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Effects of Short-Term Protein Supplementation on Muscle Work Efficiency in Elderly Adults

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**ABSTRACT**

**Objective:** This study assessed the effect of increased dietary protein intake on adaptation of energy expenditure and skeletal muscle function at rest and during low-intensity physical activity in elderly adults.

**Methods:** Using a randomized, crossover design, 12 adults (7 F, 5 M), aged 82 ± 7 y (mean ± SD) completed two 6-day periods of consuming fruit-smoothie beverages twice daily (with breakfast and lunch) containing 230 kcal and 25 g whey protein (WPro) or 25 g corn-derived glucose polymer (CHO) (total 460 kcal/day and 50 g/day WPro or CHO).

**Results:** On day 7 of each period, fasting blood urea nitrogen was 28 ± 9% higher in WPro vs. CHO (P=0.003), consistent with higher total protein intake. Fasting state energy expenditure and respiratory ratio at rest and while exercising on a stationary cycle at 1, 10, 20 watts were not different between WPro and CHO. Gross mechanical efficiency of skeletal muscle progressively increased from 1 to 10 to 20 watts, but this response was not different between WPro and CHO.

**Conclusion:** Short-term supplementation with either whey protein or glucose polymer does not differentially influence fasting state whole body substrate utilization or skeletal muscle work efficiency in elderly adults.
ACKNOWLEDGMENTS

I would like to thank Dr. Wayne Campbell for his patience and guidance throughout this project. His encouragement and support helped me accomplish my first of hopefully many more research studies. Thank you Jan Green for guiding us through recruitment, screening, and test day procedures. Also thank you Doug Maish, EMT-P, for all your help with our clinical laboratory services. Dr. Shirley Rietdyk, Dr. Jeffrey Haddad, and Dr. Steven McKenzie were also all instrumental in this research project and I sincerely appreciate all the help and guidance they provided regarding our exercise protocols. Finally thank you so much to all the volunteers and employees at University Place, without whom this project could not have been completed.
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LITERATURE AND RATIONALE

From previous research we know protein is critical for maintaining muscle size and function [3, 18]. This is particularly relevant for old adults who experience a progressive decline in muscle mass, referred to as sarcopenia. Old adults also experience a decline in substrate utilization [1, 3, 5, 18, 20]. One way of measuring substrate utilization is through oxygen consumption at rest and during low levels of exercise [7, 11, 14]. At low levels of exercise, measuring the volume of oxygen consumed (VO$_2$) presupposes a change in pulmonary VO$_2$ predicts changes in muscular VO$_2$ [4, 7, 13, 14].

Other predictors of muscle function besides substrate utilization as measured by VO$_2$, include balance and gait. Physiological declines of aging, including sarcopenia, are factors in decreased balance, gait speed, and stride length [17]. All of these factors are well-researched due to their correlation with fall risk in the elderly [17, 21].

A previous study from our lab indicated that a short-term inadequate protein diet (0.5 g·kg$^{-1}$·d$^{-1}$) caused a down-regulation of 35 of 38 gene transcript profiles involved with energy metabolism in skeletal muscle in old adults [18], compared to when they consumed an iso-energetic diet with 1.2 g of protein ·kg$^{-1}$·d$^{-1}$, representing a 0.7 g·kg$^{-1}$·d$^{-1}$ difference between groups protein intakes. Decreased transcripts from inadequate protein intakes imply an adaptive response in muscle by an increase in the efficiency of substrate utilization to preserve muscle function. This adaptive response would precede physiological changes of accommodation such as muscle wasting [18].

Consumption of an energy restricting diet lead to increased skeletal muscle efficiency in a 2003 study of weight perturbation and the effects of muscle function [14]. The energy restricting diet decreased subject’s energy and protein intakes by 10%. One could attribute the
decrease in protein intake as a component of the cause for an increase in skeletal muscle efficiency. This increase is muscle efficiency accounts for decreased non-resting energy expenditure associated with energy restriction, demonstrating an adaptive change in skeletal muscle. Muscle efficiency in this study was quantified by Gross Mechanical Efficiency which is defined as the ratio of power generated to the change in energy expenditure above resting [14]. Low levels of physical activity were used to calculate GME in this study to account for the sedentary lifestyles of their subjects.

The primary aim of our study was to investigate the effects of short-term increases in dietary protein on adaptive changes in skeletal muscle, such as the efficiency of substrate utilization in old adults. From previous research mentioned above we know decreasing protein by 0.7 g\(\text{kg}^{-1}\text{d}^{-1}\) will lead to changes in muscle transcripts. We hypothesize we will also see an adaptive change in the efficiency of substrate utilization. Also from past studies mentioned above, we know weight loss will lead to increased efficiency of substrate utilization in skeletal muscle. Old adults are in a comparable state to weight loss populations because both involve the loss of muscle mass [16]. We also hypothesize that increased protein intake in old adults will lead to decreased muscle efficiency of substrate utilization.

Our secondary aim was to evaluate other indicators of muscle function such as gait speed and balance. We hypothesize that there will be no effect of protein supplementation on gait and balance, since we will use a short term dietary intervention.

In this study, we measured substrate utilization efficiency in skeletal muscle in twelve elderly volunteers (7F, 5M) following 6 days of protein and carbohydrate supplementation. Low levels of exercise were selected to represent the sedentary lifestyle of older individuals. Their gait and balance were also measured as muscle function predictors.
METHODS

Volunteers

Potential volunteers were recruited from University Place Retirement Community in West Lafayette, Indiana. All participants obtained physician approval prior to starting the study.

The exclusion criteria for the study are listed below:

- Diagnosis of diabetes mellitus.
- Status post myocardial infarction (MI) or coronary artery bypass graft (CABG) or percutaneous transluminal coronary angioplasty (PTCA) within 6 months and/or a documented ejection fraction of less than 50%.
- Acute upper respiratory infection.
- Acute symptoms suggestive of cardiovascular disease.
- Acute symptoms suggestive of acute congestive heart failure.
- Uncontrolled hypertension at rest (systolic blood pressure greater than or equal to 160 mm Hg and or diastolic blood pressure greater than or equal to 100 mm Hg).
- Lower extremity conditions (such as osteoarthritis or peripheral vascular disease), which preclude the subject from peddling a stationary cycle at 20 watts.
- Cognitive conditions or limitations that preclude the subject from being able to understand, comprehend, or interpret instructions, fatigue or symptoms.
- Routine use of supplemental oxygen during rest or exercise.

Volunteer characteristics are included in Table 2. Twelve volunteers completed the study, seven female and five male.

All study procedures were approved by the Purdue University Biomedical Institutional Review Board, and all the volunteers were informed of the purpose, procedures, and potential
risks of the study prior to signing the informed consent document. There was no monetary compensation for participation.

**Experimental Design**

We utilized a randomized, cross-over design for this study (Figure 1). Each volunteer was tested following two six-day interventions. Between each intervention there was a 7-day washout period where volunteers returned to their normal diet with no supplementation. During the last three days of each intervention volunteers recorded all dietary intake on dietary record forms which were reviewed by a research assistant on test day to ensure completion.

There were two test days on study day 7 and day 21. On each test day, volunteers arrived in the morning having been fasted overnight for at least 8 hours. Testing lasted approximately 3 hours and included resting and non-resting energy expenditure, gait, balance, a blood draw, and body composition measurements. Before exercise protocol, volunteers completed a readiness to exercise questionnaire (Par-Q Survey) to ensure there were no medical changes recently that would prevent them from performing the exercise safely.

All test day procedures were explained and practiced by the volunteers prior to beginning the study to allow for equipment acclimation.

