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The Body Creates: A Panel

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Correlation of Skeletal Muscles and Intake of Vitamin D

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Abstract

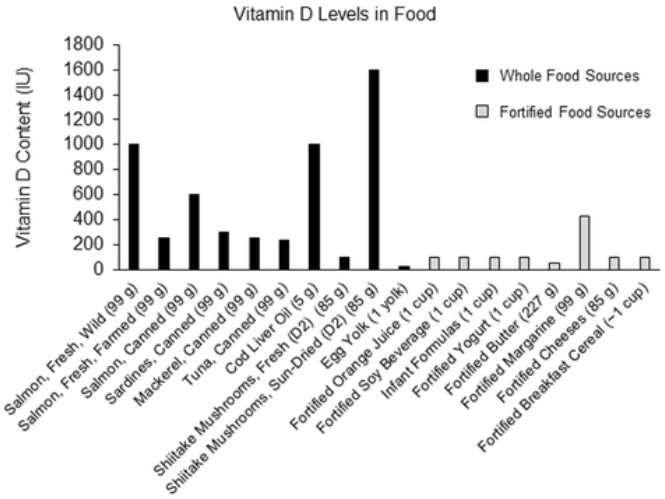
The objective of this research paper is to identify the correlation between skeletal muscles and intake of vitamin D and how it directly or inversely correlates with muscle strength, efficiency, and function. Even athletes have claimed that with extra intake of vitamin D they have an increased performance just by being out in the sun. Vitamin D can have a positive association with endurance and performance in athletes as well. A variety of people in the population today have a deficiency of vitamin D that can be simply be resolved even with simple exposure of the sun. Vitamin D intake can also be inversely related to the reduction of falls as well due to the fact that it can improve muscle strength (Girgis, Roderick, Bligh, Turner, Lau, and Gunton 2014). Vitamin D is essentially a fat-soluble vitamin found in natural food and exposure to sunlight vitamin D is essential for skeletal muscles due to neuromuscular functioning (Girgis et al., … 2014).

Keywords: [vitamin D, skeletal muscles, muscle strength, deficiency, fat soluble, athletes]

Correlation of Skeletal Muscles and Intake of Vitamin D

Skeletal Muscles and vitamin D have a direct correlation which influences muscle strength, efficiency, and function. Today there are over three million cases of vitamin D deficiency per year, which can be resolved simply by getting a little extra sunlight in people's day (Girgis, Roderick, Bligh, Turner, Lau, and Gunton 2014).

One of the major populations today of people that have skeletal muscle issues and a drop in vitamin intake is the elderly. Aging naturally results in decreased muscle function as well as future impairments due to the loss of skeletal muscle. However, vitamin D is positively associated with skeletal muscle, strength, efficiency, and function. Muscle weakness and decreased intake of vitamin d are common in elderly people, which can be instituted by a various amount of risk factors such as a poor diet, diminishing sunlight exposure, as well as reduction in the thickness of the skin. This can be largely targeted to the vast majority of the population of elderly people that reside in nursing homes. With little sunlight and continuous decrease in muscle strength and function and a necessary need for assistance. Vitamin D can be achieved in many ways even without sunlight exposure such as fatty food, which can be rich in vitamin D



(Examples of food that contain vitamin d 76.

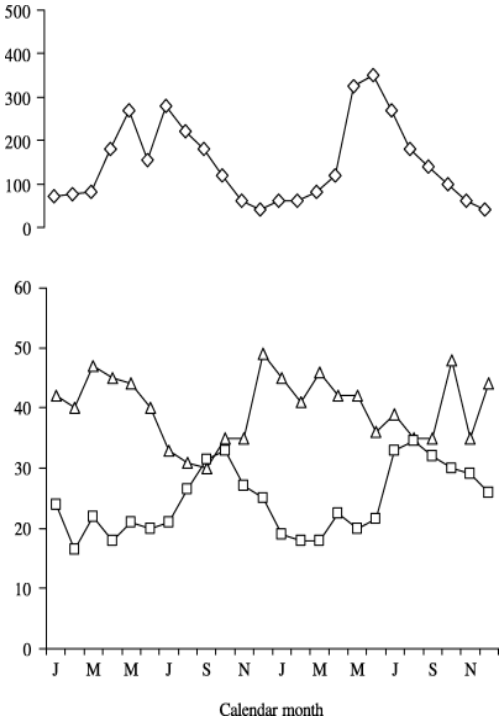
Holick, 2007).

