POTASSIUM AND MAGNESIUM

ROLES AND FOOD INTAKE

ANALYSIS

By

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Abstract:
A study of 31 male and female students at a college in Oklahoma was conducted to ascertain if Potassium and Magnesium requirements were being met. The consensus in the literature indicated an assumption that people are getting "plenty of Potassium" in their menus. Magnesium and BMI were also looked at to see if it was correlated with Potassium.

Design
Participants included a connivance sample of male and female volunteers from three nutrition classes at a community college in Oklahoma. Participants filled out a brief survey based on their computerized nutrition analysis (7 day average). Surveys included places for Magnesium, Potassium and BMI.

Results
Hypothesis 1 that potassium intake would be deficient contrary to assumptions in the literature was supported. 100% of male and female participants were deficient in Potassium. Adequate intake for Potassium is 4,700 mg a day. Average intake of participants was 1,121.90 mg.
Hypothesis 2 that Magnesium intake requirements were not being met was supported as well. 100% of male and female participants were deficient in Magnesium. Pearson's correlation for Potassium and Magnesium showed correlation was significant ($P<0.01$). BMI was not shown to be correlated.

Conclusion
Data is indicating a need for increased intake of Potassium rich foods such as fruits and vegetables. BMI was looked at to see if it was correlated with Potassium. Potassium may increase fatty acid metabolism however that could not be determined as BMI does not distinguish between adipose and muscle mass. Findings also showed a need for increased intake of Magnesium in this group. Due to the essential role of these nutrients such as improving mood, building muscle, protecting from hypertension and stroke, it may be prudent to emphasize the importance of increase intake of foods rich in Potassium and Magnesium.

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CHAPTER I

INTRODUCTION

A goal of this research is to encourage increased consumption of potassium rich foods as well as foods high in magnesium as these foods have been found to help protect from conditions such as cardiovascular disease and diabetes (Zhang et,al., 2013). Fruits and vegetables are a primary source of potassium. Increased intake of potassium may be of great value. Health benefits of fruits and vegetables have been well established (Whitney & Rolfes, 2005). Increasing intake of potassium particularly with fruits and vegetables and their juices may be highly beneficial to well-being. Potentially this high intake of potassium rich foods could decrease the risk of disease and provide increased protection from conditions such as stroke, heart attack, diabetes and hypertension as well as lead to higher energy levels (Whitney & Rolfes, 2005).

Potassium may actually help decrease adipose if as postulated in this paper it is found to increase fat metabolism (Whitney & Rolfes, 2005). Potassium is essential in many processes (Whitney & Rolfes, 2005) however; the consensus in the literature appears to be that potassium intake is not an issue to.

be taken seriously because of the assumption (Ehrlich, 2011) most people get the required amount of potassium.

These statements about adequate potassium intake which appear quite frequently may not have basis in fact as there is often a statement of this sort with no reference. This view seems to be so prevalent that potassium needs may not be addressed as often as they should be and a perhaps common deficiency may be overlooked due to lack of awareness that there is a need to increase intake for most people. The reason for this postulation is the fact that the adequate intake of 4,700 milligrams may not be so easily met by individuals that are not consuming a large intake of fruits and vegetables which is the primary source of potassium (Whitney & Rolfes, 2005). Most fruits and vegetables have several hundred milligrams of potassium in a serving and they are the main source as most other foods do not have as much potassium particularly if processed. A typical vitamin and mineral supplement based on multiple brands is about 99 milligrams of potassium which does not even come close to the requirement and may not be as easily absorbed.

Magnesium was also investigated as there is an interaction between potassium and magnesium. Magnesium may also play a role in weight management and has been found to protect from serious health concerns such as hypertension, stroke, anxiety and diabetes (Neilsen, 2010). Magnesium is also found in healthy foods such as green leafy vegetables and nuts (Whitney & Rolfes, 2005). The author will address the intake of both potassium and magnesium in the research as it may be that there is a need to add more of the foods rich in these nutrients to meet the

recommended quantities as well as benefit from the other important components in these highly nourishing foods.

STATEMENT OF PURPOSE

The purpose of this research is to show that there is a need for significantly increased intake of potassium rich foods and also foods high in magnesium to help maintain healthy weight. If it is shown that there really is a need to increase intake of magnesium and potassium it may establish new emphasis on communal meal programs such as school lunches and senior center meals**,** educational programs and policy decisions. These could help increase access to and intake of these highly beneficial foods since the main source of potassium is fruits and vegetables and the amount typically in a mineral formula is minimal - 99 milligrams compared with the recommended 4,700 milligrams a day Adequate Intake(AI) (Whitney & Rolfes, 2005). Magnesium is often ignored in the literature where nutrient intake recommendations are discussed which is concerning as it is required for maintaining potassium, and along with potassium, is known to provide a high level of protection against stroke as well as many other benefits (Whitney & Rolfes, 2005).

A high Body Mass Index (BMI) is often looked at in medical settings to determine if a person may be obese. When a person has a particularly high BMI we can infer that there may be a higher percentage of body fat. If shown there may be a link between potassium rich foods and healthy BMI it may be used as a motivator for groups of people that are concerned with maintaining a healthy physique to significantly increase intake of fruits and vegetables along with magnesium rich

foods such as nuts and green leafy vegetables. This may lead to change that will directly affect quality of life by increasing protection from serious chronic conditions and improving energy levels, elevating mood (magnesium is required for production of highly mood elevating serotonin) and increasing the likelihood of enjoying multiple benefits from a variety of components of these foods.

RESEARCH QUESTIONS

1. Are most people meeting Adequate Intake recommendations for potassium?

2. Are most people meeting AI for Magnesium?

3. Do people that are deficient in potassium or magnesium have a higher BMI than those that are meeting the Adequate Intake (AI) recommendations?

4. Potassium is essential in many processes (Whitney & Rolfes, 2005) however; the consensus in the literature appears to be that potassium intake is not an issue to be taken seriously because of the assumption (Ehrlich, 2011) most people getting the required amount of potassium?

5. Is the assumption that most people are getting an adequate intake of potassium correct?

HYPOTHESES

1. Students in sample will not be getting the adequate intact for Potassium.
2. Students in the sample will not be getting the adequate intake for Magnesium.

3. BMI will be higher in those students with a potassium or magnesium deficiency compared with participants that are meeting their Adequate Intake (AI) for potassium and magnesium.

THEORETICAL FRAMEWORK

Social Behavior Theories, Health Behavior Theories and a new Theory arising in the process of learning about electrons and metabolism will be discussed here as each is applicable to this research.

An original Theory by Fishbein and Ajzen is called Theory of Reasoned Action (Ajzen & Fishbein, 1975); Social Psychology Network (http://aizen.socialpsychology.org/publications). The Theory considers behavioral choices to be strongly influenced by expectations of consequences either positive (choosing the behavior) or negative (not choosing the behavior) combined with influence form “perceived expectations of how their society would view the behavior (considering if they approve and expect the behavior) which combined plays a strong role in a decision to change behavior (Ajzen & Fishbein, 1975). Fishbein and Ajzen discuss behavioral change as a component of Theory of Reasoned Action as “intentions that develop from an individual's perception of a behavior as positive or negative together with the individual's impression of the way their society perceive the same behavior” (Ajzen & Fishbein, 1975 p.1).

If we look at one of the goals of this research being increased intake of fruits, vegetables and nuts we can look at this Theory and if these minerals potassium and magnesium increase fat metabolism then the expected positive effects would be a

factor in potentially changing behavior resulting in eating more fruits, vegetables and nuts particularly if it is shown that there is a need to increase consumption of these foods because their adequate intake requirements of these minerals is not being met. This is the benefit: increased fat metabolism for lean appearance, this is a requirement to get there: meeting or exceeding Adequate Intake of potassium and magnesium, these are the foods providing a rich supply of these minerals: fresh fruits, vegetables (potassium), nuts and green leafy vegetables (magnesium). Magnesium plays a direct and positive role in energy production and potassium is required to increase muscle (Whitney & Rolfes, 2005).

It can be reasoned that increasing hydrogen increases metabolism as high energy electrons carry hydrogen in the electron Transport cycle of metabolism. Although some foods have a small amount of hydrogen such as carbohydrates, water has a much higher concentration (H20) and potassium is required to bring water into the cells (Whitney & Rolfes, 2005). If potassium is required to hydrate cells and water brings in needed hydrogen then it would seem from a Theoretical standpoint that potassium increases fat metabolism.

