ERGO

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We would also like to acknowledge Yaeko Bryner, Stephen & The Mr. & Mrs. Denkers Family Foundation, The George S. & Dolores Dore Eccles Foundation, The Kem & Carolyn Gardner Foundation, Richard R., II & Karen W. Fairbanks, The Ralph Nye Charitable Foundation, PSI CHI, and Gloria Z. Wurst. Their generous financial support of WSU undergraduate research students has enabled the creation of powerful and unique learning opportunities that continue to impact those involved long after the projects are completed.

LETTER FROM THE EDITOR

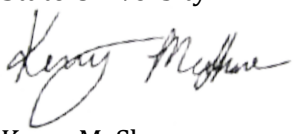
Dear Reader,

I am proud to present this year's edition of Weber State University's undergraduate research journal, ERGO. While much of scholarly publishing is undertaken by graduate students and professionals, ERGO provides a unique opportunity for undergraduates to jump-start their careers, graduate studies or both by experiencing this process early.

Acting as the editor of this journal, I have faced the difficulty of meeting deadlines, felt my eyes blur after proofreading page after page, and spent countless hours sending and answering emails. But I have also learned—I have read about bacteria in the Great Salt Lake, the potential for dark chocolate to reduce cholesterol levels, new ways to expand viewership for a television station, and so much more. I have valued every aspect of bringing this journal together and will cherish this experience for years to come.

I would like to acknowledge and give thanks to those who took part in producing the 2013 edition of ERGO: Dr. John Cavitt for giving me this opportunity and providing guidance every step of the way; my assistant editor Alexandria Stuart who was truly my right hand; Erin Daniels for her willingness to answer even the most minor of questions; Tess Woodward for using her skills to make our ideas a reality; and the faculty and peer reviewers, without whom the selection of articles would be impossible. Finally, special thanks are necessary for all of the authors who submitted their research to ERGO; this journal could not exist without your hard work and willingness to share it with us.

In its seventh year of publication, ERGO is still young and striving to widen its readership among the campus population. It is my hope that you will encourage others to read this journal, thus ensuring the future place of undergraduate research at Weber State University.



Kerry McShane
Editor-in-Chief

Botany

Native Ground Covers to Manage Invasive Weed Growth during River Restorations

Author: Ronnamay Walker
Mentor: Barbara Wachocki

Abstract

Due to increased awareness of water conservation, river restorations are becoming standard procedure in this country. Accompanying these projects is a standardized set of goals and guidelines for restoration; one of these basic goals states that during the construction phase, "No lasting harm should be inflicted on the ecosystem" and the loss of native vegetation should be minimized during in-river reconstruction activity. "Indeed, removal of any native riparian vegetation should be avoided unless absolutely necessary" (Palmer, etal. 2005). Achieving these goals can be difficult, resulting in a greater loss of native river bank vegetation than desired. Most projects remedy this with a more extensive native replanting at the end of the project. However, this period of time, while the riparian corridor is left barren, can become critical, as it provides an inviting environment for invasive weeds. Once there, they become increasingly difficult to get rid of. The primary objective of this study was to find suitable native plants to provide a cover crop for riparian areas during the time of construction. These plants would serve as a physical control aimed at minimizing the expansion of invasive weeds. In order to accomplish this task, suitable plants would need to provide adequate cover by growing quickly and densely. In addition, plants would need to meet the following criteria; to withstand

some degree of human disturbance, be attractive, low maintenance, and lastly, be a complimentary step plant to the future native community. Sixteen different native plants with ground cover habits were selected, by grower availability, and planted at three locations along the Ogden River. Observation data was recorded in a field log book and a photographic history was also taken from June 6, 2012 to November 8, 2012. Of these sixteen plants, eight met the desired criteria.

Introduction

The Ogden River Restoration Project began in 2009, with Crystal Young, hydrologist, as project director. I contacted her about the project and asked for suggestions of research areas. A major point of concern was in finding a manageable plan to slow the spread of invasive weeds in the riparian corridor during restoration. Much of the area surrounding this project had undergone recent disturbance and invasive plants already had a jump on establishment; eradicating them would not be an obtainable goal. A more logical "goal should be to recognize their presence in restoration management planning and, where possible, implement riparian restoration activities that favor native species over exotics" (Landers, 1997). The Ogden River had been used as a dump site for 100 years or more, making the clean-up portion of the project quite extensive. Twenty-five thousand tons of garbage had to be pulled from the river bed, and bank encroachment had rendered a fair amount of vegetation in poor health, requiring its removal.