The clinical phase of this study was completed from May 2012 to August 2012.

<table>
<thead>
<tr>
<th></th>
<th>Day 1</th>
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<th>20</th>
<th>21</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Dietary Records</td>
<td>Test Day 1</td>
<td>Washout</td>
<td>Dietary Records</td>
<td>Test Day 2</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Smoothie Mix 1</td>
<td>Smoothie Mix 2</td>
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</tbody>
</table>

**FIGURE 1.** Clinical phase timeline. Test days are on study day 7 and day 21 following a randomized cross-over design of treatments that lasted 6 days each. The washout period had no treatment.
Treatments

Volunteers were provided shake supplements to consume twice daily, once at breakfast and once at lunch during each of the interventions. Each supplement contained 230 kcal of energy from mixtures of carbohydrates, fat, and protein (total energy per day was 460 kcal). The two interventions had different supplements, given in a random crossover design, that differed in the amounts of macronutrients, but not total energy (Table 1). One supplement was the placebo, which contained 22 grams of polydextrose, a corn derived glucose polymer (CHO). The other supplement was the high-protein supplement, which contained 22 grams of whey protein (WPro). Both supplements contained the same amount of fat.

Table 1. Total Macronutrient Composition Smoothies During WPro and CHO Interventions

<table>
<thead>
<tr>
<th></th>
<th>WPro Smoothie</th>
<th>CHO Smoothie Mix</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy, kcal</td>
<td>225</td>
<td>237</td>
</tr>
<tr>
<td>Fat, g</td>
<td>0.3</td>
<td>0.5</td>
</tr>
<tr>
<td>Carbohydrates, g</td>
<td>56.7</td>
<td>33.4</td>
</tr>
<tr>
<td>Protein, g</td>
<td>2.5</td>
<td>25.8</td>
</tr>
</tbody>
</table>

Each smoothie was consumed twice daily during each intervention. Values reported above include 22 grams of added whey protein or polydextrose.

Volunteers were given the supplements frozen and pre-prepared prior to the start of each intervention. Volunteers were instructed to keep the smoothies frozen until the consumption of each one. All volunteers were also instructed to consume the smoothies with breakfast and lunch meals, and were told to compensate within their normal diet to account for the smoothies to achieve satiation at each meal time.

During each treatment volunteers completed dietary records during the last three days prior to testing day. This allowed for dietary acclimation for the addition of the supplement. The results of the dietary records were analyzed using the Nutritional Data System for Research (NDSR) which is a computer based dietary analysis program. We analyzed total energy intake
(kcal), total protein intake (g), and total carbohydrate intake (g) during WPro and CHO interventions, as well as pre-study for each volunteer.

**Resting Energy Expenditure**

Volunteers were rested and acclimated to room temperature for at least thirty minutes prior to testing. A neoprene hood was placed over the subject's head and resting energy expenditure was measured using indirect calorimetry for thirty minutes. We utilized a TrueOne® 2400 Metabolic Measurement System by Parvo Medics (Sandy, Utah, U.S.A.) to measure O₂ and CO₂. The last twenty minutes of data were used for analysis to provide acclimation time for the volunteer during the first ten minutes.

**Blood**

A fasting blood sample was obtained from an antecubital vein after the volunteer had rested in a seated position for 15 minutes to obtain a clinical chemistry panel, pre-albumin and complete blood count with differential.

**Non-Resting Energy Expenditure**

Fasting non-resting energy expenditure was recorded during a low level cycle ergometer protocol using indirect calorimetry during each test day. We utilized a TrueOne® 2400 Metabolic Measurement System by Parvo Medics (Sandy, Utah, U.S.A.) to measure O₂ and CO₂, which was also used in resting energy expenditure.

During this test, the volunteer wore a plastic headpiece, which had a rubber mouthpiece with a 2-way valve attached to it. A plastic breathing tube was connected from the mouthpiece to
the pneumotach. The analyzer module measured gas composition from the pneumotach and processed it to the computer.

Exercise protocol was low resistance to represent the sedentary lifestyle of most old adults. Volume of oxygen consumed and CO\(_2\) produced were recorded and energy expenditure was estimated using the Weir Equation [7].

To begin the test, the volunteer began by cycling for 2 minutes at 0 watts (no resistance on the peddles) for a warm up. Volunteers continued peddling at 1 watt for an additional four minutes after the warm up. The next stage was 10 watts of power for four minutes, followed by the last stage of 20 watts of power for an additional four minutes of peddling. Finally, there was a two-minute cool down period at 0 watts again. The entire test lasted 16 minutes, and data were collected for analysis during the last three minutes of each stage of power (1, 10 and 20 watts). During pre-study, while the volunteers were acclimated to the cycle they were instructed to find a comfortable pace, or rotations per minute (rpm), for peddling. The rpm they selected was recorded and on both test days volunteers were monitored by a research assistant to ensure they peddled at this same pace.

**Gait**

Volunteers were instructed to walk at a normal pace over a pressure-sensing walkway, the GAITRite® system by CIR Systems Inc (Clifton, NJ) . The GAITRite® measured temporal and spatial gait parameters such as step length, step width, and gait speed at a frequency of 80 Hz and transferred data to a computer with GAITRite® Gold, Version 3.4 software. The volunteer had at least twenty-five footsteps recorded by the GAITRite® during test days. Means for stride length, time in double support, cadence, and gait speed were calculated for each volunteer.
**Balance**

Standing balance was assessed using the Biodex Balance System SD™ by Biodex Medical Systems, Inc. (Shirley, NY). Three 20 second trials were performed with the volunteer standing on a steady platform force plate on each test day. The average of the three trials was reported by the machine in three parameters: overall stability index, anterior-posterior balance, and medial-lateral balance. These indices were then recorded onto a computer for each volunteer.

**Body Composition**

Body composition measurements were made in the fasting state on testing days using a bioelectric impedance machine which recorded weight (kg), and percent body fat (%). Fat-free mass (FFM) was calculated from weight and percent body fat for each volunteer as well.

**Calculations**

Gross mechanical efficiency (GME) calculations were performed using non-resting energy expenditure (NREE) and resting energy expenditure (REE) data [14]. REE was subtracted from NREE (on the cycle ergometer). NREE and REE were corrected for by the ratio of oxygen consumption and carbon dioxide expiration, or the respiratory exchange ratio (RER), of each volunteer during rest and each workload. This determined the amount of energy being expended per minute of cycling. The power generated during cycling at 1, 10, and 20 Watts was converted to kilocalories (kcal) per minute by the equation 1 W = 0.01433 kcal/min. GME was then calculated as the ratio of power generated in kcal/minute to the change in energy expenditure above resting [14].
Statistical Analysis

Statistical analysis were preformed using SPSS. Values are reported as means ± standard deviations in tables and means ± standard error of the mean in figures. All measured outcomes were analyzed by a repeated measures analysis between treatments. Statistical significance was defined as a P-value ≤ 0.05.
RESULTS

Volunteer characteristics are presented in Table 2 below. During the study percent body fat and weight did not change across treatments from pre-study measurements.

Table 2. Pre-Study Volunteer Characteristics

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, years</td>
<td>82 ± 7</td>
</tr>
<tr>
<td>Weight, kg</td>
<td>72.14 ± 11.23</td>
</tr>
<tr>
<td>Percent Body Fat, %</td>
<td>33.28 ± 8.76</td>
</tr>
<tr>
<td>Fat-Free Mass, kg</td>
<td>48.16 ± 9.73</td>
</tr>
<tr>
<td>Resting Energy Expenditure, kcal/min</td>
<td>0.850 ± 0.149 (1223 ± 214)</td>
</tr>
</tbody>
</table>

Values are reported as mean ± standard deviation. N=12 volunteers (7 female, 5 male).