DEFINITIONS

Body Mass Index (BMI) is defined by the Center for Disease Control as “Overweight and obesity are both labels for ranges of weight that are greater than what is generally considered healthy for a given height. The terms also identify ranges of weight that have been shown to increase the likelihood of certain diseases and other health problems” (Center for Disease Control and Prevention, 2012 p.1).

Adequate Intake (AI) which is an estimate of adequate nutrient intake for people that are considered to be healthy set up by the National Academy of Sciences.

Adipose: Body fat.

Hypokalemia: A condition involving a serum deficiency of potassium.

Atherosclerosis: A form of arteriosclerosis (hardening of the arteries) where various lipid (fatty acids and oil) deposits accumulate in the arteries and form plaque which involves calcification of lipid deposits. When calcium accumulates in the arteries it forms a rigid plaque when combined with lipid deposits which results in a narrowing of the arterial area and issues with circulation.

DELIMITATIONS

Study conducted involved participants from a community college in the Midwest. Participants were volunteers from nutrition classes. Only students enrolled in these classes were included in the study as nutrition students are normally familiar with measurements for increased accuracy of a nutritional analysis. Nutrition analysis software was called *MyDietAnalysis* by Pearson publishing company. Participants were mostly young adults in their early Twenty's. The nutrients included from the analysis were magnesium and potassium.

ASSUMPTIONS

The students were accurate in answering their survey as they had their reports with them from the nutritional analysis. Participants were randomly selected. Everyone in the participating nutrition classes were invited to participate if they chose to. There are no statistical processing errors.

LIMITATIONS

The study included a convenience sample of college aged students. It would be of value to have additional studies with a variety of age groups. The sample size was not particularly large. A larger sample size would increase the possibility that someone would have met the recommended Intake for the nutrients studied.

Body Mass Index (BMI) is commonly utilized to assess body composition health. It is what is looked at in medical settings. It was also very convenient considering BMI was listed on the nutritional analysis report. However, BMI is not able to specifically look at a percentage of body fat. Individuals that do not have much muscle may have more body fat than a muscular person and not have as high of a BMI as the muscular person. The person with large muscles especially if they are short may be considered in the obese range due to the muscle mass weighing more than adipose. It would be helpful to look specifically at percentage of body fat.

CHAPTER II

REVIEW OF LITERATURE

POTASSIUM

As previously noted a common comment that is appearing in a variety of literature is that most people get the recommended amount of potassium in their food. However, there does not appear to be any evidence to substantiate this common assumption. It may be that there is not enough potassium being consumed in the general population compared to the Adequate Intake recommendation. Potassium is required for hydration (Whitney & Rolfes, 2005). A person could drink gallons of water each day and still be dehydrated if there is not enough potassium to pull the fluid into the cells. Potassium is one of the primary electrolytes in the intracellular fluid.

Potassium deficiency can lead to several harmful and fatal conditions including hypertension, electrolyte imbalance and stroke (Whitney & Rolfes, 2005). A potassium deficiency is a known cause of hypertension (excessively high blood pressure) and potassium has been found to be essential in both alleviating and preventing hypertension and preventing stroke (Whitney & Rolfes, 2005). Hypokalemia is a dangerous condition and athletes, people working in an

environment causing excess perspiration, seniors and people taking medication with a diuretic effect may be even more at risk for than the general population (Whitney & Rolfes, 2005; Zhang, et al. 2013). Potassium is highly involved in muscle health and is decreased from excess perspiration. As a primary electrolyte in intracellular fluid (fluid inside the cells) potassium is required for hydration. A deficiency of potassium is known to lead to muscle weakness and muscular degeneration (Whitney & Rolfes, 2005).

Maintaining and building muscle requires large amounts of potassium. Hypokalemia can result from “excessive loss of potassium, e.g., from prolonged vomiting, the use of some diuretics, some forms of kidney disease, or metabolic disturbances. The symptoms of Hypokalemia are related to alterations in membrane potential and cellular metabolism. They include fatigue, muscle weakness and cramps, and intestinal paralysis, which may lead to bloating, constipation, and abdominal pain” (Higdon, 1984; Drake, 2010 p.1).

Hyponatremia is another concern which brings up the issue of a need for maintaining adequate intake of sodium when there is often advice to significantly reduce sodium. Sodium is needed to hold onto fluid (Maughan, Leiper, & Shirreffs, 1997). Sodium intake has to be balanced with fluid and potassium both of which need to be higher than sodium however sodium is still required in adequate amounts. According to Brotherhood;(Montain, Cheuvront, & Lukaski, 2007). Sodium, potassium and magnesium are depleted in “nutritionally significant amounts in sweat, but vitamins and trace elements are not” (p. 350).

A study involving a nutritional analysis of potassium and magnesium may be highly important to well-being of the population by potentially leading to increased public awareness with health initiatives along with other positive effects such as increased consumption of fruits and vegetables initiated by media campaigns, policy makers increasing quantity in various settings such as county senior nutrition programs, school lunches and other programs. It may be understood that fruits and vegetables are important to health however, it may very well be that we need to substantially increase the number of servings being offered in meal programs. Additionally increased public awareness of the need for increased intake is of importance as well in enhancing motivation to increase intake of these highly nourishing fruits and vegetables.

There seems to be a need for more studies and more current research in nutritional analysis of athletes and population in general. In a 4 year study of university athletes' food consumption profiles from 16 athletic teams (some men and some women) it was stated that "low potassium intakes were also common" (Short & Short, 1983 pg. 632). They were also not getting adequate Vitamin A. It may be that statements in articles that athletes are getting adequate potassium to meet their needs were based on opinion rather than an actual look at their nutritional intake. It is also important to consider that when serum potassium levels are measured they may be occasionally high or adequate when the potassium has been pulled from cells in an attempt to maintain adequate pH levels as potassium is an important alkalinizing mineral. Even if a person is not being diagnosed with Hypokalemia (dangerously low serum potassium levels)

they may not necessarily be getting an adequate intake in cells to promote cellular health and activities such as fatty acid metabolism (Whitney & Rolfes, 2005).

It appears that there may be a need for athletes to increase their intake of potassium to have an adequate intake and that with their activities their need for potassium is higher. Increased potassium intake during exercise may be of great benefit in many ways in addition to possibly increasing fatty acid metabolism (Whitney & Rolfes, 2005).

It would appear that athletes along with the general population may be able to benefit significantly by increasing their potassium levels. Many athletes may not be getting the adequate intake level of potassium and also may be utilizing large amounts of potassium for muscular needs (Qayyum, Freemantle, Carey, Page, Soper, Paterson, Robbins, 1993) and due to increased perspiration. It seems athletes and the general population would do well to replenish potassium and have higher intakes of potassium.

A primary objective from the data gathered in this study was to see if it could be ascertained as to whether this group is indeed getting enough of potassium and magnesium or if there is a need for increased intake of these nutrients. Additionally, it can emphasize the need for increased intake of fruits and vegetables and juices for potassium and more green leafy vegetables and nuts for magnesium. These highly healthful foods could contribute to enhanced well-being. One of the goals of this study is to encourage people to increase the

amount of fruits, vegetables and juices they are taking in. By doing so the health benefits they could achieve may in addition to decreasing their risk of chronic disease be of great value in their physical, mental and emotional well-being (Whitney & Rolfes, 2005).

In reading about and looking at an illustration of the electron transport which involves B vitamin coenzymes carrying hydrogen atoms with their high energy electrons yielding Adenosine Tri Phosphate (ATP), and in considering the key role that increasing hydrogen plays in aerobic metabolism and how it is so important that there is plenty of hydrogen available to generate ATP a question arose about how potassium may affect fat metabolism. Although water supplies hydrogen, it is not always abundant in the cells as some people do not take in enough potassium. Potassium is necessary to hydrate the cells. Potassium being the primary electrolyte in the intracellular fluid and water follows electrolytes. When potassium levels are too low compared with sodium levels there is a decrease in intracellular fluid due to an upset in the potassium-sodium balance. A person could drink gallons of water all day and still be dehydrated if there is not enough potassium to hydrate the cells.

It would seem that there may be a need for an increase in potassium to bring higher levels of hydration to the cells and water provides hydrogen and oxygen that by increasing potassium we increase the amount of hydrogen available for electron transport thereby, raising metabolism and increasing endurance and amount of fat being utilized.

