Capstone Cover Page

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Weber State University Bachelor of Integrated Studies Program

Name: Anthony Zenger
Date: April 2013

Project Title: Effect of Docosahexaenoic Acid on Brain-Derived Neurotrophic Factor in Obese Exercising Women

Brief summary of project:
Primary research studying the effect of Docosahexaenoic Acid on Brain-Derived Neurotrophic factor in women participating in a 12 week exercise program.

Area of Emphasis 1: Nutrition
Committee Member from that discipline: Dr. Rod Hansen

Area of Emphasis 2: Zoology
Committee Member from this discipline: Dr. Brian Chung

Area of Emphasis 3: Chemistry
Committee Member from this discipline: Ed Walker
Bachelor of Integrated Studies
4800
Capstone-Senior Project

Effect of Docosahexaenoic Acid on Brain-Derived Neurotrophic Factor in Obese Exercising Women

Anthony Zenger
Effect of Docosahexaenoic Acid on Brain-Derived Neurotrophic Factor in Obese Exercising Women

Anthony Zenger
Faculty Mentor: Rod Hansen, Ph.D

Abstract

Docosahexaenoic acid (DHA), exercise, and brain-derived neurotropic factor (BDNF) have all been linked to memory formation and maintenance (1, 2, 3). Diet and exercise are coexisting components of a healthy lifestyle suggesting that their effects on the brain and memory are complementary. This has been verified in several murine studies in which DHA supplementation enhanced the effects of exercise on levels of BDNF under normal and challenging conditions such as brain trauma and disease (4, 5). Human trials so far have been non-existent as far as we know. The purpose of this pilot study was to assess the effects of DHA supplementation on obese women participating in an exercising program. Results indicated a significant increase may occur in BDNF levels with DHA supplementation.

Introduction

DHA
Figure 1- The 22 carbon backbone of Docosahexaenoic acid showing the first carbon double bond occurring at the third carbon from the end indicating an omega-3 fatty acid (6).

Docosahexaenoic acid (DHA) is a 22-carbon omega-3 polyunsaturated fatty acid (Figure 1). DHA is a major component of neural membranes, and is linked to neural development, neuron protection and synaptic plasticity (7). Western diets that are typically high in saturated fatty acids and low in DHA are linked to increased oxidative stress in the brain, reduced neurogenesis, neuro-inflammation and increased anxiety-like behavior (8). DHA is present in almost all cell membranes regulating receptor numbers and affinity of receptors to their respective hormones, growth factors, and it also improves the fluidity of membranes which allows them to function optimally (9). With the co-activity of arachidonic acid and DHA the plasma membrane protein syntaxin 3 is activated stimulating the outgrowth of axons and dendrites and thus enhancing neurogenesis (10). Although neurons are the major target for DHA, neurons themselves are incapable of synthesizing it, and the only glial cells that have demonstrated the capacity for synthesizing DHA are astrocytes, but they require another omega-3 fatty acid precursor to do so (11).

Exercise

Studies of adult animals indicate that metabolic and neurochemical functions improve with aerobic fitness. Executive functions that are controlled by the frontal and pre-frontal cortex are enhanced in adults participating in aerobic exercise (12). Exercise induces synaptic plasticity markers in the hippocampus through a BDNF-mediated mechanism. This increases the levels of cyclic adenosine monophosphate response-
element-binding proteins (CREB), which are involved in long term memory, and synapsin I phosphoproteins that modulate the formation and maintenance of the presynaptic structures and axonal elongation (13). With exercise there is greater activation of cellular signaling pathways that are involved in neuron survival and neurogenesis, all of which indicate the involvement of BDNF (14).

**BDNF**

BDNF is a polypeptide growth factor and is one of four members of the neurotrophin family that have been characterized in mammals (15). BDNF is synthesized within the endoplasmic reticulum of neurons. Initially it is synthesized as the precursor protein, preproBDNF. This is then cleaved into proBDNF which is converted to mature BDNF by extracellular proteases, such as matrix metalloproteinase-9 and plasmin (16). Mature BDNF, or rather BDNF, protein is localized in neuronal soma and axon terminals (17), with high concentrations being found within the hippocampus when there are increased levels of neuronal activity (18).

BDNF is a powerful modifier of neuronal excitability and synaptic transmission while also playing a role in neuronal development, plasticity, survival, dendritic branching, and enhancing long-term potentiation (LTP) (5, 7). LTP plays a vital role in learning and memory formation by triggering long-lasting and even permanent changes in neural circuitry (19, 20).