Effect of Carbohydrate and Protein Intervention on Diet and Blood

Volunteers consumed the same amount of total energy during WPro and CHO interventions (Table 3). However, volunteers consumed significantly less energy during pre-study measurements.

Table 3. Energy Intake Changes Associated With WPro and CHO Interventions

<table>
<thead>
<tr>
<th></th>
<th>Pre-Study</th>
<th>WPro</th>
<th>CHO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy intake (kcal•d⁻¹)</td>
<td>1658 ± 367 a</td>
<td>1945 ± 394 b</td>
<td>1945 ± 393 b</td>
</tr>
<tr>
<td>Protein (g•kg⁻¹•d⁻¹)</td>
<td>0.95 ± 0.24 a</td>
<td>1.63 ± 0.25 b</td>
<td>0.90 ± 0.35 a</td>
</tr>
<tr>
<td>Carbohydrate (g•kg⁻¹•d⁻¹)</td>
<td>3.12 ± 0.61 a</td>
<td>3.42 ± 0.72 a</td>
<td>3.83 ± 1.40 b</td>
</tr>
</tbody>
</table>

Superscripts that vary in letters are significantly different (p ≤ 0.05).
Total protein intake was higher during the WPro intervention versus the CHO intervention and pre-study measurements. The difference in average protein intake between WPro and CHO was 0.73 g kg\(^{-1}\) d\(^{-1}\).

Total carbohydrate intake was higher during the CHO intervention compared to the WPro intervention and pre-study measurements. During the CHO intervention volunteers were consuming on average 0.41 g kg\(^{-1}\) d\(^{-1}\) more carbohydrates then during the WPro intervention.

The reported change in total protein intake during each of the treatments is supported by the change in blood urea nitrogen (Figure 2). The WPro group had a 28% higher blood urea nitrogen (mg/dL) than the CHO group.

![FIGURE 2](image)

**FIGURE 2.** Blood urea nitrogen during the WPro and CHO interventions. Values are reported as mean ± standard error of the mean. Superscripts that vary in letters are significantly different (p-value ≤ 0.05).

Pre-albumin concentration was not different between treatments (p ≥ 0.05). Pre-albumin was 25.5 ± 3.0 mg/dL for the WPro group and 24.9 ± 3.7 mg/dL for the CHO treatment.
Effect of Protein Intervention on Substrate Utilization

The figure below represents the percent of fat, carbohydrate, and estimated protein utilized during resting and cycling protocol (Figure 3). At rest volunteers were utilizing 64.2% and 58.0% fat and 21.8% and 28.0% carbohydrate during WPro and CHO treatments respectively. Fat and carbohydrate utilization was not significantly different between treatments.

![Figure 3](image)

**FIGURE 3.** Macronutrient utilization during the WPro and CHO interventions at rest and at low levels of exercise. Percentages were determined from respiratory quotient (RQ) from indirect calorimetry.

During exercise, fat utilization decreased from 1, to 10, to 20 watts, and carbohydrate utilization increased, these responses were not different between WPro and CHO.

It should be noted that our methods did not allow for accurate calculations of protein utilization. Therefore, protein utilization was set at 14% for both interventions at rest and during...
exercise. Previous research in our lab has determined this to be a reasonable assumption for protein utilization.

**Effect of Protein Intervention on Muscle Efficiency**

GME increased from 1, to 10, to 20 watts indicating an exercise response. This response was not different between WPro and CHO interventions.

![Diagram showing Gross Mechanical Efficiency (GME) during the WPro and CHO interventions](image)

**FIGURE 4.** Gross Mechanical Efficiency (GME) during the WPro and CHO interventions. Values are reported as mean ± standard error of the mean. There were no significant changes between treatments (p-value ≥ 0.05).

**Effect of Protein Intervention on Gait and Balance**

Overall stability index showed no significant differences between treatments (Table 4). anterior-posterior balance and medial-lateral balance were not significantly changed between treatments as well.
Table 4. Balance Index between WPro and CHO Treatments

<table>
<thead>
<tr>
<th></th>
<th>Overall stability index</th>
<th>Anterior-posterior balance</th>
<th>Medial-lateral balance</th>
</tr>
</thead>
<tbody>
<tr>
<td>WPro</td>
<td>0.725 ± 0.230</td>
<td>0.408 ± 0.131</td>
<td>0.458 ± 0.207</td>
</tr>
<tr>
<td>CHO</td>
<td>0.692 ± 0.264</td>
<td>0.392 ± 0.173</td>
<td>0.467 ± 0.206</td>
</tr>
</tbody>
</table>

All values are expressed as mean ± standard deviation. There were no significant differences between treatments in OBI, APB, or MLB (p-value ≥ 0.05).

Supplementation with WPro or CHO did not influence gait characteristics including time in double support and stride length in either foot. Gait speed and cadence did not show significant differences between treatments either (Table 5).

Table 5. Gait Characteristics between WPro and CHO Treatments

<table>
<thead>
<tr>
<th></th>
<th>WPro</th>
<th>CHO</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Right Foot</td>
<td>Left Foot</td>
</tr>
<tr>
<td></td>
<td>Right Foot</td>
<td>Left Foot</td>
</tr>
<tr>
<td>Double Support (sec)</td>
<td>0.36 ± 0.08</td>
<td>0.36 ± 0.08</td>
</tr>
<tr>
<td>Stride Length (cm)</td>
<td>108.83 ± 20.61</td>
<td>108.37 ± 20.68</td>
</tr>
<tr>
<td>Cadence (steps/min)</td>
<td>110.65 ± 10.76</td>
<td>113.66 ± 12.07</td>
</tr>
<tr>
<td>Gait Speed (cm/s)</td>
<td>100.19 ± 23.39</td>
<td>106.36 ± 25.65</td>
</tr>
</tbody>
</table>

All values are expressed as mean ± standard deviation. There were no significant differences between treatments in any gait characteristics measured (p-value ≥ 0.05).
DISCUSSION

The first aim of this study was to investigate the effects of supplementation of protein or carbohydrate on efficiency of substrate utilization in skeletal muscle. We know that inadequate intakes of protein, or energy restriction accompanied by protein restriction, will increase efficiency [14, 18]. Using this information, we had hypothesized that efficiency would decrease with an increase of dietary protein. This study found no evidence of protein supplementation affecting the efficiency of substrate utilization as measured by gross mechanical efficiency compared to carbohydrate supplementation.

Previous research has identified adaptive changes in muscle transcript levels involved with substrate utilization from similar short-term changes in protein (Δ = 0.7 g kg⁻¹ d⁻¹). We had expected to see changes from an opposite effect of high protein as well [18]. The lack of the adaptive response indicates short term protein supplementation may not elicit adaptive changes in muscle, and therefore may have no effect on long term physiological outcomes of accommodation. In contrast, in short-term inadequate protein intake diets, adaptation markers are evident and precede accommodation responses of muscle wasting [18].

Our secondary aim was that protein supplementation would not affect gait or balance characteristics of our volunteers. Gait data such as stride length, time in double support, cadence, and gait speed were not altered between interventions, nor were balance indices. These responses were predicted because gait and balance are long term indicators of muscle function and would most likely not be influenced by short term supplementation.

This study was unique because it investigated short-term high protein intakes for elderly adults (1.6 g kg⁻¹ d⁻¹) and subsequent muscle outcomes. Previous research focused on energy or protein restricting diets in elderly or sedentary individuals who are experiencing muscle wasting,
and its effect on muscle function. Since dietary protein is so critical in maintaining muscle size and function, research focused on supplementation is also necessary for old populations.