MAGNESIUM

Magnesium levels should also be considered. In fact, low levels of magnesium can increase risk of hypokalemia (Higdon 1984; Drake, 2010).

Magnesium also plays a role in metabolism. In a study of magnesium supplement usage it was found that participants receiving 382 mg a day of magnesium had significantly improved metabolic rate and blood pressure was reduced (Rodriquez-Morgan & Guerrero-Romero, 2014). Magnesium is highly involved with energy production adding the final high energy phosphate bond in formation of ATP (Whitney & Rolfes, 2005). These factors indicate magnesium may be helpful in weight management by possibly decreasing body fat.

Magnesium is very important in maintaining mental well-being. Magnesium is required for the formation of Serotonin. Serotonin is a neurotransmitter associated with feelings of ease and is considered highly mood elevating (Whitney & Rolfes, 2005). Even a slight deficiency of magnesium can cause a person to be tense, irritable and emotionally unstable (Whitney & Rolfes, 2005). A deficiency of magnesium is also associated with depression, anxiety and seizures (Whitney & Rolfes, 2005). Magnesium may also help protect from disorders such as obsessive compulsive disorder. Magnesium is a natural glutamate blocker. Glutamate which is found in monosodium glutamate and yeast extract is known to damage brain cells and increase symptoms of OCD, Anxiety, Migraines, Parkinson's and Seizures (Whitney & Rolfes, 2005)..

Magnesium may be protective against stroke. Magnesium is known as a smooth muscle relaxer and when there is not enough magnesium the muscles become stiff which can raise blood pressure (Neilsen, 2010). Arterial walls contain smooth muscle and are affected by both calcium and magnesium. Calcium causes blood pressure to increase when it is in the arteries whereas, magnesium helps decrease blood pressure by helping arterial walls to relax (Whitney & Rolfes, 2005). Green leafy vegetables and nuts are examples of good sources of magnesium (Whitney & Rolfes, 2005).

MAGNESIUM POTASSIUM INTERACTION

Magnesium is required to be able to absorb and utilize potassium. Mansmann (2008) discusses the important role magnesium plays with potassium stating “regardless of the cause, the ability to correct potassium deficiency is impaired when magnesium deficiency is present.” (P.1) Mansmann cites Whang, Whang & Ryan (1992), “Experimental and clinical observations support the view that uncorrected magnesium (Mg) deficiency impairs repletion of cellular potassium (K)” and they recommend that any patient with hypokalemia be administered magnesium along with potassium (p. 40). Wester (1987) points out that magnesium is involved in balancing intracellular and extracellular potassium levels also magnesium is required in a reaction where the final high energy phosphate is added in the formation of ATP (Wester, 1987;Whitney & Rolfes, 2005). Magnesium is required to pump sodium out of cell and potassium into cell (Wester,1987). Wester also comments on research which has shown in hypokalemic patients when potassium is administered it “normalizes serum

potassium but not muscle potassium" if there is also a magnesium deficiency (p. 1308). Gums (2004) states "Magnesium is closely involved in maintaining cellular ionic balance through its association with sodium, potassium, and calcium." (p.1570). It may be difficult for physicians to detect a magnesium deficiency (Sullivan,1997), Serum levels of magnesium may not be an adequate indicator of magnesium status stating that intracellular and bone levels are a more accurate indicator of total body levels of magnesium (Sullivan, 1997). Magnesium is involved in many enzyme processes and Rienhart (1988) points out that "all enzymatic reactions" involving ATP have "an absolute requirement" for magnesium (p. 2415). Research on interaction of sodium and calcium and magnesium found some interesting data about how sodium is required to maintain magnesium balance as well as calcium. According to Kodama, Nishimuta & Suzuki (2003) when participants received "adequate" calcium and magnesium while being deficient in sodium excessive amounts of magnesium and calcium were excreted in urine and absorption was only "moderate" resulting in a deficiency of magnesium and calcium. .

High blood pressure is a major health concern due to risk of stroke and other complications of this prevalent condition. It is often treated with medication however, not everyone will be able to control hypertension with medication and some side effects will result in additional symptoms. It is imperative if an athlete has hypertension or any other cardiovascular condition that they have it monitored by a physician. In addition to any medical treatment they are getting

the coconut water may be of benefit. However, first a discussion of hypertensive mechanisms is needed.

There are many mechanisms that can be causative factors in high blood pressure according to medical experts in hypertension clinics dehydration is a known cause of high blood pressure. This is a fact that is not widely known. What happens with dehydration is it causes the arterial vessels to constrict which will raise the blood pressure (Whitney & Rolfes, 2005).

A more well known cause of hypertension is arteriosclerosis. When there is a buildup of plaque in the arterial walls it causes them to stiffen as atherosclerosis is a form of arteriosclerosis (hardening of the arteries). When arteries are stiff and narrow due to fatty deposits it can raise blood pressure. As circulation decreases in the kidneys it can cause a feedback loop where kidneys stimulate higher blood pressure because of a lack of circulation to the kidneys (Whitney & Rolfes, 2005). A person with excessive lipid deposits of Low Density Lipo-protein (LDL) cholesterol and Triglycerides is more at risk for arteriosclerosis as the accumulating lipid deposits in the arteries can calcify causing a rigid plaque and raising blood pressure. Calcium in the arteries can result in higher blood pressure due to increased vasoconstriction and formation of plaque due to calcification process. Therefore, it is important to keep calcium out of the arteries. Here is where some of the electrolytes come into play, for example, magnesium will help prevent calcium accumulation in the arteries. Also, magnesium is a smooth muscle relaxant including being able to relax arterial walls which will result in decreased blood pressure. A commonly prescribed

hypertension medication is a calcium channel blocker. Magnesium is a natural calcium channel blocker (Salaman, 2005) and instead of side effects it brings side benefits such as assisting with mood elevation, relaxation, increased energy production among many other benefits (Whitney & Rolfes, 2005). It is recommended to take magnesium (500mg – 1,000 mg a dose depending on size etc.) at regular intervals for best calcium channel blocking effect in controlling blood pressure. For example, have magnesium in the morning, at lunch, mid-afternoon, and in the evening before bed. High amounts of magnesium will simply be eliminated and is not associated with any known side effects other than it can have a laxative effect (Salaman, 2005). There is an important interaction between magnesium and potassium as has been previously discussed. Also, as has been discussed potassium helps reduce blood pressure. A potassium deficiency is a known cause of hypertension and potassium has been found to be effective in preventing and correcting hypertension and reducing risk of stroke (Whitney & Rolfes, 2005). Potassium deficiency may be more common that often realized as the amount in foods considered high in potassium is a few hundred milligrams and the recommended intake (AI) is 4,700 milligrams a day. People on diuretic medication or other medications that excrete potassium or individuals with excessive urination due to infections have to be particularly careful to make sure potassium intake is adequate. Athletes are going to have to take extra care to replenish electrolytes with perspiration and increased utilization of potassium from activity. For example, as has been previously noted, potassium is required for muscle formation and athletes are often increasing muscle mass with activity.

Potassium deficiency is associated with muscular weakness and muscular degeneration whereas, adequate potassium plays an important role in muscle synthesis and keeping muscles healthy (Whitney & Rolfes, 2005).

Potassium in addition to being essential for hydration as it is one of the primary electrolytes in intracellular fluid may have many mechanisms for stroke protection in addition to preventing hypertension as potassium has been found to provide direct protection from stroke even independent of hypertension factor (Whitney & Rolfes, 2005).

Sodium is also required for hydration (Whitney & Rolfes, 2005) and an excessively low level of sodium due to some individuals possibly going to an extreme of reducing sodium may also have high blood pressure as the dehydration will raise blood pressure. Sodium may be a factor in increasing blood pressure in individuals that are “sensitive to sodium” which is estimated at about 10% of hypertensive patients however, sodium can raise blood pressure if there is not enough fluid and potassium to go along with it. It is all in a delicate balance. Therefore, it appears that fluid and electrolyte imbalance is another cause of hypertension which can be corrected.