Neurotrophins influence the maturation of developing synapses and help stabilize synapses within the adult nervous system through various mechanisms and receptors (21). Each of the neurotrophins binds one or more of the tropomyosin-related kinase (trk) receptors, members of the family of receptor tyrosine kinases. The receptor
associated with BDNF is TrkB (22), which is extensively expressed in hippocampal neurons (23), and is found within the soma, axons, and dendrites of all cortical neurons (24). Memory acquisition and consolidation are associated with an increase in BDNF mRNA expression and TrkB. Genetic as well as pharmacologic deprivation of either of these factors impairs learning and memory, and decreased levels are reported in bipolar and major depressive disorders (25).

Increased BDNF levels improve cognition and the induction of LTP by enhancing the efficacy of synaptic transmission and the quantal neurotransmitter release by increasing the number of vesicles docked at the active zone of an individual synapse allowing synapses to function with high-frequency afferent activity (5, 26, 27). BDNF also increases the phosphorylation of subunits of N-methyl-D-aspartate (NMDA) receptor channels in the hippocampus (28). NMDA receptor channels constitute the principal cellular machinery responsible for initiating many forms of synaptic plasticity in different areas of the brain, and are the predominant molecular device for controlling memory function (29). When NMDA channels open LTP is induced (30).

The pathway in which DHA increases the levels of BDNF are still under investigation. The current hypothesis is that DHA first binds to G protein-coupled receptor 40 (GPR40) on the cell membrane, which then activates protein kinase C and triggers the phosphorylation of cAMP response-element-binding proteins (CREB) (31). Phosphorylated CREB is then thought to modulate the transcription of the BDNF gene thus increasing the production of that neurotropic factor (32).
Materials and Methods

Materials

The source of the DHA was the supplement “Brainstrong Adult” from i-Health (Cromwell, CT) with a composition of 300mg DHA per capsule. This is a vegetarian DHA that is produced by the microalgae *Crypthecodinium cohnii*. Comparative analyses have shown microalgae DHA and fish-oil DHA to have identical physiological results and similar mechanisms (33, 34).

The placebo material was corn oil in capsule form. The corn oil contained saturated fats, monounsaturated fats, and the polyunsaturated fats linoleic acid (omega-6) and oleic-acid (omega-9) in a 2:1 ratio.

Subjects

Twelve women were recruited from the exercise program Weber in Motion at Weber State University in Ogden Utah. All participants were obese females with an average body mass index (BMI) of 36.6, and had no background of serious disease or current disease. BDNF levels are decreased with a high-fat diet that is typically present in obese women (8), making any increases in BDNF more apparent. All participants had been enrolled in the exercise program for three months at the time the study began.

All participants were nonsmokers, had no or low alcohol consumption (< 2 drinks/day), had no previous gastrointestinal surgery, and had no inflammatory disease. The study was approved by and performed under the guidelines of the Institutional Review Board. Informed consent was obtained from each of the subjects after oral and
written information about the nature, purpose, possible risks, and benefits of the study were presented.

Experimental design

Participants were randomly placed into two separate groups consisting of six women in each group. Group 1 consumed a daily average of 2g DHA (6-8 pills). Our value of 2g per day is based on studies that have been conducted on the effects of DHA on human cardiovascular systems have shown benefits when doses of .5-3g per day were given (35, 36). Group 2 consumed only 1g corn oil placebo since the placebo contained saturated fatty acids which may have a negative effect on BDNF levels (8). All participants were instructed to maintain their normal diet for breakfast, lunch, dinner, and incidental foods, but were advised to avoid fish. Participants consumed supplements and placebo for a period of eight weeks with blood samples taken every two weeks. All participants walked for an average of 30 minutes just before blood draws. Blood samples were obtained at the same time of day for each time point.

Measurement of DHA and BDNF levels in serum

Whole blood samples were taken every two weeks at four separate time points between March 21 and May 2. Baseline samples were taken before any supplementation occurred. Samples were collected in a red top serum Vacutainer tube, centrifuge, and serum was taken from the samples and stored in cryovials at -80°C. Serum BDNF levels were assayed using a sandwich ELISA kit from EMD Millipore Corporation. Serum is the sample of choice because of the relative ease of obtaining it and also because BDNF
readily crosses the blood-brain barrier (37). DHA levels were analyzed in the Weber State University chemistry laboratory via gas chromatography using a capillary column with parameters set to manufacturer’s standards.