This study focuses on the riparian areas where bank vegetation needed to be removed in order to access the river and accomplish restoration. There are many factors that affect the length of time these areas are left unplanted, usually between one and two planting seasons, but adequate time for invasive weeds to get a foothold. A basic strategy for weed control is providing plant competition in the form of a cover crop. Generally, plants are chosen for a certain area

because their traits are compatible with the environment. However, for restoration projects, they need to be chosen for the traits that allow them to overcome environmental set-backs. Primarily, the ability to quickly establish themselves and provide a dense cover capable of out competing invasive plants, and yet controllable enough that it does not hold a possible threat of becoming invasive and therefore blocking a natural progression in the native community. For aesthetic purposes and positive community support, plants should also be attractive and low maintenance.

My specific objective with this study was to identify a group of native plants that could be used in combination while taking into consideration the different soil types, varying landscapes, and wildlife, etc. With a variety of choices, riparian areas usually left barren and vulnerable could be planted during ongoing construction, providing weed control as well as the base for a natural succession towards the native plant community.

Materials

Native plants were required for this project and I was able to acquire them from High Mountain Plants in Draper, UT (donation), Perennial Favorites in Layton, UT (donation/ purchase), and Willard Bay Gardens in Willard, UT (purchase). In addition to this, Ogden City allowed me the use of three 10' x 20' plots along the Ogden River by request from Crystal Young of the River Restoration Project. Organic matter was purchased from the Ogden Green Waste Station and weed barrier was donated. Gardening tools, camera, field log book and labor were provided by myself.

Native Plant Species: Bold plants indicate the eight chosen plants.

Callirhoe involucrata	Hedysarum occidentale
Fragaria vesca	Heuchera pulchella
Zinnia grandiflora	Arctostaphylos uvi-ursa
Geranium viscosissimum	Sphaeralcea coccinea
Geum triflorum	Lewisia cotyledon 'Sunset group'
Sedum utahensis	Phacelia sericea
Artemisia frigida	Eriogonum caespitosum
Antennaria microphylla	Eriogonum umbellatum

3 – 10'x20' plots along the Ogden River
Organic Matter from Ogden Green Waste Station
Weed barrier

Methods

This experiment involved the use of 3 - 10'x20' plots along the Ogden River to grow different native ground covers. Three locations were chosen; Site A on the north side of the river between Lincoln Ave. and Wall Ave., Site B on the south side of the river across from Site A, and Site C, located on the north side of the river just east of the Gibson St. bridge. All three sites were marked and staked, manually cleared of weeds, organic material was added during planting, and field evaluations of soil types were taken. Plant selection was simplified by native plant availability. I was able to find sixteen different native plants with growth habits conducive for ground covers.

Each site was divided into two equal sections with smaller plots for each different species, which were planted in groupings of five. Soil texture for Site A was clay silt with medium size sub-angular aggregates and a strong structure. Site B was a silty clay loam texture with medium size granular to sub-angular aggregates with a moderate to

strong structure. Texture for Site C was rocky sand with few aggregates and a weak structure.

The primary objective was to find native plants that grew quickly enough to provide adequate cover to hinder or prevent invasive weed growth. In order to determine increased percent cover for each plant species I first measured each plant for area after planting, calculated an average plant size and multiplied by the number of plants in each plot. These measurements were taken again at the end of the growing season when plants are most robust and before plant decline. Beginning and final measurements of plant areas were compared and an increased percent cover was determined.

While in the planning stages of setting up the perimeters of this experiment, I was not sure what to expect in plant or weed growth. If invasive weeds already had a foothold I would need to implement a way for native plants to get established. I decided to use weed barrier on one half of each site; represented as Site A2, B2, and C2. The other half of each site A1, B1, and C1 did not have weed barrier. I prepared the sites the same as a restoration replanting and removed the weeds; any data to be collected on invasive weeds would depend on what grew back.

Observations for plant maintenance, attractiveness, length of growing season, and disturbance tolerance were also noted on data sheets throughout the season.