Inflammation is another factor that has been associated with hypertension. Inflammation of arterial vessels will raise blood pressure. It needs to be taken into consideration what actually causes inflammation as it has been associated with many chronic conditions particularly when there is systemic inflammation. In some cases inflammation may be due to injury for example, a sports injury or an

internal injury may be due to oxidative stress from excessive free-radical formation. Free-radicals are unstable molecules missing an electron that go around attempting to swipe an electron and in doing so cause oxidation resulting in oxidative stress if there are not enough antioxidants to compensate. Interestingly, the manganese is part of a potent antioxidant enzyme called superoxide dismutase. There are various versions of superoxide dismutase involving different minerals as components for example; there is also a copper version of superoxide dismutase (Whitney & Rolfes, 2005). Superoxide dismutase protects from the very dangerous superoxide free-radical. In any case, another way injury can take place besides an obvious sports injury or other accident would be internal injury from free-radical damage. Free-radicals are known to cause damage to structures of the body. Free-radicals are formed just from regular metabolic processes; however, exposure to toxins significantly increases production of free-radicals. Free-radicals can cause injury and injury results in inflammation.

In looking at fluid and electrolyte balance as a factor resulting in adequate hydration and establishing healthy fluid and electrolyte balance can very quickly remedy hypertension. It is well established that potassium is effective in decreasing hypertension and if the potassium deficiency is the primary cause than it can have an immediate effect. Individuals that have fluid and electrolyte imbalance will often have an acute hypertension which can be alleviated within minutes of re-establishing proper fluid and electrolyte levels (Whitney & Rolfes, 2005).

As previously noted a magnesium deficiency is associated with mood disorders such as anxiety, depression, and irritability and can cause severe fatigue and muscular stiffness (Whitney & Rolfes, 2005). Magnesium is very important for mood elevation and maintaining energy levels as magnesium is required for synthesis of serotonin and it is highly involved in energy production acting as a catalyst in the formation of ATP by being cofactor in a process adding a high energy phosphate bond to ADP for ATP (Whitney & Rolfes, 2005).

Improving lipid metabolism is important not only in weight management to decrease excess adipose to protect from conditions such metabolic syndrome which is associated with high LDL, VLDL and Triglycerides , reduced HDL and insulin resistance along with fatty liver. In an interesting study on rodents coconut water showed to be very beneficial in protecting from all of these factors. In the study male albino rats were put on a feeding program that significantly increased serum levels of total cholesterol along with LDL and VLDL and Triglycerides.

According to study authors, adding coconut water “counteracts” the increase in serum Total cholesterol, LDL, VLDL and Triglycerides while increasing the healthy HDL cholesterol. Another important finding in the study was that when rats were fed coconut water it significantly decreased fatty levels in the liver, heart, kidneys and aorta. Additional observations included increased conversion of cholesterol into bile acids and an increase in bile excretion with “much less fatty accumulation” in liver and aorta in rats that were supplemented with coconut water (Sandhya & Rajamohan, 2006 p. 400). Additional research is needed including research on lipid metabolism in humans. If this is the case, in

humans that coconut water can dramatically reduce fatty liver disease and hyperlipidemia than it may be of great benefit to individuals with these conditions in addition to being beneficial in supplying high quantities of potassium.

A combination of coconut oil and onion eradicated parasites (Mehlhorn et al., 2011). In a study of obesity in rats where one group was fed long chain fatty acids and the other group received MCFA's it was shown that medium chain fatty acids significantly decreased adipose also these rats fed medium chain fatty acids had "improvements in nitrogen balance" (Simon, Fernandez-Quintela, Portillo & Del Barrio, 2000 p. 337).In a study of rodents and potassium it was potassium had a strong cardio protective effect (Gaby, 2007). It was stated that "high potassium intake improved left ventricular relaxation" and reduced oxidation (Gaby, 2007 p. 1).Components of coconut oil such as capric acid contain a monoglyceride called monocaprin which may be an effective antimicrobial.

Monocaprin was shown to eradicate all strains of gonorrhea (Bersson, Steingrimsson & Thormar, 1999). In a study comparing various fatty acids Lauric acid and moncaprin both from components of coconut were the most effective in eradicating streptococci A and group B strep. Capric acid also was most effective at eradicating Staphylococcus. The mechanism of monocaprin in eliminating group B strep was studied and the findings showed that group B strep is eradicated "by disintegration of the cell membrane" of the group B strep by the monocaprin and study authors point out that the highly effective monocaprin may be helpful as an antimicrobial in eliminating infections as well as preventing infections from these bacteria (p. 670), Potassium requirements. It has been

established that the Adequate Intake for potassium is 4.7 grams a day. It has been suggested that most people are meeting their needs of potassium in their menus in a variety of articles.

In a review of the literature some early studies of food consumption and nutrient intake were conducted on athletes. A study on nutrient intake of US national synchronized skaters found that nutrient intakes were deficient in potassium and magnesium (among other nutrients) authors stated "…it is important to encourage all team members to maintain adequate dietary intakes to support the positive performance and well-being of individual synchronized skaters and the entire team" (Ziegler & Jonnalagadda, 2006 p. 314). Knez and Peake (2010) conducted a study on ultra endurance athletes with a 7 day nutrition diary and questionnaire including supplementation information, which indicated athletes were meeting recommendations for most nutrients however, in women folate and potassium were "slightly less" than recommended daily intake and it was not a significant amount of variation from recommendation. A study of nutrient intake with 44 adolescent Tennis players by Juzwiak, et al. (2008) found potassium intake was deficient in 100% of athletes and magnesium was deficient in 98%. Athletes were above recommendations on protein and lipids and deficient in a variety of nutrients. It was pointed out that "observed nutritional deficiencies represent an additional barrier for adolescents engaged in competitive sports to achieve an optimum nutrition to maintain growth, health and performance" (Juzwaik, et al. 2008, p. 1209).

Fluid and electrolyte levels must be balanced as an imbalance can be an emergency situation for all individuals. It is possible some people may have a higher requirement for increased fluid and mineral consumption due to illness, environmental factors or increased activity. Athletes may need to increase their consumption of fluids and minerals due to increased perspiration and high demands of muscles for activity. In looking at perspiration it is pointed out by Chammorro, Maughan, Serratosa and Zachwiega (2005) that perspiration rates will vary considerably among individuals. In their study of perspiration and male professional soccer players they analyzed perspiration levels in volume and also electrolytes in sweat compared with fluid consumption. Players had “free access” to *a* sports drink and mineral water in a practice session and did not urinate.

Results indicated that players sweat volume was on average 2193 ml and their body mass decrease was 1.23 Kg (range was 0.50 kg – 2.55kg) which study authors pointed out indicated “dehydration” of 1.59 percent (average from range) of pre-session body mass and fluid consumption only replaced 45% of sweat volume with a range of 9% to 73% sweat volume replacement. Potassium excretion in sweat was on average 8 mmol (range: 5 – 12 mmol). Only 23% of Sodium excretion was replaced ranging from “virtually none” replaced when only drinking water and 62% replaced with a sports drink. Authors concluded “these elite soccer players did not drink sufficient volume to replace” what was excreted in perspiration “which was in accord” with what other researchers have found with different levels of soccer players and other athletes as well (Chammorro, Maughhan, Serratosa & Zachwiega, 2005 p. 900). Athletes may need to be

encouraged to drink regardless of thirst as thirst is lagging behind dehydration (thirst is known to lag behind dehydration even in sedentary) and also replenishment beverages must have minerals to replace electrolytes and be consumed in sufficient quantity to replace excretion from activity.

A study on electrolyte and fluid replenishment with participants exercising in heat found that after rehydrating with either *a* sports drink, Apfelschorle (carbonated juice mixture), Evian water, or mineral water at a volume of 150% body-mass decrease from exercise found hydration status was not completely replaced to pre-exercise level with the exception of *a* sports drink also electrolytes were in “negative balance” except for Apfelschorle beverage replacing potassium to “positive balance.” (Shirreffs, Aragon-Vargas, Keil, Love & Phillips, 2007 p. 244). It seems that athletes may need some juice to replenish potassium along with sports drinks if a sports drink is not supplying sufficient potassium.