Statistical analysis

All statistical analyses were carried out using Number Cruncher Statistical Analysis Package. A repeated measures ANOVA was used to analyze DHA and BDNF data. Significance was determined at P < 0.05. The data are reported as mean +/- standard deviation.

Results

Several samples were unable to be obtained due to attrition. Of an expected 24 samples from the placebo group only 17 were obtained, and one participant was completely withdrawn from the study due to difficulties obtaining post-baseline samples. Of the expected 24 samples from the DHA group 21 were obtained with 4 errors occurring during content analysis leaving 17 valid samples for statistical analysis.

DHA Levels

A repeated measures ANOVA (P<0.05) indicated that once supplementation began the DHA group had significantly higher serum levels of DHA (Figure 2). Data are represented with a +1 standard deviation.

BDNF Levels
BDNF levels within Group 1 had an overall decline, while in Group 2 the average level had a slight increase over the eight week period. There was a statistically significant difference obtained at the third and fourth time points. One might try to normalize these levels to body mass, but there is no correlation (38). BDNF levels are shown in Figure 3 with a ±1 standard deviation (P<0.05).

![DHA Levels Over Four Timepoints](image)

Figure 2- DHA average serum levels over a period of eight weeks with four time points. Participants supplementing DHA had significantly higher levels throughout the duration of the study.
Figure 3- BDNF average serum levels over a period of eight weeks with four time points. Participants supplementing DHA had significantly higher levels of serum BDNF at the third and fourth time points.

**Discussion**

This pilot study provides novel direct evidence that DHA supplementation in obese exercising women may positively influences the levels of serum BDNF. The upward trend that is visible in Figure 2 is most likely due to the significant increase of serum levels of DHA that were seen in the participants. BDNF levels within the DHA group did not rise as dramatically as expected, but it should be noted that the levels of BDNF are serum levels and are not truly representative of the levels within the hippocampus where BDNF is most abundant. Within the placebo group there was a steady drop in levels which is expected in diets that are deficient in DHA (39).

The final results of this study would have been truly significant had the initial number of participants been greater, and the attrition less severe. The lack of more robust
data is clearly due to insufficient data points; however, the results from the DHA group are very promising that further research will definitively correlate increased BDNF levels with DHA supplementation. The revelation that significant results can be found in a pilot study with such a low number of participants is strong evidence that a follow up study with a larger participant database should ensue.

Conclusion

Our results show that DHA supplementation may enhance the positive effects that exercise has on serum levels of BDNF. Importantly, our results are novel as they provide the first direct evidence that BDNF levels are influenced by DHA supplementation in humans. Furthermore, given the involvement of BDNF in depression (40) and neurodegenerative diseases such as dementia and Alzheimer’s disease (41), if follow-up studies conclude that DHA supplementation increases the levels of BDNF it would suggest that DHA is a highly accessible form of intervention that could be used in concurrence with other standard methods of care.
References


8. Sharma, Sandeep, Zhuang, Yumei, and Gomez-Pinilla, Fernando. Diet transition to a high-fat diet for 3 weeks reduces brain omega-3-fatty acid levels, alters BDNF signaling


Similar Extent as a Fish Oil-rich Diet against AOM-induced Colonic Aberrant Crypt Foci in F344 Rats." Food and Chemical Toxicology 47.2 (2009): 316-20.


36. Tong, Haiyan, Ana G. Rappold, David Diaz-Sanchez, Susan E. Steck, Jon Berntsen, Wayne E. Cascio, Robert B. Devlin, and James M. Samct. "Omega-3 Fatty Acid Supplementation Appears to Attenuate Particulate Air Pollution-Induced Cardiac Effects and Lipid Changes in Healthy Middle-Aged Adults." Environmental Health Perspectives 120.7 (2012): 952-57.


January 27, 2012

Rod Hansen & Anthony Zenger
HPHP
2801 University Circle
Ogden, UT 84403

Rod & Anthony,

Your project entitled "Effect of Docosahexaenoic Acid A(DHA) on Brain-Derived Neurotrophic Factor (BDNF) in Women Participating in a Twelve Week Exercise Program" has been reviewed and is approved as written. The project was reviewed as "expedited" and moderate risk because it comprises taking blood samples from participants.

Subjects are considered adults and may choose not to participate. Subjects are required to sign informed consent forms to participate. You have a professional completing the blood samples. You have one year to complete the study.