Results

Results for increased percent cover showed that eight of sixteen plants had an increase in cover of 70% or more (Table1). (The remaining eight plants were eliminated as candidates for this project.) The growth increase shown by these eight plants demonstrated their ability to establish quickly and achieve density capable of reducing invasive plant growth, the main objective, and were, therefore, selected for further observation. The table below shows the

percent of increased or decreased growth for each species over a growing season, with the top eight highlighted.

Table 1: Percent increased cover per species over a growing season.

	Kinnikinnick	Cranesbill	Old Man's Whiskers	Coral Bells	Utah Vetch	Utah Sedum	Fringed Sagewort
Site A1	43%	95%	91%	28%	58%	96%	93%
Site A2	23%	94%	90%	24%	0%	95%	
	Coral Bells	Poppy Mallow	Wild Strawberry	Zinnia	Kinnikinnick	Cranesbill	
Site B1	21%	98%	88%	74%	59%	85%	
Site B2	38%	96%	85%	78%	48%	78%	
	Purple Fringe	Sulpher Buckwheat	Globe Mallow	Mat Buckwheat	Sunset bitterroot	Little leaf Pussytoes	Fringed Sagewort
Site C1	38%	-18%	70%	0%	-41%	90%	
Site C2	0%	-37%	60%	-30%	-41%		95%

Callirhoe involucrata, Poppy Mallow: (97%) This plant looked very spindly and sparse for the first month but turned out to cover the greatest area with its spreading, mat-forming habit reaching 4' to 5' in length. It is an attractive, drought-tolerant perennial with dark pink flowers that does well in medium to course textured soils.

Sedum utahensis, Utah Sedum: (95.5%) This was one of the last plants to be selected; the plant, very small for the time of season, was received in a seedling flat. As the underdog in this experiment, this plant was one of the quickest to establish itself, growing densely and close to the ground, leaving no room for any other plants to move in.

Artemisia frigida, Fringed Sagewort: (94%) This plant rated highest, filling in and establishing itself quickly. It is an attractive blue-green, with fuzzy stems, allowing the least number of weeds to grow among it. Requiring no maintenance, it thrives in both sandy and clay soil. Also known as Prairie Sagewort, it is an aromatic, mat-forming, perennial well suited to grass and broad-leafed herb communities. Seedlings are competitive and can establish in areas with herbaceous competition. It is adapted to mine spoils, perhaps better than any other species of Artemisia. It can be used as a biological control to reduce rapid weed

expansion on large disturbed sites but can be controlled when it is too abundant. Fringed sagewort is a good pioneer shrub for stabilizing disturbed sites. Its strong taproot and numerous lateral roots help stabilize gullies and reduce soil erosion. These rooting characteristics enable the shrub to resist considerable grazing and trampling. It also provides forage for livestock and forage and habitat for wildlife in both North America and Asia (McArthur, E. Durant & Taylor, Jeffrey R.).

Geum triflorum, Old Man's Whiskers: (90.5%) This plant was an unexpected surprise, growing quickly and densely. It is clothed basally, with a persistent leaf base that blocks weed growth very well. It has attractive foliage and flowers (Munger, 2006).

Antennaria microphylla, Little-Leaf Pussytoes; (90%) This plant has a mat-like habit and grows well in sandy soil, not as quick to establish as others but very dense in coverage. It also had a high tolerance for disturbance. Flowering in early–midsummer, it adapts well to moist, open areas, flood plains of streams, and margins of alkaline depressions (Antennaria microphylla, 2008).

Geranium viscosissimum, Sticky Geranium: (88%) This plant established quickly but not as densely as others. It is an attractive plant that can cover large areas. It was also the first to be affected by cold weather.

Fragaria vesca, Wild Strawberry: (86.5%) This native strawberry has a clumping habit; however, it is very dense and about 12" in height providing good cover. Pretty white flowers and small tasty, edible fruit make this a good choice, while providing food for other creatures.

Zinnia grandiflora, Rocky Mountain Zinnia: (76%) This plant established very quickly. With its mounding habit it provided a very thorough coverage. Also known as Wild Zinnia, or Prairie Zinnia, it is a perennial that grows 4-8 inches high and slowly spreads by rhizomes to become a groundcover. Papery yellow flowers cover the plants

from mid-summer until frost. It thrives in rugged terrain preferring hot, sunny spots with well-drained soil (Olson, 2011).