In addition to perspiration when individuals are physically active they may be utilizing considerably more electrolytes for muscle activity. There is a sodium potassium Pump (Na K pump) that is required for muscular activity also potassium is known to be essential in maintaining muscle health which may be in part because of being a component of the Na K pump as well as being involved in muscular contraction and hydration as potassium is required for a multitude of enzyme processes and hydrates muscles and is required for conversion of carbohydrates into muscular glycogen (Whitney & Rolfes, 2005) It does seem clear potassium plays a key role in maintaining muscular well-being

and according to Whitney and Rolfes (2005),, a deficiency of potassium is associated with muscle fatigue, muscle weakness and also muscular degeneration. In order to build and maintain muscle mass adequate potassium is required. One of the roles of muscular contraction of potassium is with the sodium potassium pump. According to Lunde, Verburg, Vollestad & Sejersted, (1998), with high intensity exercise changes in Na and K “favour depolarization, smaller action potentials and inexcitability” activating Na K pump and “the pump may contribute in maintaining excitability and contractility by keeping cells more polarized than ion gradients predict” (p. 215).

Fluid and electrolyte balance is important in preventing muscle cramps. Canter and Delhagen (1990) point out the importance of maintaining fluid and electrolyte balance by rehydrating with fluid containing carbohydrate, sodium and potassium and quote Dr. Donald Mars, of the University of Florida School of Medicine who points out the necessity of preventing heat stroke among athletes by drinking “electrolyte-replacement drinks containing glucose, sodium and potassium before, during and after exercise” (p. 12).

CHAPTER III

METHODOLOGY

Study Design

A study of 31 male and female students at a college in Oklahoma was conducted to ascertain if potassium and magnesium requirements were being met. The consensus in the literature indicated an assumption that people are getting their potassium requirements met from their menus. Magnesium and BMI were also looked at to see if it was correlated with potassium.

Surveys were given to volunteers to fill out. Two instructors had volunteered to include their classes for recruitment. These were small classes with almost all students volunteering for each class except for one or two that did not have their menu analysis with them. Attendance sheets as well as surveys were collected. As a thank you, primary investigator gave a presentation at the beginning of each class on nutrition and mental well-being. Participants signed their surveys and letters of consent. An attendance sheet was distributed and collected from all students in each class.

.Participants

Participants included a convenience sample of male and female volunteers from three nutrition classes at a community college in Oklahoma. Participants were asked during their nutrition classes if they would like to participate in a study.

Procedures

The participants were volunteers from three different nutrition classes and both of their instructors had agreed to include their students that decided they would like to participate. Volunteers were given a brief survey to fill out based on their menu analysis. The software program that was utilized in the study is called "*MyDietAnalysis"* by Pearson Publishing Company. The participants entered 7 days of food intake into the software program and they were able to print a report which included an analysis of their nutrient intake and Body Mass Index was included in their report.

Participants filled out a brief survey based on their computerized nutrition analysis (7 day average). Surveys included places for magnesium, potassium and BMI Study design: a 3 day menu analysis which will be analyzed with "Mydiet" software program. Participants will be asked to record on provided sheets everything they eat and drank for 3 days. An analysis of a 3 day average of potassium and also magnesium levels for each participant included both percentages compared to Adequate Intake recommendations as well as quantity of intake in milligrams. If a participant is meeting the AI recommendations for potassium for example, then it would read as 4,700 milligrams and will be listed

as 100% of recommended intake. The 3 day analysis has a bar graph with percentage and milligram intake comparing actual and recommended intake. This bar graph page will be listed in the data report for each participant. Next the entire group will be averaged with a comparison of actual and recommended intake for magnesium and potassium. Body Mass Index was also analyzed.

Statistical Analysis

It was expected that if potassium intake was deficient than magnesium intake would be deficient and if potassium requirements were met as indicated by the Adequate Intake (AI) than magnesium level would meet the recommended intake as well. Pearson's correlation for potassium and magnesium showed correlation was significant ($P<0.01$). Pearson's correlation was 2-tailed. BMI was not shown to be correlated.

CHAPTER IV

FINDINGS

A study of 31 male and female students at a college in Oklahoma was conducted to ascertain if potassium and magnesium requirements were being met. The consensus in the literature indicated an assumption that people are getting “plenty of potassium” in their menus. Magnesium and BMI were also looked at to see if it was correlated with potassium. Participants included male and female volunteers from three nutrition classes at a community college in Oklahoma. Participants filled out a brief survey based on their computerized nutrition analysis (7 day average). Surveys included places for magnesium, potassium and BMI.

Hypothesis 1 that potassium intake would be deficient contrary to assumptions in the literature was supported. 100% of male and female participants were deficient in potassium. Adequate intake for potassium is 4,700 mg a day. Average intake of participants was 1,121.90 mg. Hypothesis 2 that magnesium intake requirements were not being met was supported as well. 100% of male and female participants were deficient in magnesium.

See figures 1- 5. It was expected that if potassium intake was deficient than magnesium intake would be deficient and if potassium requirements were met as indicated by the Adequate Intake (AI) than magnesium level would meet the recommended intake as well. Pearson's correlation for potassium and magnesium showed correlation was significant ($P<0.01$). Pearson's correlation was 2-tailed. BMI was not shown to be correlated.

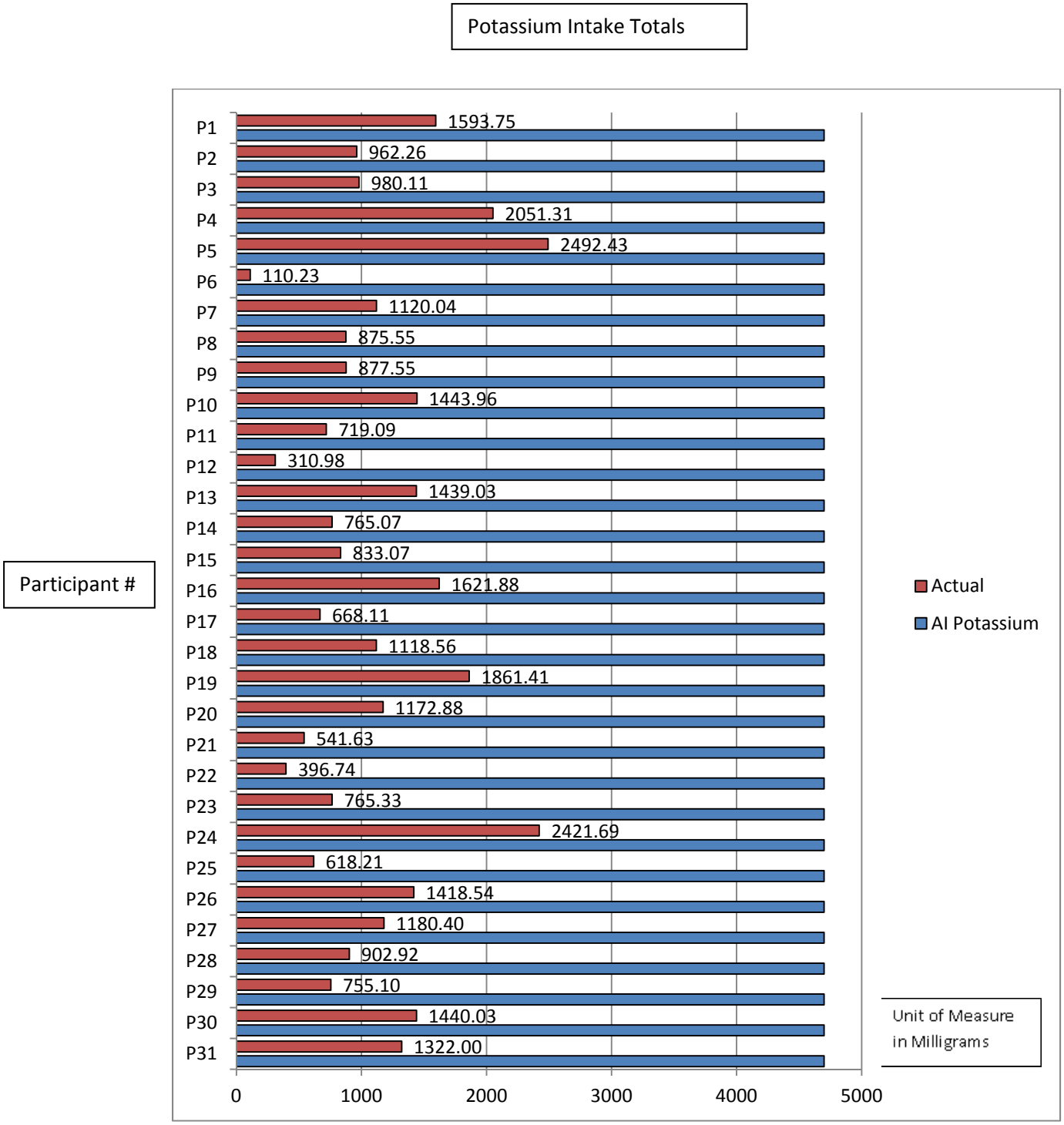

Figure 1 Potassium intake total compared to the adequate intake Potassium.