Due to the fact that vitamin D's primary influence is released in tissue from a vitamin d receptor, it is considered a hormone rather than a vitamin. "Vitamin D has been researched to affect skeletal muscle metabolism in three ways by mediating gene transcription, through rapid pathways not involving DNA synthesis and lastly by the allergic variant of VDR" (Close, Russell, Cobley, Owens, Wilson, Gregson, Morton, 2013). A VDR (Vitamin D receptor) has been found in humans located in the skeletal muscles cells that bind 1.25(OH) d3 (Hormone that plays a role in mineral homeostasis) after this hormone travels to the nucleus it can possibly act directly on muscle cell membrane (Close et al., … 2013).

In the elderly population there also has been research to show the correlation between elderly people and skeletal muscle leg extension and its involvement with vitamin D. This all can be traced back to a specific serum called 25(oh) D3 studies. An example where this is shown is when 349 elderly people were involved in a study and out of those people , those with a significantly lower percentage of this serum has significant problems in hand strength and has very little sunlight exposure and had fallen recently (O'Brien, & Jackson, 2012). There also has been research that shows when a variety of women who were vitamin d deficient received a number of healthy levels of vitamin d needed during a time period of six months, their walking distances, as well as muscle and knee strength, were improved significantly, while similar elderly women who did not have their intake of vitamin D did not have significant strength in skeletal muscles (Close et al., …2013). Vitamin D supplementation even in elderly people can help them dress more quickly and perform their activates of daily living everyday in a fraction of the time such as brushing their teeth, walking, and more. Many individuals that reside in nursing homes experience falls that can result mostly in fractures. Vitamin D intake increases muscle strength,

knee strength, and distance in walking (Ceglia, 2009) but there are many factors to strengthen muscle as well, however, vitamin D is one of the primary ones.

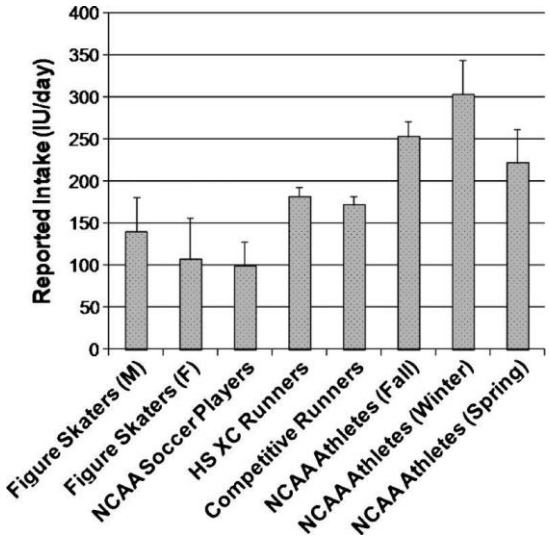
Another factor that is affected by skeletal muscles and the intake of vitamin D is muscle fat. Vitamin D deficiency and cause myopathy as well as increase in body sway and movement. Osteomalacia (A bone conditions that occurs when there is not an efficient way to mineralize the bone) has been associated with muscle weakness for centuries. Falls have also been increasingly related to lack of muscle mass or tone (Close et al., … 2013).There is also a variation between seasons for the incidents when fall occurs largely correlating to winter. This can directly be related to vitamin D intake or lack of sunlight due to less time outside. Musculoskeletal weakness and pain are known symptoms of deficiency in Vitamin D as well (Close et al., … 2013).



Vitamin D also enhances lower-extremity function and increases BMD (Body mass). In a study, Russian authors reported that ultraviolet radiation improved speed in a 100-meter dash in four students who were receiving increased vitamin D compared to those who practiced and

trained indoors (Koundourakis, Androulakis, Malliaraki, & Margioris, 2014). The intake of vitamin D also increases performance in athletes as well. Biopsies of adults with vitamin D deficiency have shown skeletal muscle type two atrophy (Koundourakis et al., … 2014) .Type two skeletal muscles also happen to be the first muscles that react when one is falling. Muscle tissues of those who are deficient in vitamin D also reveal enlarged interfibrillar spaces of fat (Koundourakis et al., … 2014).

In a study it was reported that there was an increase in fiber composition in an area containing muscle fibers related to type two atrophy in muscle biopsies from elderly women with treatment of hydrooxyvitamin D after a time span of three to six months (Shuler, Wingate, Moore, & Giangarra, 2012). Another study found evidence that forty-eight elderly stroke survivors who received 1000 IU's of vitamin D2 significantly increased their type-two muscle fiber and percentage over a two-year period (Shuler et al., … 2012). Multiple studies in communities with elderly adults have found a direct correlation between vitamin D status and physical performance.