Table 2: Desirable traits of species with over 70% increased cover growth.

	Poppy Mallow	Utah Sedum	Fringed Sagewort	Old Man Whiskers	Little Leaf Pussytoes	Sticky Geranium	Wild Strawberry	Rocky Mtn. Zinnia
Quick Growth	X	X	X	X	X	X	X	X
Dense Growth	X	X	X	X	X	X	X	X
Disturbance Tolerance			X		X			
Low Maintenance	X	X	X	X	X	X	X	X
Attractiveness	X		X	X		X	X	X
Season Length	X	X	X	X	X		X	X
Weed Deterrence	X	X	X	X	X	X	X	X
TOTALS	6	5	7	6	6	5	6	6

Discussion

The primary objective of this study was to find suitable native plants to be used as a cover crop during the construction phase of restoration projects to provide a preventive maintenance tool against invasive weeds. A secondary objective was to achieve this goal within the parameters set by the standardized restoration guidelines; that no lasting harm is done to the ecosystem during construction and that the loss of native vegetation is minimized (Palmer); both of which are achieved. Furthermore, the beginning stages of re-establishing a native plant community are already in the works with these ground covers.

This study looked at sixteen plants and found half to have promising traits suitable for restoration work. Although this study was a sampling of native plants and applied on

a very small scale, the plant success was much more than I had anticipated. I was also surprised by the plants' ability to flourish in clay soils.

I also feel that plantings of combinations of these species would be possible and beneficial; for example, Antennaria microphylla would be best in sandy areas or rock beds, Artemisia frigida would be advantageous for a bank area prone to erosion, Fragaria vesca for areas where birds and wildlife are encouraged, Callirhoe involucrata for large areas in need of quick cover, and lastly, Zinnia grandiflora could be placed in an area where excessive foot traffic needs to be discouraged.

A possibility for a future study might be in larger planting covering a ¼ mile of river rather than just sample plots. I feel that cover crops have the possibility of altering the present methods for weed control in a beneficial and positive way.

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Shoot Development of Ruscus Hypoglossum Resembles Compound Leaf

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Mentor: Ron Deckert

Abstract

With its bizarre display of modified stems and seemingly primitive form, Ruscus hypoglossum is a botanical oddity. Of especial interest, the shoots of this plant do not branch, and do not continue to grow after emerging from the bud. As R. hypoglossum is a flowering plant, it would be expected that the shoot tips would contain a region of cellular division, and that the shoots would be able to elongate. This study uses a classical illustrative approach with the aid of photographic microscopy to show the internal and external features of a R. hypoglossum specimen. These illustrations depict four stages of the plant's aerial shoot growth. The observations show that R. hypoglossum does not have indeterminate growth. Instead, its branched stems do not add branches or elongate after maturation; what shape emerges from the bud remains the shape for the life of the shoot. This makes the shoot more like a compound leaf than a branched stem. As the shoot arises from an underground rhizome, the overall growth pattern of R. hypoglossum bears a striking resemblance to that of a fern, not a flowering plant. This could have implications for the evolutionary history of the Ruscus genera, and may call for a reassessment of plant organ classification.

Introduction

Plant anatomists have developed a system of classification and naming plant organs and tissues. Precise definitions are assigned to leaves, stems, and roots and most plants fit into this terminology. However, human systems of classification do not always apply to certain plants as some plants possess features that bend and break the rules. Ruscus hypoglossum is one such exception. It is a small evergreen monocot native to the forests of Eurasia (Figure 1). Each wiry vertical stem arises from a thick rhizome, a modified stem that runs horizontally below the soil, and appears to display lanceolate leaves 7-8 cm long. However, these are not true leaves but modified stems called cladophylls, a common feature of the family Asparagaceae, to which Ruscus belongs. The true leaf may be found on the center of a cladophyll on either face. A scaly flowering structure nestles at the base of the true leaf, which is unusual for flowering plants. Some botanists argue that this is not a true leaf at all, but a modified leaf or bract (Ecology, 2012). The leaf and flower structure may not be present on all cladophylls. Perhaps most interesting is the fact that there does not appear to be an apical bud on the mature stems. The apical bud is a meristem, or region of active cell division resulting in growth of the plant body. Most of the flowering plants, of which Ruscus is a member, have an apical bud at the tip of shoots so that the stems can continue to grow. This is the usual mechanism of primary or elongating growth for flowering plants.