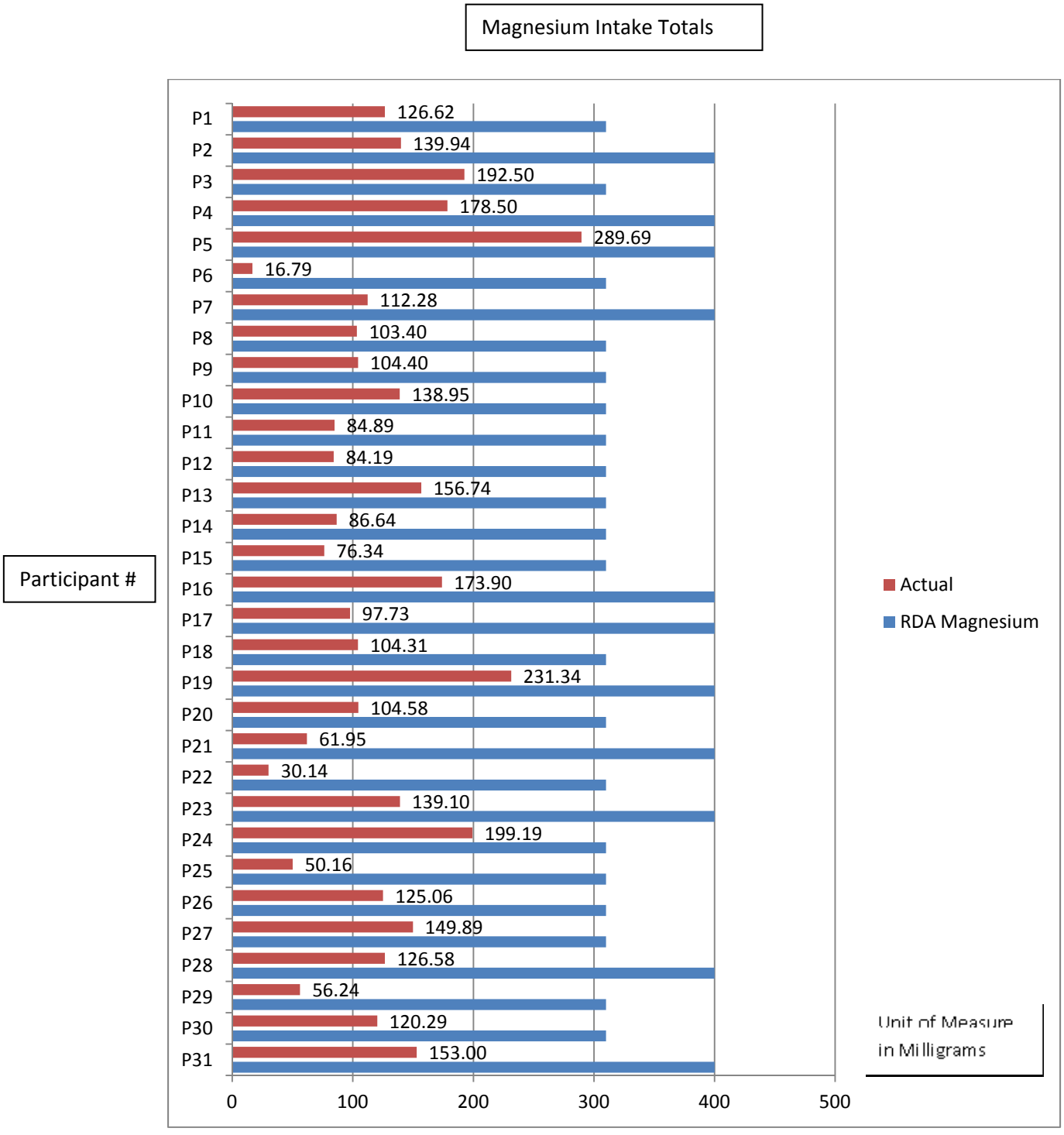

Figure 2 Magnesium intake total compared to the RDA of magnesium.

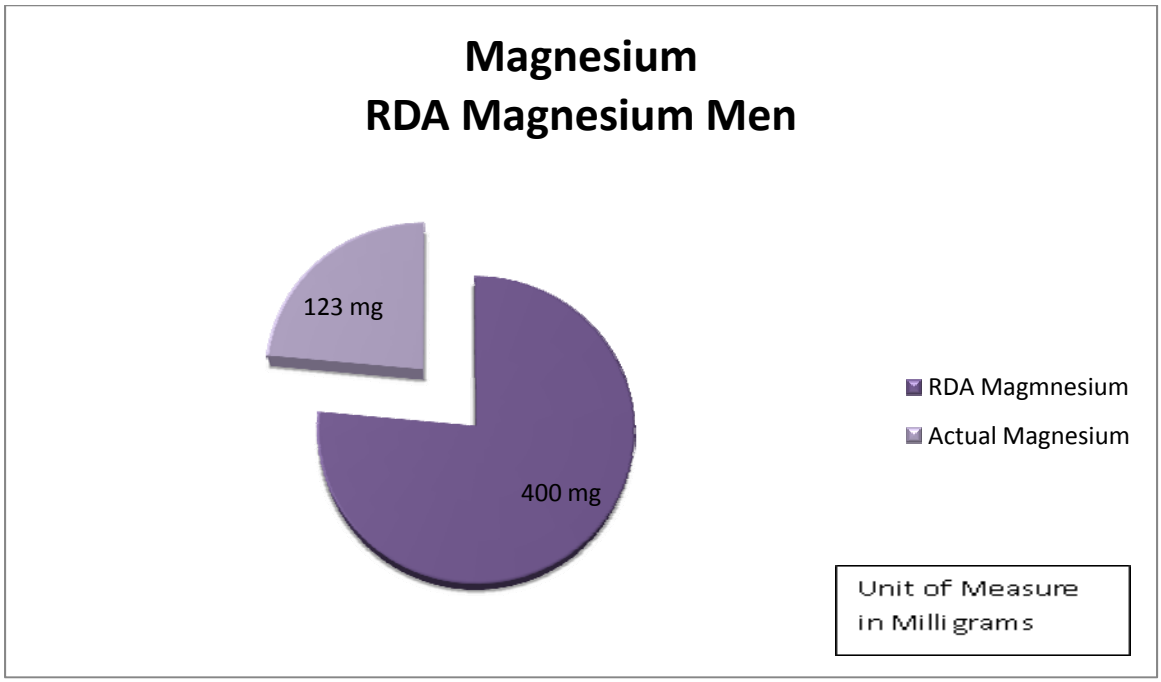

Figure 3 Magnesium RDA for men compared to the actual intake.