This study was also novel because it investigated muscle efficiency at very low powered stationary cycle ergometry. Rosebaum et al. in 2003, found that changes in muscle work efficiency are most prevalent at low levels of physical activity [14]. Also, this study reported that using a cycle ergometer can be a surrogate for activities of daily living [14]. Their subjects were not comparable in age to ours, but they were confined to a research facility and considered sedentary. A sub-maximal test, as used in previous research on muscle function in old people may not be appropriate. Utilizing low powered exercise such as in the present study may be more representative of the activities of daily living of old people.

This study was limited in statistical power due to the small number of subjects that participated. This study was also limited because it was not a complete dietary intervention, rather just a supplementation. Our results show increases in total energy intake during supplementation from pre-study measurements due to lack of complete compensation. We know from previous research that increases in energy intake will influence resting and non-resting energy expenditure, so it is important to keep volunteers on an iso-caloric diet while manipulating their protein and carbohydrate intake [14].

Future research should be aimed at investigating the effects of protein supplementation for longer interventions in elderly adults. It would be especially important for a longer intervention to have maintained weight of volunteers by having them consume an iso-caloric diet as mentioned above. Also future research should focus on comparing inadequate versus supplemental protein intakes. The present study included a group with supplemental protein during WPro (1.63 g kg\(^{-1}\) d\(^{-1}\)), but the CHO control group also consumed adequate protein too.
(0.9 g·kg⁻¹·d⁻¹). Since we know inadequate protein leads to adaptive changes in muscle, having a low protein group could serve as a control for the protein supplemented group.

In conclusion, the present study represented two groups of elderly individuals who consumed short-term diets of adequate protein intakes, and high protein intakes. No adaptive changes in muscle occurred between high protein (WPro) or adequate protein (CHO) intakes as measured by substrate utilization at rest and during exercise. The exercise protocol was low intensity, which represented activities of daily living for old people. This could be indicative that supplementation of protein to already adequate protein intakes may not elicit any later changes of accommodation in elderly individuals.
REFERENCES


Appendix 1: Recruitment Flyer
Men and Woman Age 65 and Older Needed For Research Study

Dr. Wayne Campbell in the Department of Nutrition Science, Stone Hall, Purdue University, West Lafayette, IN is conducting a research study to assess diet and muscle function in adults 65 years and older. This study will be conducted at University Place Senior Living Community.

This study includes 2 parts, over a period of 26 days.

Part 1 of this study will last approximately 5 Days with 1 Test Day
Part 1 and 2 of this study will last approximately 26 Days with 3 Test Days

Measurements Will Include:

- Resting Energy Expenditure
- Exercise Energy Expenditure (Stationary Bike Exercise)
- Body Composition (lean and non-lean body tissue)
- Blood Chemistry Profile
- Diet Analysis
- Physical Energy Level Questionnaires
- You Will Be Asked To Consume A Dietary Supplement In Part 2

Are you 65 or older and in general good health, non-smoking, do not have diabetes, or acute heart or lung diseases? Are you physically able to ride on a stationary bike at an easy pace for up to 16 minutes? If so, please contact:

Kristen Clark at clarkk@purdue.edu Or Kathryn Sands at 765-496-6480
Appendix 2: Screening Consent Form
Diet and Muscle Function in Older Adults

Professor Wayne W. Campbell, Ph.D.
Purdue University
Department of Nutrition Science

Purpose of Research
The purpose of this study is to assess if your diet, body composition, and physical abilities affect how many calories your body burns at rest and while doing low-intensity exercise.

Specific Procedures
The information you will provide during screening may also be used for the study. You have been asked to fill out a Medical History Questionnaire and give your doctor a form to send back to us that determines your eligibility. You will then return that information back to the Department of Nutrition Science at Purdue University. We will then schedule a meeting to review your information and describe the study in detail. Once you have a good understanding of what we are asking you to do and if you agree, then we can start the study.

Screening measurements: # OF DAYS: 1 TOTAL ESTIMATED TIME: ~ 1 hour

Medical History Questionnaire, Physician’s Clearance Form:
You have provided (to the best of your knowledge) a complete history of all of your medical disorders during the screening process. To the best of your knowledge, you are free from disease that might make participation in this study unsafe. You will let Professor Campbell know all of the medications, drugs, and/or supplements that you currently take. You have also provided your physician’s clearance form allowing you to participate in this study. If requested by Professor Campbell, you will agree to stop taking some or all of these medications, drugs, and/or supplements two weeks before and during this study. You will not be asked or required to change any of your prescription drug intake without the authorization of your personal physician. It is expected that you will not take any new medications, drugs, and/or supplements during this study. It is expected that you will not change the dose of medications that you keep taking during the study. If you find that you must change the dose of your medications, you will contact Professor Campbell before the medication change or as soon as possible immediately afterward.

Duration of Participation
Screening procedures will take approximately 1 hour to complete.

Benefits to the Individual
There is no direct benefit for participating in this study. However, you may benefit from the information given to you concerning your general overall health.
**Risks to the Individual**
There are no known risks when completing questionnaires. There is a risk of breach of subject confidentiality but safeguards are in place to minimize this risk as outlined above.

**Compensation**
You will not be paid for completing this screening process.

**Injury or Illness**
Purdue University will not provide medical treatment or financial compensation if you are injured or become ill as a result of participating in this research project. This does not waive any of your legal rights nor release any claim you might have based on negligence.

**Confidentiality**
The project’s research records may be reviewed by the Purdue University Institutional Review Board, Office of Human Research Protections, and by departments at Purdue University responsible for regulatory and research oversight. All records will be kept confidential in locked cabinets/rooms for at least three years and after the close of the study. The data will be kept indefinitely and may be used for future studies. All records, data, and specimen will only be available to the principle investigator or his designee for analysis purposes.

**Voluntary Nature of Participation**
You do not have to participate in this screening evaluation. If you agree to participate you can withdraw your participation at any time without penalty.

**Contact Information**
If you have any questions about this research project, you can contact Professor Wayne W. Campbell at (765) 494-8236. If you have concerns about the treatment of research participants, you can contact the Institutional Review Board at Purdue University, Ernest C. Young Hall, Room 1032, 155 S. Grant St., West Lafayette, IN 47907-2114. The phone number for the Board is (765) 494-5942. The email address is irb@purdue.edu
Documentation of Informed Consent
I HAVE HAD THE OPPORTUNITY TO READ THIS PARTICIPANT SCREENING CONSENT FORM AND HAVE THE RESEARCH STUDY EXPLAINED. I HAVE HAD THE OPPORTUNITY TO ASK QUESTIONS ABOUT THE RESEARCH PROJECT AND MY QUESTIONS HAVE BEEN ANSWERED. I AM PREPARED TO PARTICIPATE IN THE SCREENING EVALUATION FOR THE RESEARCH PROJECT DESCRIBED ABOVE. I WILL RECEIVE A COPY OF THIS CONSENT FORM AFTER I SIGN IT.

_________________________________  ________________
Screening-Participant’s Signature        Date

_________________________________  ________________
Researcher’s Signature                  Date

Please check only one of the two boxes below

☐ You agree to allow the use of your data and/or specimens collected during this screening evaluation to be used for future research that is unrelated to this study.

_________________________________  ________________
Screening-Participant’s Signature        Date

☐ You request your data and/or specimens collected during this screening evaluation to NOT be used for any future research that is unrelated to this study.

