Framework in Global Health

Global Health Scholars Program

February 2009 Fellowship Recipient

Proposal Title:

"Child Energetics in American Samoa"

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I entered Brown as a premed student with a strong interest in anthropology and international studies. After considering a double major in anthropology and biology, I decided to major in Human Biology, a major that perfectly accommodated my interests in the human body and human experience. The more I learned in my biology and anthropology courses, the more I became interested in how physical and social health interact. I decided to seek out Brown professors who were involved in global or community health, and as my mom is a nutritionist and I have always had in interest in the subject, Dr. McGarvey's work on obesity and diabetes in Samoa caught my attention the most. After speaking with Dr. McGarvey and doing some research for him last summer, I decided to take his class, The Burden of Disease in Developing Countries. Taking this class only solidified my interest in the work that he was doing, and after a few meetings with him this fall the project proposed here began to take shape. I have begun to analyze some data for him and his assistant from one of his previous studies in Samoa, and with this preliminary work I have begun to gain a deeper understanding of his work and a greater appreciation for the realities of global health research. The project proposed here provides an opportunity for me to continue working with Dr. McGarvey and deepening my understanding of how global health research works.

Specific Aims:

Obesity and overweight have become a significant public health problem in the West due to a shift to more sedentary lifestyles and energy-dense food. As developing countries adopt western lifestyles and diets, they experience the same epidemiological transition from infectious disease to chronic diseases such as obesity, diabetes mellitus, and other cardiovascular diseases. This shift in epidemiological trends is paralleled by a shift in patterns of physical activity and dietary behaviors referred to as the nutrition transition. In few places are these transitions more apparent than in American Samoa. The importation of high-caloric, low-nutritional value American foods, accompanied by urbanization and a shift from farm- to factory-based work has transformed the way of life in American Samoan communities over the past thirty years (1). This transformation has led to the emergence of obesity and cardiovascular disease as a considerable burden on the population.

A significant proportion of children and adolescents in American Samoa are overweight or obese, and this proportion has increased from the 1970s to 2003. While the rapid weight gain in American Samoan children and adolescents is known, its exact causes and the relationship between dietary intake and physical activity patterns is not well understood. Dr. McGarvey has conducted some preliminary analysis of physical activity in Samoa and American Samoa, which has shown that patterns of physical activity differ between the two. Furthermore, a large

proportion of boys and girls in American Samoa do not spend the recommended minimum of 2.5 hours of activity per week (1). However, the implications of these results, and what they mean for the health of these adolescents, require further study. We therefore need accurate measurements of physical activity and energy expenditure in order to better assess the relationship between different levels of physical activity and different levels of overweight and obesity in American Samoan children and adolescents.

The most accurate types of measurements of energy expenditure for community fieldwork derive from activity monitors and doubly-labeled water (DLW). Prior international research on energy expenditure and physical activity that utilized DLW as a means of measuring energy expenditure has proven the efficacy of the method in collecting reliable data in developing world settings (1). This same type of detailed data is crucial to understanding the relationship between variation in activity levels and variation in overweight and cardiovascular disease risk factors in Samoa and American Samoa. It is the goal of this project to collect data on the energy expenditure and physical activity of adolescents in American Samoa by means of DLW and activity monitors. These more detailed measures of energy expenditure will provide information that will allow for a more accurate estimation of physical activity patterns in American Samoan youth and their relationship to the growing obesity epidemic in the population.

The specific aims of the proposed research are:

1)To determine the feasibility and acceptability of using DLW and activity monitors as methods for collecting data on the energy expenditure and physical activity of children and adolescents in American Samoa. This will be determined by collecting DLW and activity monitor data on a small population of approximately 30 American Samoan children and adolescents. We hypothesize that the methods proposed here will be acceptable in this population and will provide accurate measurements of physical activity.

2) To determine the levels of physical activity of children and adolescents in American Samoa based on energy expenditure as measured by the DLW and activity monitors. This will provide preliminary data on physical activity in children and adolescents in American Samoa that will serve as the basis for a later, larger study.

3) To measure dietary intake using the 24-hour recall method. We will adapt existing dietary interviews from work with Pacific islanders in Hawaii and New Zealand.

Background and Significance:

Although we know that changes in diet and physical activity are ultimately responsible for the obesity epidemic, the extent of the contribution of an individual's energy expenditure to his risk of being overweight or obese is not well documented. While some studies have shown an inverse relationship between levels of physical activity and adiposity, others have shown no relationship at all. Due to these mixed findings, there is a need for the adaptation of improved energy expenditure measures that are objective and reliable. The best technique that currently exists to objectively measure energy expenditure is the use of doubly-labeled water. By using

doubly-labeled water alongside activity monitors we can greatly contribute to the current body of data on physical activity and its influences on weight gain and cardiovascular disease.