(Current Sports Medicine Reports Shuler et al., … 2012 The intake of vitamin D in a day based on sports).

In the analysis of the cross-sectional study of the Longitudinal Study of the Aging

Amsterdam reported that older adults with lower serum 25(OH) D performed really poorly in physical performance compared to those elderly adults who did have a significant intake of the serum. A different longitudinal study on Japanese older community dwellers women with impairments involving physical functions, that higher baseline of the serum increased physical performance (Close et al., … 2013). Random clinical trials have also examined the supplementation of vitamin D and their relationship to physical performance. They found that specifically vitamin D in calcium improved body sway in ambulatory elderly women by approximately nine percent over the period of eight weeks and even improved the lower extremities muscle performance too. (Halfon, Phan, and Teta, 2015).

However, if this serum increases physical performance than lower amount of this serum can also subsequently result in and increased risk of falling which specifically is targeted to individuals under the age of seventy-five (Halfon et al ., … 2015). A similar setup has been shown in elderly populations in a randomized controlled trial (Bischoff, 2012) which showed that treatment with vitamin D along with calcium over a time period of three months shows forty-nine percent decreases in falls. Vitamin D and its receptor are important for skeletal muscle strength and performance and in optimizing skeletal muscle function. Vitamin D exerts directly on skeletal muscle function. It has been recorded that the administration of hormonal vitamin D metabolite decreases the number of falls. Along with this, it has been reported that 1, 25(OH2) D3 (Vitamin D metabolite) regulates muscle growth, strength, and contractility in other target cells this serum receives short and long term responses to skeletal muscles (Chun , 2012). This hormone stimulates muscle cell proliferation and differentiation through nuclear VDR gene transcription as well as growth in the signaled pathway in skeletal muscles (Brisswalter, & Louis, 2013).

Vitamin D is mostly ignored in sports health. However vitamin D serum if in efficient levels actually peak neuromuscular performance. However in athletes possibly the only ones that can reach the amount of the serum of vitamin d needed are lifeguards. The practice of ultraviolet irradiation and increased physical performance is not a new phenomenon it's been around for ages (Shuler et al., … 2012). Numerous beneficial effects have been reported such as a reduction in pain with sports related injuries, improved strength, reaction time, and endurance. Application of this, however, is very difficult because different skin pigmentations and colors require more ultraviolet radiation than others (Girgis et al., … 2014). For example, African Americans require ten times more Ultra Violet Exposure to reach the same level of vitamin D intake as fair skinned individuals do. There is also evidence to show high vitamin D intake and less risk for skeletal muscle injury. Those who were injured in a recent football study had significantly lowered vitamin D levels than those who were not injured (Brisswalter, & Louis, 2013).

There is a strong relationship between vitamin D and skeletal muscle correlation. For examples diseases like rickets (Disease caused by softening and weakening of the bones commonly found in children due to inadequate intake of vitamin D), there is increased skeletal pain and weakness (O'Brien et al., … 2012). This causes muscle atrophy, increased contracting time, prolonged muscle relaxation). Increased vitamin D intake relates back to many musculoskeletal benefits including concentration, strength, and power even decrease in muscle protein degradation.

Vitamin D is also related to testosterone and endogenous hormone used typically for muscle training. A recent study was done on two thousand and twenty-nine men showed that vitamin D correlated with testosterone in men (Brisswalter et al., … 2013). A recent study done on two thousand and twenty nine men showed that vitamin D correlated with testosterone in

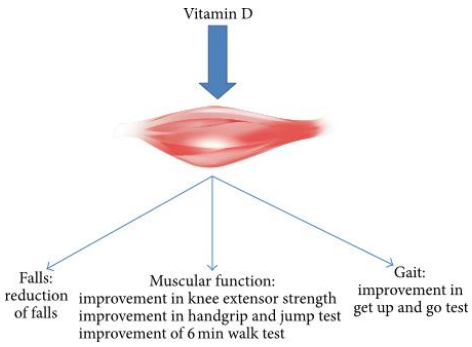
men. A low level of testosterone was found in eighteen percent of the men in the study these men also have significantly lowered levels of vitamin D as well (Close et al., … 2013). Also in a different twelve month randomized control trial fifty-four males demonstrated that the group receiving three thousand thirty-two IU of vitamin D has a significant increase in circulating hydrooxyvitamin D and overall testosterone. Vitamin D has also been shown to correlate with grips and quadriceps strength and physical fitness (Close et al., … 2013).