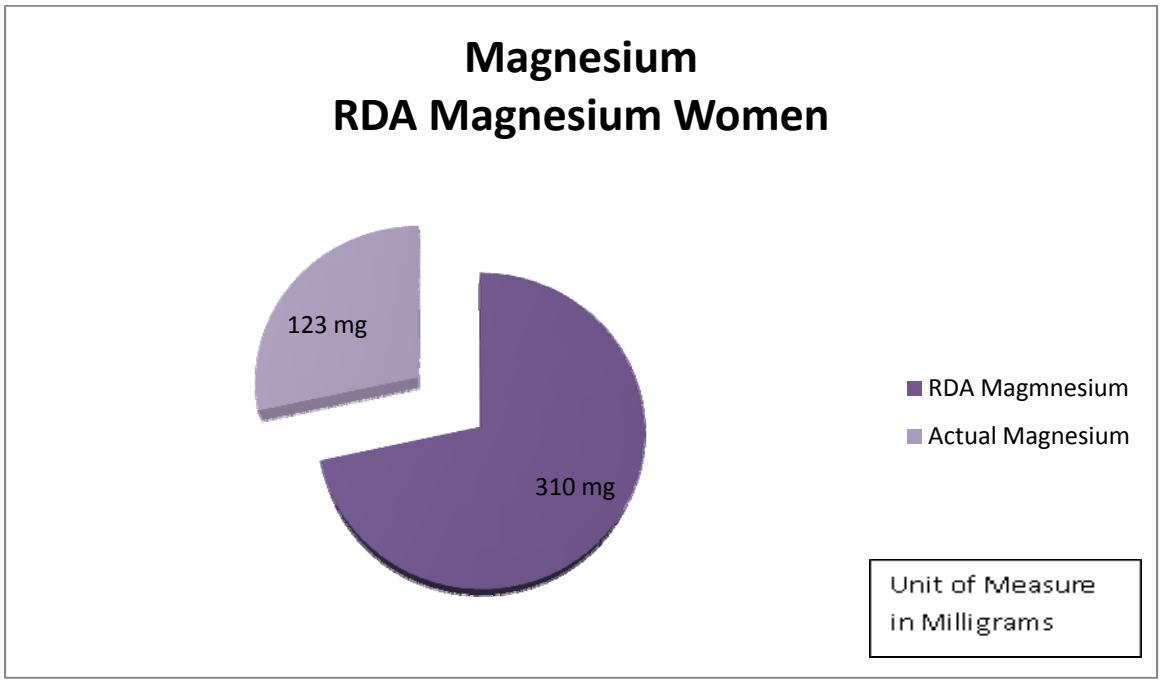

Figure 4 Magnesium RDA for women compared to the actual intake.

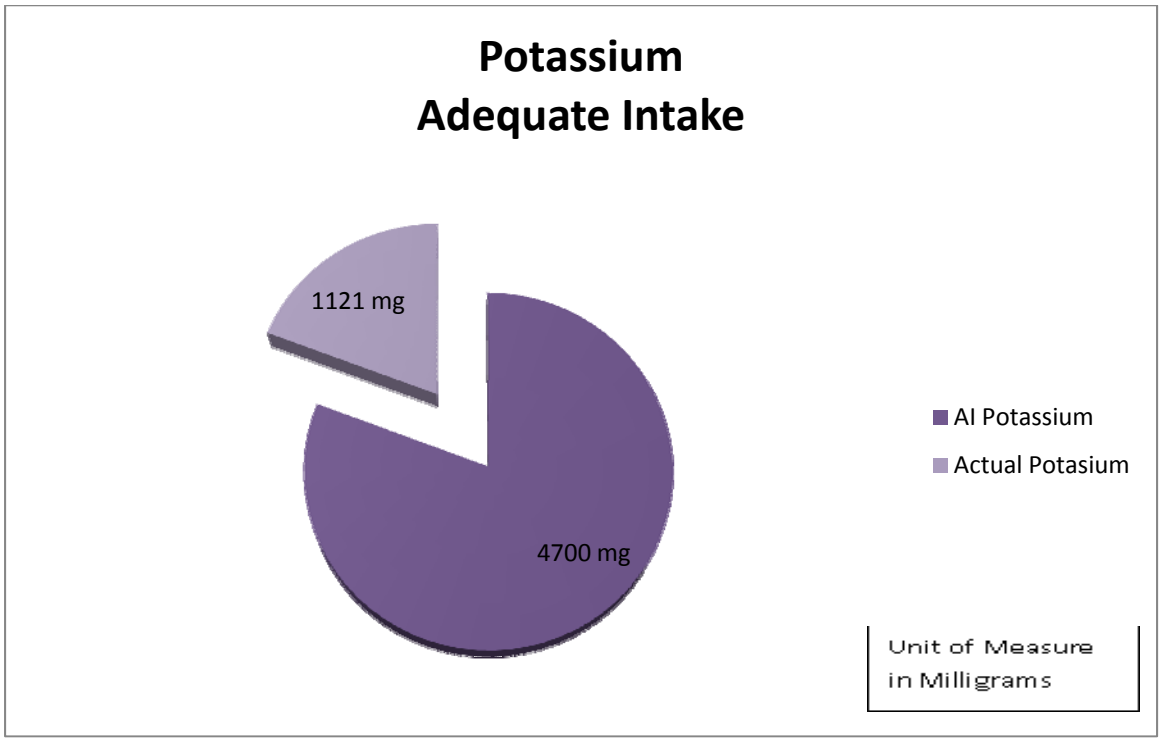

Figure 5 Adequate Intake Potassium and actual intake for both male and female.

	Number	Minimum	Maximum	Mean	Standard Deviation
AI Potassium	*31*	*4700*	*4700*	*4700*	*0.00*
Actual Potassium	*31*	*110.23*	*2492.40*	*1121.90*	*569.88*
Percentage AI Potassium	*31*	*6.00*	*53.00*	*24.06*	*11.43*
RDA Magnesium	*31*	*310*	*400*	*341.93*	*43.77*
Actual Magnesium	*31*	*5.00*	*72.00*	*35.19*	*15.54*
Percentage RDA Magnesium	*31*	*15.90*	*50.00*	*24.71*	*8.01*

Table 1 Study data unit of measure is milligrams.

CHAPTER V

CONCLUSION

Some of the goals regarding this research included being able to show that there is a need for significantly increased intake of potassium rich foods as well as foods high in magnesium. Showing that there may be a need for increased consumption of these foods could establish new emphasis on communal meal programs such as school lunches or senior center meals educational programs and policy decisions that could help increase access to and intake of these highly beneficial foods. This can lead to change that will directly affect quality of life by increasing protection from serious chronic conditions and improving energy levels, elevating mood and increasing the likelihood of enjoying multiple benefits from a variety of components of these foods. Data is indicating a need for increased intake of potassium rich foods such as fruits and vegetables. BMI was looked at to see if it was correlated with potassium. Potassium may increase fatty acid metabolism however that could not be determined as BMI does not distinguish between adipose and muscle mass.

More research is needed that includes percentage of body fat or fatty acid metabolism instead of BMI. Findings also showed a need for increased intake of magnesium in this group. Due to the essential role of these nutrients such as improving mood, building muscle, protecting from hypertension and stroke, it may be prudent to emphasize the importance of increase intake of foods rich in potassium and magnesium. Emphasis on the importance of increasing intake of potassium and magnesium rich foods in educational settings may be highly beneficial. By encouraging increased consumption of potassium rich foods a new level of health may be possibly achieved and may provide enhanced protection.

Future Research Recommendations

It would be good to have a larger study with a variety of age groups where it may be more likely that some people would meet the requirements for these minerals. It would be good to look at potassium and fatty acid metabolism more directly and measure percentage of fat being utilized when taking in potassium. If potassium is measured it is important to include magnesium along with potassium since magnesium is required for potassium uptake.

Sports drink formulation: Sports drinks are very popular among athletes and the general population particularly during hot weather. With so many people relying on these such as the sports drinks for rehydration needs it would seem by modifying the formula and including more fruit and vegetables as a component of the formula it could be of enormous value as increasing intake of fruits and vegetables and their juices could potentially contribute to enhanced well-being in a large percentage of the population that enjoys sports drinks.

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APPENDICES

APPENDIX A
IRB Approval

Oklahoma State University Institutional Review Board

Date:	Monday, March 17, 2014
IRB Application No	ED13198
Proposal Title:	Dissertation: Potassium and Magnesium roles and food intake analysis
Reviewed and Processed as:	Exempt

Status Recommended by Reviewer(s): Approved Protocol Expires: 3/16/2017

Principal Investigator(s):

Jeanette Fronterhouse
8123 Forest Glen Rd
Claremore, OK 74019

Douglas Smith
180 CRC
Stillwater, OK 74078

The IRB application referenced above has been approved. It is the judgment of the reviewers that the rights and welfare of individuals who may be asked to participate in this study will be respected, and that the research will be conducted in a manner consistent with the IRB requirements as outlined in section 45 CFR 46.

The final versions of any printed recruitment, consent and assent documents bearing the IRB approval stamp are attached to this letter. These are the versions that must be used during the study.

As Principal Investigator, it is your responsibility to do the following:

1. Conduct this study exactly as it has been approved. Any modifications to the research protocol must be submitted with the appropriate signatures for IRB approval. Protocol modifications requiring approval may include changes to the title, PI advisor, funding status or sponsor, subject population composition or size, recruitment, inclusion/exclusion criteria, research site, research procedures and consent/assent process or forms
2. Submit a request for continuation if the study extends beyond the approval period. This continuation must receive IRB review and approval before the research can continue.
3. Report any adverse events to the IRB Chair promptly. Adverse events are those which are unanticipated and impact the subjects during the course of the research; and
4. Notify the IRB office in writing when your research project is complete.

