and blood pressure measurements will be obtained for each participant during the initial examination session. Height, weight, skinfold thicknesses, and circumferences will be measured using standard anthropometric techniques to calculate BMI and indices of fat distribution. Blood pressure will be measured using mercury sphygmomanometers and the auscultatory method, as per normal procedure (34).

Additionally, parents will be administered a health questionnaire to determine potential history of cardiovascular disease.

Plan for Analysis and Dissemination:

All data obtained during the pilot study will be compiled and analyzed using Excel and SAS. Upon the completion of the data collection this summer, I intend to carry over the research for my senior thesis. Working with Dr. McGarvey, I will critically analyze and study the relationship between adiposity, CVD risk factors, diet, and physical activity based on the data we collect over the summer to produce a written thesis paper. In addition, I will work with Dr. McGarvey to compile the results of our pilot study into a proposal for a larger, more in-depth study in the future.

Budget:

Item	Description	Estimated Cost
Transportation	Flight to American Samoa On-island transportation	$2000 $500
Housing	Rent for 3 months	$700
Meals	Food for 3 months	$300
	TOTAL	**$3500**

Funding for research equipment and a paid Samoan research assistant will come from Professor McGarvey's research funds, not from this scholarship.

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