Anonymity and confidentiality are addressed appropriately, and the type of information gathered could not "reasonably place the subjects at risk of criminal or civil liability or be damaging to the subjects' financial standing, employability, or reputation" (Code of Federal Regulations 45 CFR 46, Section 46.101).

You may proceed at this time.

Please remember that any anticipated changes to the project and approved procedures must be submitted to the IRB prior to implementation. Any unanticipated problems that arise during any stage of the project require a written report to the IRB and possible suspension of the project.

A final copy of your application will remain on file with the IRB records. If you need further assistance or have any questions, call me at 626-7370 or e-mail me at lgowans@weber.edu.

Sincerely,

Linda Gowans, Ph.D.
Chair, Institutional Review Board, Education Subcommittee
Title of Project: Effect of Docosahexaenoic Acid A(DHA) on Brain-Derived Neurotrophic Factor (BDNF) in Women Participating in a Twelve Week Exercise Program

Primary Investigator(s): Rod Hansen & Anthony Zenger

Reviewer: Linda Gowans, Ph.D.
Chair, Institutional Review Board
Education Subcommittee

Date: January 27, 2012

COMMITTEE ACTION

YOUR PROPOSAL (PROJECT) AND CONSENT DOCUMENTS HAVE BEEN RECEIVED AND CLASSIFIED BY THE HUMAN SUBJECTS IN RESEARCH COMMITTEE AS:

____ High Risk  X  Moderate Risk  ____ Low Risk

BY THE FOLLOWING PROCESS:

____ Full board review  X  Expedited review  ____ Exemption

THE PROJECT HAS BEEN:

X Approved  ____ Not Approved

COMMENTS: See Attached Approval Letter

Linda Gowans  1-27-2011
IRB Education Subcommittee Chair  REVIEW DATE

INVESTIGATOR'S RESPONSIBILITY AFTER COMMITTEE ACTION

The federal regulations provide that after the committee has approved your study, you may not make any changes without prior committee approval except where necessary to eliminate apparent immediate hazards to the subjects. Further, you must report to the committee any changes that you make and any unanticipated problems involving risks to subjects or others that arise.
INVESTIGATOR'S STATEMENT OF ASSURANCE

The attached investigation involves the use of human subjects. I understand the University policy concerning the use of human subjects and I agree:

1. To obtain informed consent of subjects who are to participate in this project;

2. To report to the Human Subjects in Research Committee any unanticipated effects on subjects which become apparent during the course, or as a result, of experimentation and the actions taken as the result;

3. To cooperate with members of a committee charged with the continuing review of the project;

4. To obtain prior approval from the Committee before altering or amending the scope of the projector implementing changes in the approved consent form; and

5. To maintain documentation of consent forms and progress reports as required by institutional policy.

PRINCIPAL INVESTIGATOR'S SIGNATURE
Fill in all blanks. Does the subject group include healthy volunteers? _x_ yes ___ no
Does the subject group include ill persons? ___yes _x_ no
Are subject groups excluded for medical reasons? ___yes _x_ no
Are there vulnerable subject groups? ___yes _x_ no
    If yes, is the exclusion criteria for the study specified? ___yes ___ no
Are any subjects under the age of 18? ___yes _x_ no
Are any subjects under the age of 12? ___yes _x_ no
Are any subjects over the age of 70? ___yes _x_ no

Dr. Rodney Hansen
Health Promotion and Human Performance

PRINCIPAL INVESTIGATOR'S NAME (typed)       DEPARTMENT

2801 University Circle, WSU
Ogden, UT, 84408

MAILING ADDRESS/MAIL CODE

CITY, STATE, ZIP

(801) 626-7748

PRINCIPAL INVESTIGATOR'S SIGNATURE (signed)       TELEPHONE

TELEPHONE

DEPARTMENT CHAIR'S SIGNATURE (signed)       TELEPHONE

1
A. APPLICATION FORM

1. TITLE
Effect of Docosahexaenoic Acid (DHA) on brain-derived neurotrophic factor (BDNF) in Women Participating in a Twelve Week Exercise Program

2. DESCRIPTION OF THE STUDY
This research project will examine the effect of DHA on production of BDNF in exercising women. Women will be recruited from the Weber State University Weber in Motion (WIM) program. WIM is a group training program for women with a BMI over thirty. Twelve volunteers will be recruited from this group. Six participants in the study will be given a daily dose of 3g DHA. This will be obtained by ingesting DHA supplement pills. The other six participants will be given a mineral oil placebo that is encased in a vegetarian capsule. Participants will all be required to walk daily for thirty minutes. Blood will be obtained at four time points: once prior to the initiation of the first DHA doses, and every two weeks for the six week duration. A licensed phlebotomist will draw 5-10 ml of blood from each participant within five minutes of finishing exercise on that day. BDNF will be assayed in the serum by ELISA. These procedures are routinely conducted in the Health Promotion and Human Performance (HPHP) department. All samples and laboratory disposables will be disposed of in accordance with WSU Environmental Health Services protocol.