Soccer is a common sport that requires strength, efficiency, and function as well as endurance as well and increased span of running (Koundourakis et al., … 2014). Vitamin D intake is important for these types of sports, which involve neuromuscular coordination. However there is a negative effect on increased stress training and vitamin D similar to military training. While low-stress training creates a boost of vitamin D. Vitamin D is also linearly associated with the ability to jump along with strength in pre-adolescent girls (Hazzell, Deguire, & Weiler, 2017). However, vitamin D doesn't play and primary rise in exercise performance it proves a secondary role in exercise performance. Vitamin D receptors are virtually in every tissue of the body but they have also been identified in skeletal muscle tissue as well. The discovery of this suggests that vitamin D plays a huge role in skeletal muscles (Briswalter et al., … 2013).

There also has been researching done in rodents to determine if vitamin D will help restore skeletal muscle after skeletal muscle injury. Inducing an injury of male rodents on the solos muscle did this. After their injury, they received an amount of vitamin D (Bikle et al., … 2013). This vitamin D application caused a significant increase in muscle proliferation 4 days after the injury compared to those rodents that did not receive vitamin D. Vitamin D low baseline seems to be a sign of progression into disability. Supplementation of vitamin D can also increase

gait speed. Another experiment found that treatment with eight thousand four hundred IU's of vitamin D3 reduced sway movement in the elderly patients. (Halfon, Phan, & Teta, 2015). In the invecchiare in Chianti study, there was a significant association between low intake of vitamin D and poor physical performance assessed by a short physical performance battery test which was the ability to stand up from a chair and maintain one's balance in increasingly difficult positions. (Halfon et al., … 2015). In another study investigating falls those associated with higher levels of vitamin D were much faster in the test which consisted of standing up from a chair walking three meters and walking back and sitting in that chair

(Christakos, Hewison, Gardner, Wagner, Sergeev, Rutten, Bikle, 2013).