_________________________________  ________________
Screening-Participant’s Signature        Date
Appendix 3: Study Consent Form
RESEARCH PARTICIPANT STUDY CONSENT FORM
Diet and Muscle Function in Older Adults

Wayne W. Campbell, Ph.D.
Purdue University
Department of Nutrition Science

Purpose of Research
This is a two-part project to improve our scientific understanding of diet, body composition and energy use in older adults. Part 1 will assess if your diet, body composition, and physical abilities affect how many calories your body burns at rest and while doing low-intensity exercise. Part 2 will assess how dietary protein intake affects muscle energy use and your daily perceived vigor.

Medical History Questionnaire, Physician’s Clearance Form
You have provided (to the best of your knowledge) a complete history of all of your medical disorders during the screening process. To the best of your knowledge, you are free from disease that might make participation in this study unsafe. You will let Professor Campbell know all of the medications, drugs, and/or supplements that you currently take. You have also provided your physician’s clearance form allowing you to participate in this study. If requested by Professor Campbell, you will agree to stop taking some or all of these medications, drugs, and/or supplements two weeks before and during this study. You will not be asked or required to change any of your prescription drug intake without the authorization of your personal physician. It is expected that you will not take any new medications, drugs, and/or supplements during this study. It is expected that you will not change the dose of medications that you keep taking during the study. If you find that you must change the dose of your medications or a new medication, you will contact Professor Campbell before the medication change or as soon as possible immediately afterward.

Procedures To Be Used
This study includes two parts. Part 1 is shown on the study table (next page) as study days one through five (1-5). Part 2 will consist of days 6-26 on the study table below. After participating in Part 1, if you are interested in continuing with our research study, you can participate in Part 2.

<table>
<thead>
<tr>
<th>Description</th>
<th>Part 1</th>
<th>Part 2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Day 0</td>
<td>Day 1</td>
</tr>
<tr>
<td>Screening</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Study and Equipment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Review</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diet Supplement</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wash out Period</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Body Composition</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Blood Sample</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Energy Expenditure</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Part 1: The study will consist of one test day. Prior to the test day, you will be asked to record everything you eat, how it was prepared, and the quantity consumed throughout the days on a 3-Day food record sheet, which will be provided. Also during these three days, you will be asked to complete an energy-level survey with each meal. This survey will have you rate your daily perceived energy level.

Part 2: You will continue to consume your normal diet with the addition of a daily nutritional supplement. At the beginning of the supplementation, you will be asked by our research team to consume 2 supplements/day. One will be consumed at the first eating occasion of the day (i.e., breakfast) and the second one will be consumed at the second eating occasion of the day (i.e., lunch). You will be asked to consume these supplements for two 6-day interventions (total of 12 days). Between these interventions, there will be a washout period of no supplements to be consumed lasting from Day 13-19. The supplements will be composed of dietary carbohydrates, protein and fat (total of 500 calories/day). The supplements for each intervention will differ in the amount of protein, consisting of either a high protein or low protein shake.

During these interventions, on the last three days you will be asked to record everything you eat, how it was prepared, and the quantity consumed throughout the days on a 3-Day food record sheet provided. Also during these last three days both interventions you will be asked to complete an energy-level survey with each meal. This survey will have you rate your daily perceived energy level.

**Test Days**
Test days include days 5, 12, and 26. All three of these test days will be identical. Each test day will last approximately 3.5 hours. You will need to be in a fasted state. You will be asked questions about any recent changes in your health. You will also be asked to complete the following tests conducted by a member of our research staff:

A. **Body Composition:**
   Your height and weight will be measured. The amount of lean to non-lean tissue will be determined by stepping on a scale for about 10-15 seconds while barefoot. You may hold on to handle bars for balance.

B. **Blood sample:**
   You will have about 4 teaspoons of blood drawn from a vein in the crook of your arm using a needle. The sample will be used to measure clinical indicators of your health, including liver and kidney functions, risk of diabetes, acute illness, and if your body has adequate protein.

C. **Energy Expenditure:**
   You will lie on a bed in a reclining position for a total of 60 minutes. During the first 30 minutes, no measurements will be taken and you will simply lie quietly and relax. After 30 minutes, a large clear plastic hood will be placed over your head and the amount of oxygen you breathe in and out will be measured for the next 30 minutes.

<table>
<thead>
<tr>
<th>Bicycle Test</th>
<th>X</th>
<th>X</th>
<th>X</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical Ability Test</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Dietary Records</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Energy Level Survey</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>
You will be able to breathe normal room air, which is continually flowing into the hood during the procedure. This test is used to measure how many calories of energy you are burning while resting.

D. Bicycle Test:
This test measures how many calories you are using during easy-paced exercise on the stationary bike. You will pedal for approximately 16 minutes including a warm up and cool down session. During the test, a plastic headset will be worn to hold the mouthpiece and tubes for the air measurements. You will breathe through a mouthpiece attached to plastic tubes. Room air will always flow through the tubes. We will measure how fast and how much air you are taking in and breathing out. Periodically, you will be asked to rate how hard you are exercising. A heart rate monitor will be used to measure your heart rate before, during, and after exercise.

After the bicycle test, you will receive a snack and beverage before continuing with any further testing.

E. Physical Ability Tests:
A series of tests will be done to determine your physical abilities.

Postural Stability
You will simply be required to fit a square object through an opening of varying size while reaching movements and posture are monitored while standing on the force plate.

Walking Gait
You will walk across a pressure-sensing walkway. The GaitRight measures gait parameters such as step length, step width, and gait speed.

There is a hierarchy of gait tasks. In the first level, you will be seated. In the second level, you will walk over a walkway with no obstacles. In the third level, obstacles will be placed on the walkway where you must step over and continue walking. In the fourth level, you will walk and step over obstacles while carrying a tray with four plastic cups.

F. Dietary Food Record:
A member of Prof. Campbell’s research staff will review your 3-Day food records with you to make sure the information is complete and accurate.

Duration of Participation
The study will take a minimum of 5 days to complete, but may take longer depending on your availability for testing for Part 1. If you participate in Part 1 and Part 2, the study will take a minimum of 26 days to complete, but may take longer depending on your availability for testing.

Benefits to the Individual
There is no direct benefit of participating in this study. However, you may perceive a benefit from knowing your body composition, how many calories you burn, and the results of the blood analyses.

**Risks to the Individual**
The following risks exist:

- **Blood Draw**
  You may experience discomfort and the development of a small bruise and/or infection at the puncture site on your arm where the blood is drawn. You may also feel lightheaded and there is a slight risk of fainting. The amount of blood drawn is about four (4) teaspoons (two-thirds of a fluid ounce or 20 milliliters) and is small enough that it should present no hazard to your physical well-being.

- **Energy expenditure**
  There is a risk of a feeling of claustrophobia occurring when clear plastic hood is placed over your head. If this occurs, you can always remove the hood or signal to the attendant and he or she will remove it for you.

- **Bicycle Testing**
  The cycling exercise should feel easy to moderately hard. During exercise, we will monitor your heart rate and stop the test at any time if your heart rate goes above an acceptable level for submaximal exercise based on age. If you feel discomfort, you can stop peddling at any time during the test. The bicycle seat could potentially be uncomfortable as well. Risks include shortness of breath, uncomfortable fit of mouthpiece, muscle and joint soreness, cardiac arrest, or death. Qualified responders will be on hand to provide assistance if the need arises.

- **Functionality Tests**:  
  There is a risk of falling. If you should feel any discomfort, fatigue, lightheadedness, or chest pains the tests can be stopped.

- **Supplement (Part 2 only)**:  
  You may experience some gastro-intestinal discomfort with the supplement used in the study.

There is risk of breach of confidentiality. There are no known risks associated with: weight and height measurements, fat body tissue measurements and completing questionnaires and surveys.