3. DURATION OF THE STUDY
Data collection is scheduled to begin February 20th, 2012 and will be completed by June 2012.

4. MULTICENTER STUDY
This is not a multi-center study.

5. NUMBER OF SUBJECTS
Twelve healthy overweight/obese women will be recruited.

6. HEALTH STATUS OF THE SUBJECTS
All subjects will be healthy participants in the WSU WIM program. All participants are required to have a medical provider review their medical history and sign a form stating they are qualified to participate in a marathon walking program. All subjects will be nonsmokers, have moderate alcohol consumption (< 2 drinks/day), not be pregnant, have had previous gastrointestinal surgery, or have any inflammatory disease.

7. SUBJECT GROUPS EXCLUDED
No subject group is excluded.

8. AGES OF SUBJECTS
Subjects will be over eighteen years of age and under the age of seventy.

9. DESIGN OF THE STUDY
This study is a two group design with repeated measures. Comparisons will be conducted both between groups and within groups over time. The project will take place over six weeks. Data
will be collected before initiation and then every two weeks for a total of four time points for each subject.

10. RISKS TO SUBJECTS
Although very rare, risk from venipuncture to obtain blood for blood analysis can include infection, bruising, and mild discomfort. All phlebotomy procedures follow protocols required by WSU EHS. Briefly, a single blood sample will be obtained using standard procedures routinely done in the WSU Nutrition Biochemistry Laboratory; using sterile procedures, blood will be taken using a 22 gauge needle on a butterfly catheter from the antecubital vein, which is located on the anterior part of the arm at the bend of the elbow, on the non-dominant arm. Six cc’s of blood will be drawn and placed in appropriate Vacutainers. A hired Utah certified phlebotomist or Registered Nurse will conduct all of the blood draws. Needles will be used only once and used needles will be collected for disposal in an approved WSU EHS container. The participants will be instructed to compress the site where the blood was drawn to help prevent hematomas (bruising) from occurring.

There is also a very remote chance that taking DHA may cause mild gastro intestinal distress, burping, and slight upset stomach when beginning supplementation, however; the body adjusts quickly in these cases, and these side effects are very unlikely.

11. BENEFITS TO SUBJECTS AND OTHERS
The subjects will not be offered payment of any kind for their services.

12. COSTS TO BE BORNE BY SUBJECTS
The subjects will not be responsible for any part of the study.

13. IS CONFIDENTIALITY ASSURED
Subjects will be recruited from participants in the WSU WIM Program conducted through the HPHP department at WSU. Potential subjects will be informed of the intent, design, benefits, and potential (although rare) possible risks of venipuncture to obtain blood for BDNF analysis. Interested subjects will sign a consent form prior to any data collection. Subjects will have the option of dropping out of the study at any time for any reason.

The privacy, security and confidentiality of the subjects will be maintained by referring to each subject by a sequential number which is determined when they are admitted to the study. All data, subject background, and any other information pertinent to the study will be kept by Rod Hansen in a locked desk file in the nutrition laboratory or the personal office of Rod Hansen. He will be the only person given access to this information.

14. CONTRACT OR GRANT NUMBER
Office of Undergraduate Research

15. NAME OF PRINCIPAL INVESTIGATOR AND DEPARTMENT

Principle investigator:
PI: Rodney Hansen
2801 University Circle
Department of Health Promotion and Human Performance
Weber State University

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B. DESCRIPTION OF THE STUDY

**Background Information:** This research project will examine the effect of Docosahexaenoic Acid (DHA) on increasing brain-derived neurotrophic factor (BDNF) in obese and/or overweight women participating in an exercise program. BDNF is found in the hippocampus and cerebral cortex of the brain. It can also be found in circulating blood within the platelets and plasma (Chan, et al., 2008). BDNF may prevent neural death, promote neuronal growth, and neural regeneration (Gold, et al., 2003). Therefore, BDNF may improve brain health and lifestyles that enhance BDNF levels may be beneficial.