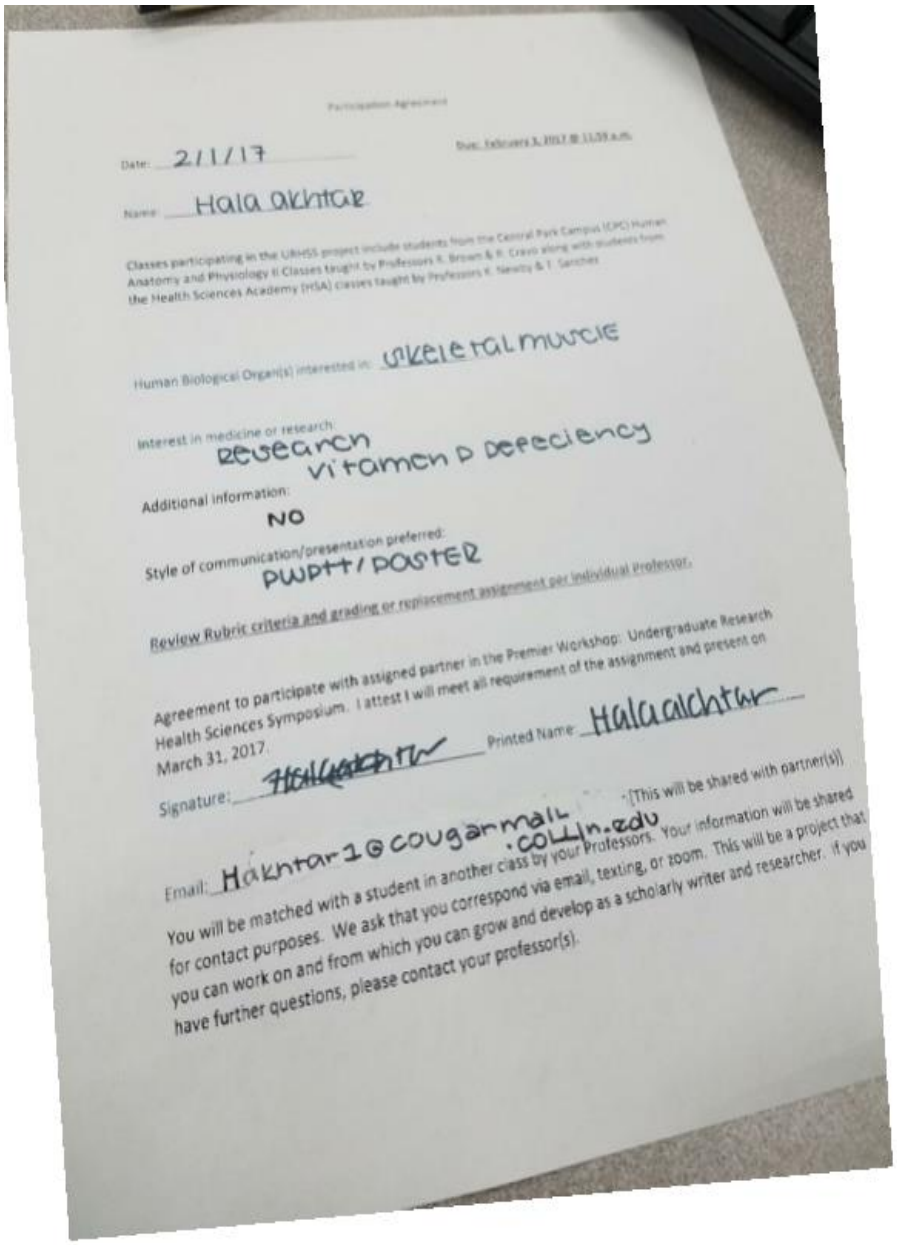


Christakos, S., Hewison, Gardner, Wagner, Sergeev, Rutten, Bikle, 2013). (Clinical effect of vitamin D on muscle gain). There also is a clear association between vitamin D and frailty. Data from an observation study showed that one thousand six hundred and fifty-nine men with ten percent frailty showed that there was an association between vitamin d and frailty (Halfon et al., … 2015). There was another study with chickens that were raised right from when they were hatched on a vitamin D deficient diet and after three weeks they were hypocalcaemia and appeared frail and weak. This study demonstrated the objective weakness of these chickens with myopathy that was also vitamin D deficient.

In conclusion, vitamin D has an array of effects involving skeletal muscle strength and

functions as well as sports health and performance in athletes in can also improve the regeneration of skeletal muscle after injury and decrease risk in falling as well as increase the activity of dialing living in the elderly population. (Chun et al., … 2012). There are a variety of sports you can play to get your intake of vitamin D but it can even be based on skin pigmentation and color the amount of vitamin D one will receive. The preventive care for vitamin D deficiency is simple as well recognize the signs and symptoms of vitamin D deficiency get enough food such as fish and oranges in to get your vitamin D level up or simply enjoy time outside in the sun (Close et al., … 2013). Vitamin D has an array of effects and benefits to optimize skeletal muscle function and strength.

Appendix A



Participation Agreement

Date: 2/1/17 Due: February 3, 2017 @ 11:59 a.m.

Name: Hala akhtar

Classes participating in the UHHSS project include students from the Central Park Campus (CPC) Human Anatomy and Physiology II Classes taught by Professors K. Brown & R. Cravo along with students from the Health Sciences Academy (HSA) classes taught by Professors K. Newby & I. Sanchez

Human Biological Organ(s) interested in: skeletal muscle

Interest in medicine or research: research vitamin D deficiency

Additional information: NO

Style of communication/presentation preferred: PWPTT/ POSTER

Review Rubric criteria and grading or replacement assignment per individual Professor.