**Compensation**
You will not be paid any money for doing this research study.

**Injury or Illness**
Purdue University will not provide medical treatment or financial compensation if you are injured or become ill as a result of participating in this research project. This does not waive any of your legal rights nor release any claim you might have based on negligence.

**Confidentiality**
The project's research records may be reviewed by the Purdue University Institutional Review Board, Office of Human Research Protections, and by departments at Purdue University responsible for regulatory and research oversight. All records will be kept confidential in locked cabinets/rooms for at least three years and after the close of the study. The data will be kept indefinitely and may be used for future studies. All records, data, and specimen will only be available to the principle investigator or his designee for analysis purposes.

**Voluntary Nature of Participation**
You do not have to participate in this study. If you agree to participate you can withdraw your participation at any time without penalty.

**Human Subject Statement:**
If you have any questions about this research project, you can contact Professor Wayne W. Campbell at (765) 494-8236. If you have concerns about the treatment of research participants, you can contact the Institutional Review Board at Purdue University, Ernest C. Young Hall, Room 1032, 155 S. Grant St., West Lafayette, IN 47907-2114. The phone number for the Board is (765) 494-5942. The email address is irb@purdue.edu.

**Documentation of Informed Consent**
I have had the opportunity to read this consent form and have the research study explained. I have had the opportunity to ask questions about the research project and my questions have been answered. I am prepared to participate in the research project described above. I will receive a copy of this consent form after I sign it.

Participant Consent for Part 1 of our research:

<table>
<thead>
<tr>
<th>Participant’s Signature</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Printed Name</td>
<td>Date</td>
</tr>
<tr>
<td>Researcher’s Signature</td>
<td>Date</td>
</tr>
</tbody>
</table>

Participant Consent for Part 2 of our research (to be signed after completion of Part 1):

<table>
<thead>
<tr>
<th>Participant’s Signature</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Printed Name</td>
<td>Date</td>
</tr>
<tr>
<td>Researcher’s Signature</td>
<td>Date</td>
</tr>
</tbody>
</table>

Please check only one of the two boxes below:
I agree to allow the use of my data and/or specimens collected during this research project to be used for future research that is unrelated to this study.

______________________________                   __________________
Participant’s Signature                                      Date

☐ I request my data and/or specimens collected during this research project to NOT be used for any future research that is unrelated to this study.

______________________________                   __________________
Participant’s Signature                                      Date
Appendix 4: Physician Clearance Form
Physician Clearance Form

To Whom It May Concern:

Patient, ______________, has expressed interest in participating in a two-part research study being conducted at University Place Senior Community. The study is being conducted by Professor Wayne Campbell in the Department of Nutrition Science at Purdue University.

**Part 1.** The purpose of this study is to determine the metabolic effects of using low intensity exercise to represent the recreational lifestyle of adults 65yrs and older.

**Part 2.** The purpose of this study is to investigate the effects of a normal or high dietary protein intake (supplemented through a nutritional shake) on muscle function in adults 65yrs and older. We are also investigating chronic fatigue in this population.

During **the study the following parameters will be measured:**

- Resting Metabolic Rate
- Blood Lipids
- Blood Glucose
- Body Wt
- Dietary Intake
- Body Composition (fat and lean mass)
- Blood Clinical Chemistry Panel (including kidney & liver functions)
- Physical Function test

**Energy Expenditure during low intensity exercise using a Stationary Cycle:**

Each participant will sit on a stationary cycle and pedal against very light to moderate resistance for up 16 minutes.

Heart rate and perceived exertion will be monitored. As well, medical emergency services are available at University Place Senior Community if needed.

**Cycle protocol will include the following:**

A 2 minute warm up period at 0 (very light) resistance, 4 minutes of cycling at 0 (very light) resistance, 4 minutes of cycling at 10 (light) watts of resistance, 4 minutes of cycling at 20 (moderate) watts of resistance, and a 2 minute cool down period at 0 (very light) watts resistance.

**The exclusion criteria are as follows:**

- Age < 65 years
- Diagnosis of diabetes mellitus.
- Post myocardial infarction (MI) or coronary artery bypass graft (CABG) surgery within 16 weeks
- Post percutaneous transluminal coronary angioplasty (PTCA) within 4 weeks.
- Acute upper respiratory infection, symptoms suggestive of cardiovascular disease and symptoms suggestive of acute congestive heart failure.
- Uncontrolled hypertension at rest (systolic blood pressure greater than or equal to 160 mm Hg and/or diastolic blood pressure greater than or equal to 100 mm Hg).
- Lower extremity conditions (such as osteoarthritis or peripheral vascular disease), which preclude the subject from peddling a cycle at 20 watts.
- Cognitive conditions or limitations that preclude the subject from being able to understand comprehend or interpret instructions, fatigue or symptoms.
- Routine use of supplemental oxygen during rest or exercise.
- Lactose Intolerant
This study has the approval of the Institutional Review Board at Purdue University. As part of the protocol, physicians’ clearance is required. Please sign and date this form if you agree that this patient is suitable to participate in this study. If you need more information or have any question regarding this study please call.

Thank You, Wayne Campbell, Ph.D., Professor, Dept of Nutrition Science, Purdue University, 765-496-6342

Physician Comments:

☐ I have reviewed the information and in my professional opinion, the described study activities are not contraindicated for this patient.

______________   __________                      _____________________________________________
Physician Name                      Date

You may return this form by fax to our office of Nutrition Science at Purdue University at 765 494 0674.
Appendix 5: Volunteer Medical History Questionnaire
MEDICAL HISTORY QUESTIONNAIRE

The following questions are designed to obtain a thorough preliminary medical history. The information you provide will help us to make the best determination about your eligibility for a particular study. Please answer all questions and provide as much information as you possibly can. This questionnaire, as well as any other medical information you provide will be kept confidential and will not be shared with any unauthorized person or organization unless you specifically request us to do so.

Name: ___________________________________________

Street Address: _______________________________________________

City, State, Zip: _______________________________________________ 

Telephone number: Home ( )___________ Work ( )______________

Date of Birth: __________ Age: _____

mm-dd-yy

Sex: M _____ F _____

Height _____ Weight _____

Personal Physician's Name: __________________________ Phone___________

Address: __________________________________________________________________________

__________________________________________________________________________________

Last grade completed in elementary or high school: ________________

Education completed since leaving elementary or high school:

_____ None

_____ Vocational School

_____ Community or Junior College

_____ Four Year College

_____ Graduate School

_____ Professional School

Occupation
Current occupation or occupation at retirement:

__________________________________________________________________________________

Marital Status
Living Situation

- Married
- Single, never married
- Divorced
- Separated
- Widowed

Do you have any pets? No ____ Yes ____ (please describe)

Race

- Caucasian (white)
- Hispanic
- African American
- American Indian
- Asian/Pacific Islander
- Other, please indicate

Personal Health History

Have you ever been hospitalized or had surgery? Yes _____ No _____

Please list all hospitalizations and surgeries to the best of your recollection

<table>
<thead>
<tr>
<th>Disease/Operation</th>
<th>Age when Hospitalized</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

List any disease or illness you have had not listed on the previous page (e.g., mumps, measles, broken bones, etc.)

- ___________________________________________________________________________
- ___________________________________________________________________________
- ___________________________________________________________________________
- ___________________________________________________________________________

Are you allergic, sensitive or intolerant of any foods or medications? Yes____ No____
If yes, please describe:
- Food:
- Medication:
- Other:

Are you currently seeing a doctor or other health care provider for any reason?