There is evidence from previous studies that show DHA supplementation significantly increased BDNF levels in mice (Jiang, et al., 2008). DHA has also been shown to improve cognitive function, promote neuroplasticity, and protect against neurological lesion (Wu, et al., 2008). Exercise and physical activities have been linked to increased levels of BDNF in animal studies (Chan, et al., 2008). One study found that thirty minutes of moderate exercise significantly increased BDNF production in multiple sclerosis patients and controls (Gold, et al., 2003). In another study short episodes of high intensity exercise transiently increased serum levels of BDNF in humans (Currie, et al, 2008). In regards to studies that investigate the effects of DHA on BDNF levels in obese subject, there is very little research at all. Additionally, there has been research on BDNF levels and exercise in obese humans, but there has been very little research that has investigated DHA effects on BDNF in exercising human subjects. This study may show evidence that DHA enhances the effects of exercising on BDNF levels affecting brain health in obese, exercising women.

The objective of our research is to investigate any association of DHA and BDNF in exercising obese women. This study will contribute to future clinical studies that study positive effects of exercise for obese individuals. We hypothesize that BDNF levels will increase in obese subjects after exercise which will improve brain function as well as improve physical health.

**Experimental Methods**- All participants in the study will take a three grams of vegetarian mineral oil placebo or three grams of DHA supplements. Participants will walk for thirty minutes. Five minutes after exercise a licensed phlebotomist will draw 5-10 ml of blood from each participant. Blood will be obtained at four time points: first, prior to the initiation of the exercise program and then every two weeks for the six week duration (four total time points). BDNF will be assayed in the serum by ELISA. This procedure is routinely conducted in the Health Promotion and Human Performance department. All samples and laboratory disposables will be disposed of in accordance with WSU Environmental Health Services protocol.

**Recruitment Procedures**- Obese and/or overweight women will be recruited from the Weber State University Weber in Motion (WIM) program. WIM is a group training program for students with a BMI over thirty. Twelve volunteers will be recruited from this group.
References


C. INFORMED CONSENT

See attached copy of Consent Form
Informed Consent

You will be a participant in a study researching the effects of exercise and Docosohexaenoic Acid (DHA), an omega-3 fatty acid, on brain-derived neurotropic factor (BDNF). BDNF is a protein that stimulates survival, development, and function of neurons which are core components of the brain. BDNF can be found in circulating blood. There is significant evidence from previous studies that show the positive effects of DHA and exercise on brain health and function. We hypothesize that subjects supplementing DHA and exercising will have an increase in BDNF levels after exercise which will improve brain function as well as improve physical health. BDNF is measured from blood samples which will be obtained from participants four times throughout the study.

I agree to enter the DHA/exercise and BDNF study in the Department of Health Promotion and Human Performance at Weber State University. I understand that I will be placed in a group that takes 3g of fish oil per day, or a 3g mineral oil placebo. I understand that I will be blinded to which group I am in until the study is completed.

I understand that although very rare, risk from venipuncture for blood analysis can include infection, bruising, and mild discomfort. I also understand that there is a very slight chance of mild gastro-intestinal distress, burping, and slight upset stomach associated with supplementing DHA or the placebo.

I understand that I will not be financially responsible for any part of the study, nor will I receive any compensation for my participation.

I understand I have the option of dropping out of the study at any time for any reason. If I do drop out of the study, I agree to return to the investigators any unused supplements provided to me for the study.

I understand that any information about me will be kept strictly confidential by the investigators.

______________________________________
Signature of Participant

Questions or Concerns:
Dr. R Hansen, PhD of the department of Health Promotion and Human Performance at Weber State University on (801) 626-7748 (rhansen@weber.edu) or Anthony Zenger, a student at Weber State University, who will be the research assistant in the study, on (801) 781-0696 (anthonytzenger@gmail.com).
Certificate of Completion

The National Institutes of Health (NIH) Office of Extramural Research certifies that Rodney Hansen successfully completed the NIH Web-based training course "Protecting Human Research Participants".

Date of completion: 09/20/2010

Certification Number: 527085
Certificate of Completion

The National Institutes of Health (NIH) Office of Extramural Research certifies that Anthony Zenger successfully completed the NIH Web-based training course “Protecting Human Research Participants”.

Date of completion: 02/07/2011
Certification Number: 614665