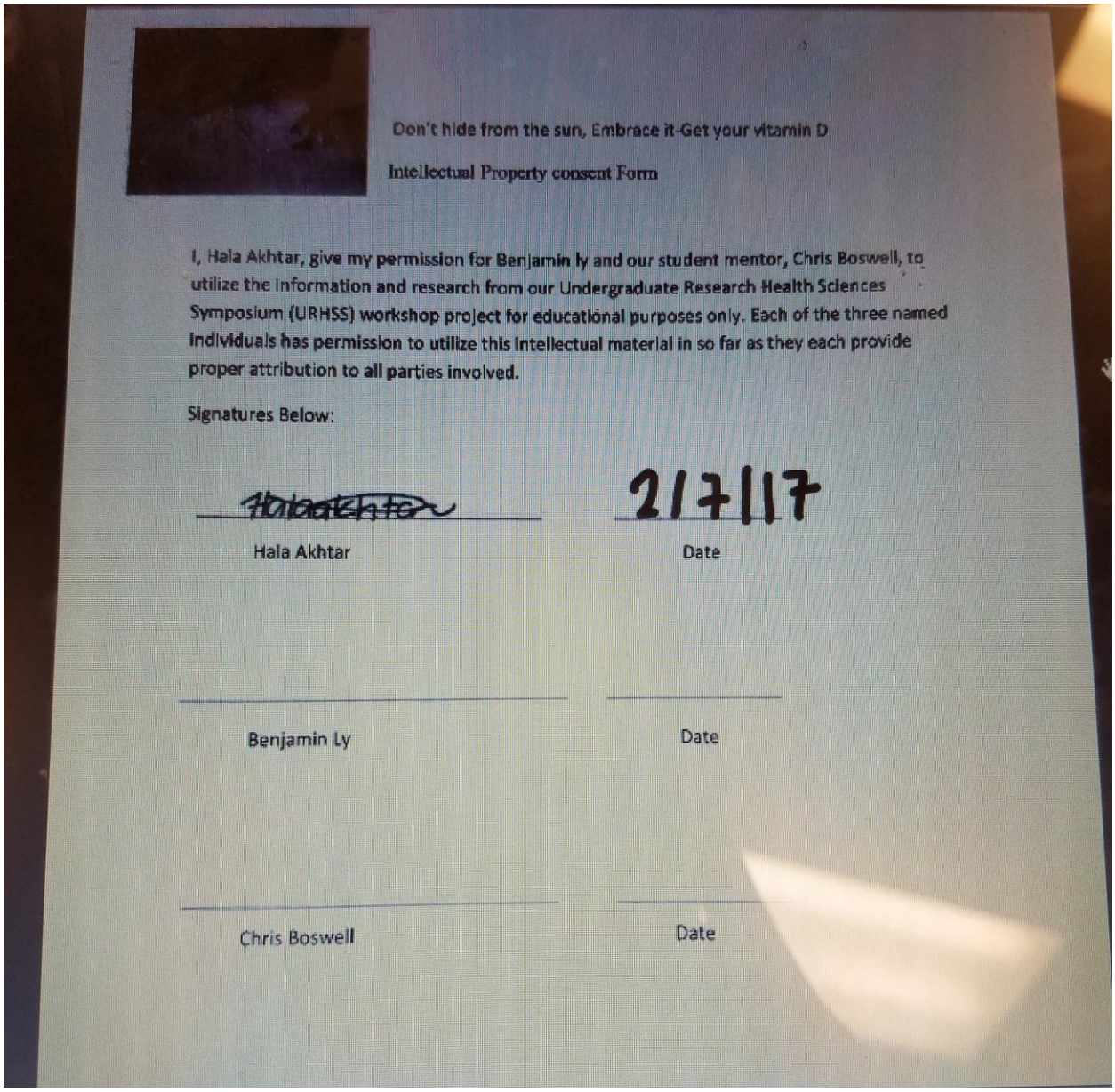
Agreement to participate with assigned partner in the Premier Workshop: Undergraduate Research Health Sciences Symposium. I attest I will meet all requirement of the assignment and present on March 31, 2017.

Signature: [redacted] Printed Name: Hala akhtar

Email: Hakhtar1@cougarmail.collin.edu *[This will be shared with partner(s)]

You will be matched with a student in another class by your Professors. Your information will be shared for contact purposes. We ask that you correspond via email, texting, or zoom. This will be a project that you can work on and from which you can grow and develop as a scholarly writer and researcher. If you have further questions, please contact your professor(s).

Appendix B



Don't hide from the sun, Embrace it-Get your vitamin D

Intellectual Property consent Form

I, Hala Akhtar, give my permission for Benjamin ly and our student mentor, Chris Boswell, to utilize the information and research from our Undergraduate Research Health Sciences Symposium (URHSS) workshop project for educational purposes only. Each of the three named individuals has permission to utilize this intellectual material in so far as they each provide proper attribution to all parties involved.

Signatures Below:

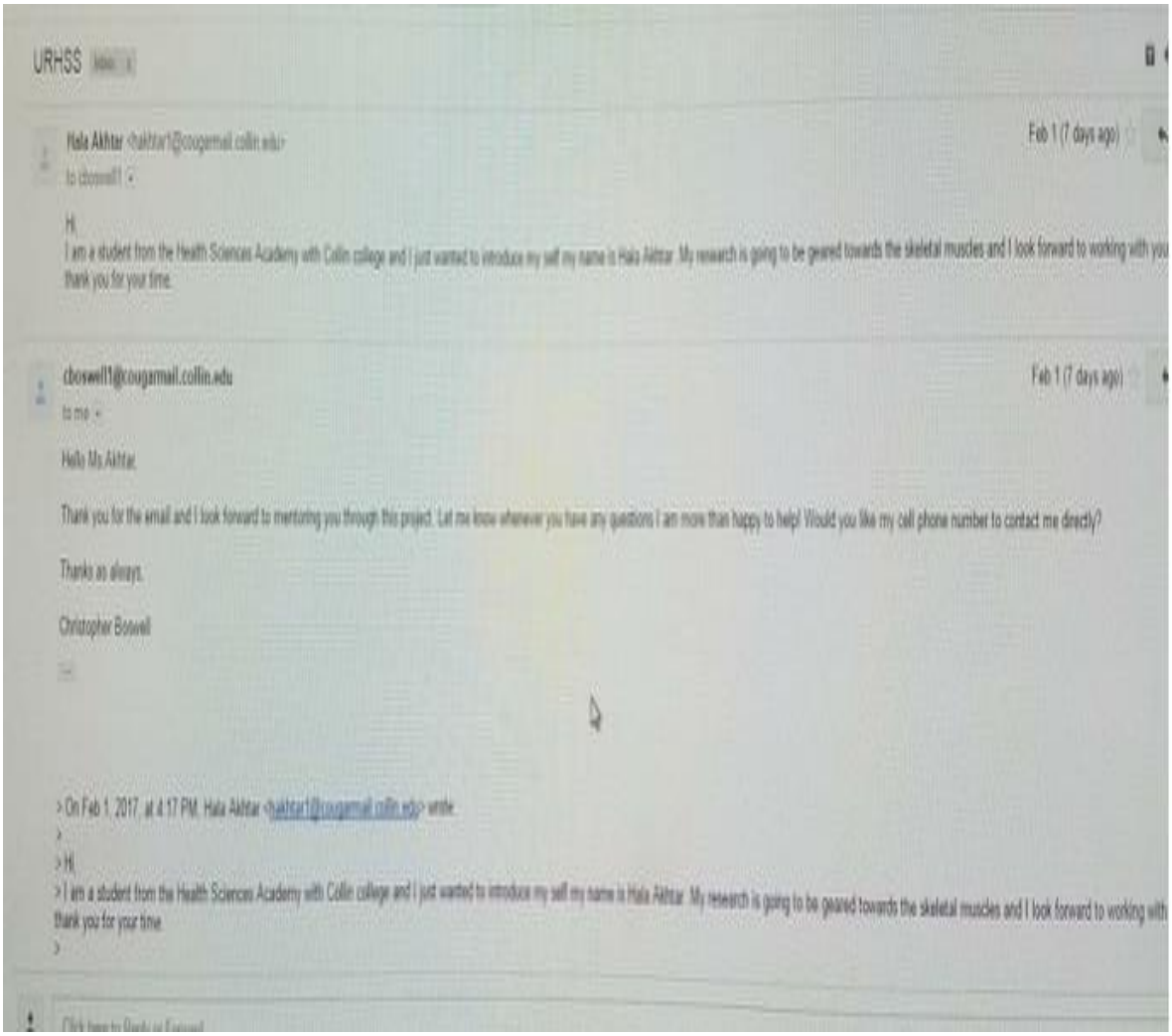
Hala Akhtar — 2/7/17

Hala Akhtar — Date

Benjamin Ly — Date

Chris Boswell — Date

Appendix C copy of introductory email to student mentor



Research Project Outline Appendix D

I. Introduction

   A. Correlation between vitamin D and skeletal muscles function, strength, and efficiency

   B. Relationship between Vitamin D deficiency and skeletal muscle function which is commonly decreased with lack of Vitamin D and fatigue

II. Vitamin D Examples

   A. Scenarios where the skeletal muscles and vitamin D come together to improve strength and efficiency

   B. How vitamin D affect muscle strength among ambulatory elderly people

   C. Comparing athletes by their muscle strength and performance when they receive vitamin D versus their performance without it.

III. Skeletal muscles and how vitamin D affect it

   A. Observing the vitamin d receptor in human skeletal muscle tissue and its correlation between age and vitamin D intake.

   B. How to be aware of vitamin d deficiency and lack of muscle strength and ways to fix it

   C. Preventative care options that can be provided to get vitamin D to prevent loss of strength in skeletal muscles and possible symptoms in skeletal muscles that can allude to Vitamin D deficiency

Research Proposal Appendix E

This research paper will explore the correlation between skeletal muscles, strength, function, and efficiency and its relationship to vitamin D. Our mode of delivery will be a research paper along with a poster which we will present at the Undergraduate Research Health Sciences Symposium Workshop. The members of our team include Hala Akhtar, Chris Boswell, and Benjamin Ly. Along with the poster we will have visuals with pictures of regular skeletal muscles along with ones affected by lack of vitamin and have talk through presentation along with handouts. Focusing on vitamin D deficiency and symptoms along with signs that warn individuals of vitamin D deficiency. There are more than 3 million cases of vitamin D deficiency per year which can simply be resolved even by basking outside in the sun (Girgis, Roderick, Bligh, Turner, Lau, and Gunton 2014). This directly leads to skeletal muscle function which is what we cover in this paper. The roles will be divided by Benjamin doing half of the body of the essay while Hala Akhtar does the other half of the body of the essay both will create the reference page together along with any additions to the annotated bibliography. Hala Akhtar is responsible for doing half of the preparation of the presentation and making handouts as well while Benjamin Ly will contribute with the other half of the Presentation with examples of the skeletal muscles.