Yes _____ No _____
If yes, please explain:

- ___________________________________________________________________________

Do you have, or have you ever had any of the following conditions?
<table>
<thead>
<tr>
<th>Condition</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alteration of your ability to remember</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recurring headaches</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recent changes in your vision</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Numbness of an arm or leg</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weakness of an arm or leg</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Difficulty in speaking or slurred speech</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fainting or dizziness</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Difficulty in walking (staggering)</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Shortness of breath</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lung or Respiratory Disease</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rheumatism or arthritis</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pain in joints</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Osteoporosis</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Osteopenia</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heart disease</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Epilepsy</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tumors</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mental illness</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bleeding or clotting disorders</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Risk for infectious diseases</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(AIDS, IV drug use, blood transfusions, hemophilia, hepatitis)</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Skin: rashes, lumps, moles, itching, eczema</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nose, sinuses: frequent colds, sinus trouble</td>
<td></td>
<td></td>
</tr>
<tr>
<td>nose-bleeds, deviated septum</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Neck lumps, swollen glands, pain or stiffness</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Breasts: lumps, nipple discharge, pain</td>
<td></td>
<td></td>
</tr>
<tr>
<td>or discomfort</td>
<td></td>
<td></td>
</tr>
<tr>
<td>For women: Date of last mammogram</td>
<td></td>
<td></td>
</tr>
<tr>
<td>High blood cholesterol</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Date of last reading</td>
<td></td>
<td></td>
</tr>
<tr>
<td>System</td>
<td>Conditions</td>
<td>Yes</td>
</tr>
<tr>
<td>--------------</td>
<td>-----------------------------------------------------------------------------</td>
<td>-----</td>
</tr>
<tr>
<td>Stomach</td>
<td>chronic indigestion, ulcer, hiatal hernia, heartburn, trouble swallowing, vomiting</td>
<td>Yes</td>
</tr>
<tr>
<td>Intestine</td>
<td>constipation, diarrhea, change in bowel habits, irritable bowel disorder, colitis, polyps</td>
<td>Yes</td>
</tr>
<tr>
<td>Rectum</td>
<td>hemorrhoids, bleeding, polyps</td>
<td>Yes</td>
</tr>
<tr>
<td>Liver, gallblader</td>
<td>hepatitis, gallstones</td>
<td>Yes</td>
</tr>
<tr>
<td>Urinary</td>
<td>frequent urination, urgency, burning, pain, blood in urine, infection, kidney stones</td>
<td>Yes</td>
</tr>
<tr>
<td>Incontinence</td>
<td>Loss of bladder or rectal control</td>
<td>Yes</td>
</tr>
<tr>
<td>Adult undergarment products</td>
<td>such as Depends?</td>
<td>Yes</td>
</tr>
<tr>
<td>Cancer</td>
<td>any form of cancer, skin or other</td>
<td>Yes</td>
</tr>
<tr>
<td>Diabetes mellitus</td>
<td>high blood sugar</td>
<td>Yes</td>
</tr>
<tr>
<td>Insulin</td>
<td>diet</td>
<td>Yes</td>
</tr>
<tr>
<td>Pills</td>
<td>no treatment</td>
<td>Yes</td>
</tr>
<tr>
<td>Family history</td>
<td>of diabetes mellitus</td>
<td>Yes</td>
</tr>
<tr>
<td>Blood pressure</td>
<td>had or been told that you had high blood pressure</td>
<td>Yes</td>
</tr>
<tr>
<td>Chronic illness</td>
<td>any chronic illnesses</td>
<td>Yes</td>
</tr>
<tr>
<td>Constipation</td>
<td>problems</td>
<td>Yes</td>
</tr>
</tbody>
</table>
Have you ever been treated for an eating disorder?  
Yes _____  No _____

If yes, when and what type?  ________________________________

List all the prescribed medications you are currently taking:

<table>
<thead>
<tr>
<th>Medicine</th>
<th>Cause of Medication</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

List all the over-the-counter Physician recommended medications you are currently taking:

<table>
<thead>
<tr>
<th>Medicine</th>
<th>Cause of Medication</th>
</tr>
</thead>
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</table>

List all the over-the-counter medications you are currently taking:

<table>
<thead>
<tr>
<th>Medicine</th>
<th>Cause of Medication</th>
</tr>
</thead>
<tbody>
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</table>

Would you be willing to have your Physician give written approval for you to discontinue **only** your Physician recommended and self-prescribed medications for the duration of the study?

If yes, please have your Physician sign and date the bottom of this page indicating his/her approval.

____________________________  ________________  
Physician Name  Date

____________________________  ________________  
Volunteer Name  Date

Physician Comments:
____________________________________________________________________________________
____________________________________________________________________________________

**For Females Only**

Do you currently have menstrual periods?  Yes _____  No _____
If yes, is your cycle regular? Yes _____ No _____

What is the typical length of your menstrual cycle? _____ days

What is the typical length between menstrual periods? _____ days

When was your last menstruation? __________________________

Do you or have you ever had menstrual problems, vaginal discharge, irregular bleeding, sexually transmitted illness.
Yes _____ No _____

If yes, please explain: ____________________________________________________

Are you sexually active? Yes _____ No _____

If yes, what type of contraceptives do you use? ________________________________

Age of menopause if applicable: ________________

Type of menopause: _____ natural _____ surgical _____ other

Estrogen replacement: Yes _____ No _____

If yes, please explain:
____________________________________________________________________________________

Last PAP smear: ____________________________

Number of pregnancies: ____________________________

Number of births: ____________________________

Type of delivery: ____________________________

Your age at time of birth (s): ____________________________

Date of Hysterectomy (if applicable): ____________________________

Reason: ________________

**Dietary Information**

Are you currently taking any vitamins, minerals or health food supplements at least once per week on a regular basis? Yes _____ No _____ If yes, please describe:

<table>
<thead>
<tr>
<th>Supplement</th>
<th>Amount</th>
<th>How often</th>
<th>How long</th>
<th>Reason</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tbody>
</table>

Would you be willing to stop your vitamins, minerals or health food supplements if needed while participating in a study? Yes _____ No _____

Are you currently following a special diet (i.e., vegetarian, diabetic, low fat, lactose free)?

Yes _____ No _____ If yes, what kind? ________________________________

Has this diet been prescribed by your health care provider? Yes _____ No _____
If accepted for a study, are you willing to follow a diet that may vary from your current food intake?  
Yes _____ No _____

Have you had a weight loss or gain in the last 6 months? Yes _____ No _____  
If yes, how much? _____ lbs. Gain _____ Loss _____ (check one)

How do you describe your appetite?  Poor _____ Fair _____ Good _____

When required during the study, would you be willing and able to eat only the items provided by the Nutrition Laboratory, Purdue University?  
Yes _____ No _____

Do you have problems eating high-fat foods? Yes _____ No _____

Do you have any food allergies/intolerance? Yes _____ No _____  
If so, please explain:  
_____________________________________________________________________________  
_____________________________________________________________________________

Do you drink caffeinated beverages? (coffee, tea, soda) Yes _____ No _____
If yes, how many caffeinated beverages do you drink in an average day? _____/day  
If required during a study, would giving up caffeine cause any problems for you?  
Yes _____ No _____

Do you drink alcoholic beverages? Yes _____ No _____  
If yes, how many alcoholic beverages do you consume in an average week? _____/wk  
Can you forego drinking alcoholic beverages for the duration of a research study?  
Yes _____ No _____

Do you have a problem drinking milk or eating dairy products?  
Yes _____ No _____  
If yes, what happens?  
_____________________________________________________________________________  
_____________________________________________________________________________

How many meals do you typically eat in a day? ______________

Please list the typical times that you eat throughout the day (meal #1 is the first meal of the day; only list the times for the meals that you eat):  

Meal #1: ______________  
Meal #2: ______________
Meal #3: ___________
Meal #4: ___________
Meal #5: ___________
Meal #6: ___________
Meal #7: ___________

**Exercise History**

What kind of work are you engaged in? ______________________________________

How long have you been engaged in this type of work? ________ years.