Please note that approved protocols are subject to monitoring by the IRB and that the IRB office has the authority to inspect research records associated with this protocol at any time. If you have questions about the IRB procedures or need any assistance from the Board, please contact Dawnett Watkins 219 Cordell North (phone: 405-744-5700, dawnett.watkins@okstate.edu).

Sincerely,

Sheila Kennison, Chair
Institutional Review Board

APPENDIX B
Consent Form

ADULT CONSENT FORM

OKLAHOMA STATE UNIVERSITY

PROJECT: Dissertation: Potassium and Magnesium roles and food intake analysis

INVESTIGATORS:
Doug Smith, Ph.D; Jeanette Fronterhouse, M.S. Oklahoma State University

PURPOSE:
This study will examine Potassium and Magnesium intake quantities and compare with the Adequate Intake recommendations and will also look at Roles of Potassium and magnesium and see if there is a relationship between BMI and percentage of intake of Potassium and magnesium.

PROCEDURES
You will complete one questionnaire. Questionnaire will ask for your milligrams of magnesium, potassium and your age, gender and BMI. You will also be asked to describe your exercise level which can be found on your menu analysis. This questionnaire will assess your milligram and percentage of mineral intake compared with Adequate Intake (AI) recommendations from 2 week day food logs and one weekend food log and also BMI….. This study is designed to last approximately 10 minutes. The time will be divided (about 5 minutes each with about 5 minutes on potassium and 5 minutes on magnesium filling in percentages and milligrams for each.

RISKS OF PARTICIPATION:
There are no known risks associated with this project which are greater than those ordinarily encountered in daily life.

BENEFITS OF PARTICIPATION:
There are no direct benefits to you but you may gain an appreciation and understanding of how research is conducted.

CONFIDENTIALITY:
The records of this study will be kept private. Any written results will discuss findings and will not include information that will identify you. Research records will be stored securely and only researchers and individuals responsible for research oversight will have access to the records. It is possible that the consent process and data collection will be observed by research oversight staff responsible for safeguarding the rights and wellbeing of people who participate in research.

COMPENSATION:
There are no direct benefits to you but you may gain an appreciation and understanding of how research is conducted.

CONTACTS :

You may contact Dr. Doug Smith or Jeanette Fronterhouse at the following addresses and phone numbers, should you desire to discuss your participation in the study and/or request information about the results of the study: Jeanette Fronterhouse 918 266-8918 Office: Academic and Campus Services SE 2202 Tulsa Community College or Doug Smith Ph.D Colvin Center, Dept. of Health and Human Performance in School of Applied Health and Educational Psychology Oklahoma State University, Stillwater, OK 74078, (405) 744-5500 If you have questions about your rights as a research volunteer, you may contact Dr. Shelia Kennison, IRB Chair, 219 Cordell North, Stillwater, OK 74078, 405-744-3377 or irb@okstate.edu

PARTICIPANT RIGHTS:
I understand that my participation is voluntary, that there is no penalty for refusal to participate, and that I am free to withdraw my consent and participation in this project at any time, without penalty.

CONSENT DOCUMENTATION:
I have been fully informed about the procedures listed here. I am aware of what I will be asked to do and of the benefits of my participation. I also understand the following statements:
I affirm that I am 18 years of age or older.

I have read and fully understand this consent form. I sign it freely and voluntarily. A copy of this form will be given to me. I hereby give permission for my participation in this study.

_____

Signature of Participant Date

I certify that I have personally explained this document before requesting that the participant sign it.

_____

Signature of Researcher Date

APPENDIX C

Computer Program used to calculate AI and RDA of Magnesium and Potassium.

MyDietAnalysis: Report

All Daily Reports

A variety of reports and information combined into one document.

Profile Info

Personal: Female 23 yrs 5 ft 10 in 295 lb

Day(s): Day 1, Day 2, Day 3

Activity Level: Active — Strive for an Active activity level.

Weight Change: Lose 2 lb per week — Best not to exceed 2 lbs per week.

BMI: 42.3 — Normal is 18.5 to 25. Clinically Obese is 35 or higher.

Actual Intakes -vs- Recommended Intakes

The actual intakes -vs- recommended intakes report displays the amount of nutrients consumed as they compare to your dietary intake recommendations in a bar graph format.

Nutrient	Actual	Rec.	Percent	0 50 100 150
Basic Components				
Calories	1,795.32	2,600.47	69 %	
Calories from Fat	791.18	728.13	109 %	
Calories from SatFat	209.55	234.04	90 %	
Protein (g)	57.37	107.05	54 %	
Carbohydrates (g)	210.02	357.56	59 %	
Sugar (g)	92.70			
Dietary Fiber (g)	26.50	36.41	73 %	
Soluble Fiber (g)	0.19			
InSoluble Fiber (g)	0.45			
Fat (g)	87.91	80.90	109 %	
Saturated Fat (g)	23.28	26.00	90 %	
Trans Fat (g)	0.20			
Mono Fat (g)	21.29	28.89	74 %	
Poly Fat (g)	16.68	26.00	64 %	
Cholesterol (mg)	129.19	300.00	43 %	
Water (g)	2,717.72	2,700.00	101 %	
Vitamins				
Vitamin A - RAE (mcg)	531.38	700.00	76 %	
Beta-carotene (mcg)	5,121.94			
Vitamin B1 - Thiamin (mg)	0.40	1.10	37 %	
Vitamin B2 - Riboflavin (mg)	0.53	1.10	48 %	
Vitamin B3 - Niacin (mg)	9.01	14.00	64 %	
Vitamin B6 (mg)	0.96	1.30	74 %	
Vitamin B12 (mcg)	0.48	2.40	20 %	
Vitamin C (mg)	80.90	75.00	108 %	
Vitamin D - mcg (mcg)	0.87	15.00	6 %	
Vitamin E - Alpha Toc. (mg)	5.56	15.00	37 %	
Folate (mcg)	192.88	400.00	48 %	
Minerals				
Calcium (mg)	674.74	1,000.00	67 %	
Iron (mg)	8.54	18.00	47 %	
Magnesium (mg)	170.51	310.00	55 %	
Phosphorus (mg)	478.40	700.00	68 %	
Potassium (mg)	1,764.59	4,700.00	38 %	
Selenium (mcg)	16.56			
Sodium (mg)	2,406.97	2,300.00	105 %	
Zinc (mg)	4.69	8.00	59 %	
Other				
Omega-3 (g)	1.36			
Omega-6 (g)	15.22			
Alcohol (g)	0.00			
Caffeine (mg)	152.33			

APPENDIX D
Potassium/Magnesium Questionnaire

Date_____

All information is kept confidential. Please look at your actual compared to recommended intake page from your mydietanalysis printout and fill in following information:

Magnesium _____milligrams

Potassium_____ milligrams

BMI _____

Signature_____

Thank you.

VITA

Jeanette Joy Fronterhouse

Candidate for the Degree of

Doctor of Philosophy

Dissertation: POTASSIUM AND MAGNESIUM ROLES AND FOOD INTAKE ANALYSIS

Major Field: Health, Physical Education and Leisure

Biographical:

Education:

Completed the requirements for the Doctor of Philosophy in Health, Physical Education and Leisure at Oklahoma State University, Stillwater, Oklahoma in May, 2014.

Completed the requirements for the Master of Science in Health, Physical Education and Recreation at Oklahoma State University, Stillwater, Oklahoma July 1990.

Completed the requirements for the Bachelor of Science in Journalism and Broadcasting/ Radio/TV/Film-New and Public Affairs at Oklahoma State University, Stillwater, Oklahoma 1987

Published Research;
Jacobson, B., Smith, D., Fronterhouse, J.,Kline, C., Boolani, A., (2012). Assessment of the Benefit of Powered Exercises for Muscular Endurance and Functional Capacity in Elderly Participants. *Journal of physical activity and healthp.1030-1035*

Experience:
1992 – Present Tulsa Community College, South East Campus
Adjunct Instructor. Courses taught include: Honors Nutrition, Nutrition, Personal Health, Anatomy and Physiology, Human Physiology.

1998 – 2005 Roger State University
Adjunct Instructor. Courses taught include: Nutrition and Health Concepts.