Annotated Bibliography Appendix F

Bischoff-Ferrari, H. A. (2012). Relevance of vitamin D in muscle health. *Reviews In Endocrine And Metabolic Disorders, 13*(1), pp. 71-77, 71-77. Doi: 22 October 2012.

This journal will outline the impact of vitamin D on muscle health. This article will also Discuss whether there's a relationship between vitamin D and fall prevention. Finally trial And data will be examined and review to assume the serum hydroxyvitamin D

Ceglia, L., Niramitmahapanya, S., Da Silva Morais, M., Rivas, D. A., Harris, S. S., Bischoff-Ferrari, H., -Hughes, B. (2013). A Randomized study on the effect of vitamin D3 Supplementation on skeletal muscle morphology and vitamin D receptor concentration in Older women. *The Journal of Clinical Endocrinology and Metabolism, 98*(12). Retrieved February 3, 2017, from https://academic.oup.com/jcem/article-lookup/doi/10.1210/jc.2013-2820 This journal reviews Vitamin D and its function on skeletal muscles. Along with its Intake in older women who have specific vitamin D receptor.

Ceglia, L., & Harris, S. S. (2012). Vitamin D and its role in skeletal muscle. *Calcified tissue international, 92*(2), 151-162. Retrieved February 3, 2017, from http://link.springer.com/article/10.1007/s00223-012-9645-y. This reviews the role of Vitamin D and its role in skeletal muscle. Researches positive variation with muscle Strength and vitamin d and the inverse relationship between vitamin D and falling.

Girgis, C. M., Clifton-Bligh, R. J., Turner, N., Lau, S. L., & Gunton, J. E. (2014). Effects of Vitamin D in skeletal muscle: falls, strength, athletic performance and insulin sensitivity. *Clinical endocrinology, 80*(2), 169-181.

Reviews the evidence provided for vitamin D and its correlation with skeletal muscles. Also

Examines the relationship between vitamin D and athletic performance.

Hazzell, T. J., Deguire, J. R., & Weiler, H. A. (2017). *Vitamin D: an overview of Its role in skeletal muscle physiology in children and adolescents. 70*(9). Retrieved February 3, 2017, from https://academic.oup.com/nutritionreviews/article-Abstract/70/9/520/1835339/Vitamin-D-an-overview-of-its's-role-in-skeletal.

This journal reviews children and their effect of vitamin D and optimal muscle strength. As Well as the effect of Vitamin D on muscle strength proliferation and differentiation.

Shuler, F. D., Wingate, M. K., Moore, H. G., & Giangarra, C... (2012). Sports health of vitamin D. *Sports health: A Multidisciplinary Approach, 4*(6). Retrieved February 3, 2017, from http://journals.sagepub.com/doi/abs/10.1177/1941738112461621

Vitamin D is a skeletal hormone that provides many skeletal benefits. Musculoskeletal Injury And prevention are affected by levels of vitamin D. vitamin D deficiency is a Common issue today that leads to injury

Stockton, K., Kandiah, D., Paratz, J., & Bennell, K. (2012). *Fatigue, muscle strength and vitamin D status in women with systemic lupus erythematous compared with healthy controls. Lupus, 21*(3). Retrieved February 2, 2017, from http://journals.sagepub.com/doi/abs/10.1177/0961203311425530

The purpose of this study is to evaluate vitamin D levels in women with SLE compared with Healthy people.

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The study of the role of vitamin D in musculoskeletal function among elderly people.

Wahl, D. A., Cooper, C., Eggersdorfer, E. M., Hilgler, J., Hoffman, K., Jose, R. . . . Dawson-Hughes, B. (2012). *A global representation of vitamin D status in healthy populations. Archives of osteoporosis, 7*(1), 155-172. Retrieved February 3, 2017, from http://link.springer.com/article/10.1007/s11657-012-0093-0

Studies selected a random group of male and females from the general population and their Vitamin D levels and how it relates to skeletal muscles

Wacker, M., & Holick, M. (2013). Vitamin D—Effects on skeletal and extra skeletal health And the need for supplementation. *Nutrients, 5*(1), 111-148. Doi: 10.3390/nu5010111

Vitamin D plays a crucial role in the function of the skeleton and skeletal muscles. This Study. Also determines the need for vitamin D supplementation.

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