In terms of physical demands, how would you rate your position?

- very active
- active
- slightly active
- sedentary

In which of the following positions do you spend most of your time at work?

- sitting
- sitting and standing
- walking and standing

About how much time on the job do you spend sitting?

- all
- more than 1/2
- about 1/2
- less than 1/2
- almost none

Do you lift and carry heavy things in your work?  frequently
- sometimes
- infrequently

Do you take walks in good weather?  frequently
- sometimes
- infrequently

Do you do manual work at home (e.g., painting, repairing, etc.)?

- frequently
- sometimes
- infrequently

Do you mow your lawn or work in your garden?  frequently
- sometimes
- infrequently

Do you take part in sports during their season?  frequently
- sometimes
- infrequently

List the sports and/or exercise that you engage in and the number of times per week:

____________________________________________________________________________________
____________________________________________________________________________________

In the past, were you a regular sport or exercise participant?

- frequently
- sometimes
- infrequently

When and why did you cease participating?

Approximate date: _________________
Reason for quitting: ________________________________________________________________
Do you have any condition that would prevent you from being physically active?  
Yes _____ No _____  
If yes, please explain:_______________________________________________

Smoking History

Do you smoke cigarettes at present?  
Yes _____ No _____

If yes, how many packs per day?  
less than 1/2 pack  
1/2 to 1 pack  
1 to 2 packs  
more than 2 packs  

Do you inhale?  
Yes _____ No _____

How long have you been smoking?  
less than 1 year  
1 to 5 years  
more than 5 years  

Did you smoke cigarettes in the past and quit permanently?  
Yes _____ No _____

If yes, how many packs per day did you smoke?  
less than 1/2 pack  
1/2 to 1 pack  
1 to 2 packs  
more than 2 packs  

Did you inhale?  
Yes _____ No _____

When did you quit?  
less than 1 year  
1 to 5 years  
more than 5 years  

Do you smoke cigars at the present?  
Yes _____ No _____

If yes, how many cigars per day?  
less than 2  
2 to 5  
more than 5  

Did you smoke cigars in the past and quit permanently?  
Yes _____ No _____

Do you smoke a pipe at present?  
Yes _____ No _____

If yes, how many pipefulls do you smoke per day?  
less than 2  
2 to 5  
more than 5  

Did you smoke a pipe in the past and quit permanently?  
Yes _____ No _____
Appendix 6: Pre-Exercise Questionnaire
Pre-Exercise Questionnaire

Subject Name: _______________________________

Date: _______________ Time: _______________

Has your health status changed since the last time we saw you?

   No Changes

   YES (please describe)

Have your medications (types or dosages) changed since the last time we saw you?

   No Changes

   YES (please describe)

Have you experienced any injuries or illness since the last time we saw you?

   No

   YES (please describe)

Have you experienced any symptoms of illness including, but not limited to, dizziness, nausea, lightheadedness, fatigue, gastrointestinal distress, diarrhea, shortness of breath, chest pain or fever within the past 48 hours?

   No symptoms

   YES (please describe)

Subject Initials: _______________________________

Investigator Name: ____________________________
Appendix 7: Food Record Forms
### Completing Multiple Day Food Records

**General Instructions for Keeping Records**

- Please use ink and write clearly.
- Please complete the food records for the **number of days** and **specific days of the week** (i.e. weekend days vs. weekdays) that were specified by the dietitian or study coordinator.
- Remember to **not** change your eating habits.
- Record **everything** you eat and drink in a 24 hour period, from midnight to midnight, preferably right after it's consumed.
- Write each food, beverage, or ingredient on a **separate line**.
- Start each **new day** on a **new page**. If you need more than one page per day, please mark the pages.
- Fully describe foods & beverages, including **brand names**, when possible. If the item is cooked, please **describe how it is prepared** (e.g. boiled, broiled, grilled, baked, fried, etc.)
- Estimate the **portion sizes** of everything you consume. Refer to page 2, “Seven Ways to Size up your Servings,” for help with estimating portion sizes.
- Include items you add at the table. List them on separate lines. (e.g. margarine on a baked potato)
- You may attach copies of recipes.

<table>
<thead>
<tr>
<th>Breads</th>
<th>Beverages</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Indicate if whole wheat, white, etc.</td>
<td>- List the type of milk – whole, 2%, etc.</td>
</tr>
<tr>
<td>- Record number, size, &amp; portion.</td>
<td>- List whether fruit juice is fresh, frozen, sweetened, and if calcium fortified.</td>
</tr>
<tr>
<td>- Include sandwich condiments &amp; additions (e.g. lettuce, tomato, mustard)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Cereals</th>
<th>Desserts</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Record cooked cereal in portions of cup and amount eaten after cooking.</td>
<td>- List commercial brand or homemade.</td>
</tr>
<tr>
<td>- Record dry cereal in level portions of cup.</td>
<td>- Record portion size of cakes, pies, and cookies by indicating thickness, diameter, width or length (e.g. brownie 2&quot; x 2&quot;)</td>
</tr>
<tr>
<td>- Note if milk, fruit, sugar, etc are added and the amounts (e.g. 1 tsp brown sugar).</td>
<td>- Candy - # of pieces or size in ounces</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Cheese</th>
<th>Fruits</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Record the size in inches or weight in oz.</td>
<td>- Indicate if fresh, frozen, dried, or canned.</td>
</tr>
<tr>
<td>- Describe fat content – skim, 1%, 2%, whole.</td>
<td>- If whole, record # eaten and size (1 apple, 3&quot; diameter).</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Meats, Fish, Poultry</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>- Record size in inches or weight in ounces, without bone, after cooking.</td>
<td></td>
</tr>
<tr>
<td>- Indicate leanness (e.g. % fat ground beef).</td>
<td></td>
</tr>
<tr>
<td>- Describe how meat was prepared.</td>
<td></td>
</tr>
</tbody>
</table>
Remember:

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3 ounces of meat is about the size and thickness of a deck of playing cards or an audiotape cassette.</td>
</tr>
<tr>
<td>2</td>
<td>A medium apple or peach is about the size of a tennis ball.</td>
</tr>
<tr>
<td>3</td>
<td>1 ounce of cheese is about the size of 4 stacked dice.</td>
</tr>
<tr>
<td>4</td>
<td>1/2 cup of ice cream is about the size of a racquetball or tennis ball.</td>
</tr>
<tr>
<td>5</td>
<td>1 cup of mashed potatoes or broccoli is about the size of your fist.</td>
</tr>
<tr>
<td>6</td>
<td>1 teaspoon of butter or peanut butter is about the size of the tip of your thumb.</td>
</tr>
<tr>
<td>7</td>
<td>1 ounce of nuts or small candies equals one handful.</td>
</tr>
<tr>
<td>MEAL</td>
<td>PLACE</td>
</tr>
<tr>
<td>------</td>
<td>-------</td>
</tr>
<tr>
<td>B = Breakfast</td>
<td>P = Prepared</td>
</tr>
<tr>
<td>L = Lunch</td>
<td>H = Home</td>
</tr>
<tr>
<td>D = Dinner</td>
<td>R = Restaurant</td>
</tr>
<tr>
<td>S = Snacks</td>
<td>O = Other</td>
</tr>
</tbody>
</table>

Participant ID#: _________________________
Day of Week: _______________________
Date: __/__/___