Physical activity can be calculated from total energy expenditure. Doubly-labeled water (DLW) measures an individual's total energy expenditure based on how much of the isotope comes out in the urine. The difference between the amount of labeled oxygen ingested as DLW and the amount recovered in the urine is the amount that was lost as carbon dioxide during metabolism. This is the individual's total energy expenditure. If we subtract resting energy expenditure (measured through indirect calorimetry) and the thermic effect of food (10% of total energy expenditure), we are left with the energy that was expended as a result of physical activity. The precision of this measurement would lend new insight into the effects of physical activity on the development of obesity and cardiovascular disease. The advantages of using DLW to measure energy expenditure was shown in a recent study where energy expenditure, as measured by the DLW method, was shown to be strongly associated with lower mortality risk in the elderly (1).

Applying the same technique to children and adolescents in American Samoa would provide quality evidence for the levels of physical activity in the population and its association with risk for obesity and cardiovascular disease. We will also use activity monitors alongside the DLW, which have traditionally been used as a method for measuring physical activity. The activity monitors are accelerometers that record the duration, intensity, and frequency of physical motion, which will provide data to support that collected from DLW. Together, these data will provide new quality information on the physical activity patterns of children and adolescents in American Samoa, lending new insight into the relationship between physical activity, adiposity, and cardiovascular disease. It is important to study children and adolescents specifically because patterns of physical activity and diet during childhood and adolescence have been shown to be significant determinants of behavior into adulthood (1). Furthermore, the proportion of overweight and obesity in children and adolescents in American Samoa has increased in the past decades and represent a significant aspect of the overall obesity epidemic in Samoa and American Samoa.

Methods and Procedure:

The proposed project will be based at the Tafuna Family Health Center, in Tafuna, American Samoa, a clinic of the Department of Health of the American Samoan Government. We will also have some working relations with the American Samoa Community College Land Grant. Research will be conducted on approximately 30 American Samoan children and adolescents, on which we will collect data from DLW and activity monitors, as well as dietary surveys. The recruitment of study participants will take place in neighboring villages and will be mediated by local research assistants and translators. After informed consent has been obtained from parents and participants, the prospective participants will be screened and prepped for administration of activity monitors and DLW.

The data to be collected will include: BMI, blood pressure, and anthropometric measurements; dietary data based on 24-hour food recall; physical activity from activity monitor; and total energy expenditure from DLW.

BMI, blood pressure, and anthropometric measurements will be taken at baseline after consent has been obtained. Participants' diets will be determined based on 24-hour recall, and a

health questionnaire will be administered to participants' parents to determine history of cardiovascular disease in the family.

Activity monitors will be administered at the same baseline session, and will be worn by participants over a period of seven days, during which the accelerometer will measure activity counts per minute. These will be converted to kilocalories per day and will be adjusted for individual body size. Subjects will be asked to wear the monitors for the duration of the seven-day period, removing them only to shower or during sleep, if uncomfortable.

Total energy expenditure will be measured by the DLW over a period of 9-11 days. The DLW will be administered orally, and each dose will be calculated based on the individual subject's weight and body composition. Subjects will then return to the clinic after 5 days and 9 days for collection of urine samples. Upon each of these visits, the activity monitors will be checked to ensure that they are working properly. The urine samples will be collected and stored at 20°C, and labeled with the subject's ID, date, and time of collection. Results from these samples will provide the total energy expenditure of the individual. In order to determine energy expenditure as a result of physical activity, we will subtract resting energy expenditure and the thermic effect of food from the total energy expenditure measured by the DLW. For this study, resting energy expenditure will be calculated based on valid equations used with Maori youth. Analysis of these samples will be carried out upon return to the States.

Plan for Analysis and Dissemination:

After the data has been collected, they will be analyzed using Excel and SAS. The results of this pilot project will serve as the basis for determining the feasibility of conducting a later, larger study. They will also serve as the basis for my senior honors thesis project, during which I will continue to work with Dr. McGarvey to further explore the implications that these data have for the relationship between energy expenditure and physical activity, and adiposity and other cardiovascular disease risk factors.

Budget:

Airfare- $2,000
Housing and Food- $1,000
On-island transportation- $500
Research materials and data collection expenses- to be covered by Dr. McGarvey's funds