The purpose of this study is to test the hypothesis that once R. hypoglossum vertical branches arise from the rhizome, they do not continue primary growth. This would imply that the aerial stems do not have indeterminate apical growth, as there is no region of cellular growth on the tip of the stem. Previous studies of Ruscus species focus on the floriculture potential or saponin content (Agnello, et al., 2007, pp. 211-215). The 19th century work of German natu-

ralist Carl Sanio presents an anatomical description (as cited in Ball, 1947, p. 820). Due to the scant resources on Ruscus, even a brief revisitation of R. hypoglossum would advance the understanding of what defines plant organs and tissues.

Materials and Methods

The specimen of R. hypoglossum was grown in the Weber State University greenhouse. Upright stems of varying ages were analyzed by dissection for what various features were present at each point in development. I illustrated several stages of growth beginning with the most mature stems, which could be viewed with the naked eye. The youngest bud cross section was photographed at 400X with a Canon EOS Rebel T3 camera mounted on a compound light microscope. The photos were viewed with Digital Photo Professional, and a final illustration was drawn as a composite of these images. I completed all the illustrations by hand, using a gel ink pen over graphite pencil.

Results

The hypothesis that R. hypoglossum lacks indeterminate growth can be confirmed based on this study. The aerial plant body, depicted in Figure 1, consists of aerial stem branches, the crown of the rhizome, and shoot buds. The buds originate from tips of rhizome branches and emerge through the soil protected by bracts, shown in Figure 2. Within the bud is the developing shoot (Figure 3). Each cladophyll is represented at this stage, and even earlier, as in Figure 4, which is a bud only 4 mm wide. This figure also shows the developing central stem, which appears as a squat region of cell division beneath the already visible cladophylls. As the shoot emerges, the central stem elongates with the cladophylls already attached. The cladophylls on a juvenile stem in Figure 5 unfurl as the central stem elongates; the leaf and floral structure is visible and will mature as the stem reaches its determinate length.

Discussion

One possible reason that R. hypoglossum appears to lack indeterminate growth is that the aerial branches are analogous to a compound leaf in relation to the whole plant, that is, a single leaf divided into leaflets. For this to be true, it would have to be said that the rhizome is the main stem. The buds are located on the tips of rhizome branches, which implies that the rhizome tips are, in effect, apical meristems. Primary growth then occurs at right angles, first horizontally in the rhizome, then vertically in the shoot. The vertical stems do not develop new branches after emerging from the buds. They are photosynthetic units much as frond-like compound leaves. Ruscus is then a plant on its side, with an arrangement more akin to that of a fern than a flowering plant.

More questions arise from this study. There are other species of Ruscus that exhibit branching and may then contain different meristematic regions. More exact methods, such as epi-illumination and scanning electron microscopy would show where and how each tissue layer and organ is formed. Though Ruscus hypoglossum is a rabbit-hole as far as terminology is concerned, it offers a unique opportunity to explore histogenesis and morphology.

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Figure 1: The aerial body of R. hypoglossum. The flat cladophylls (A) are branches of the stem, and may bear flower structure and a single true leaf (B). Each upright stem (C) arises from the rhizome (D). This drawing depicts a plant with the lower branches removed. Stem buds (E) also emerge from the rhizome.

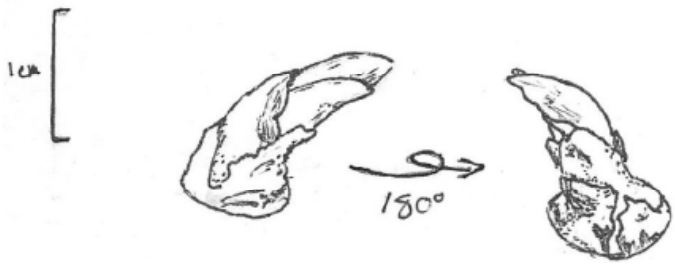

Figure 2: The external features of the emerging stem bud. Protective bracts envelope the developing stem within.

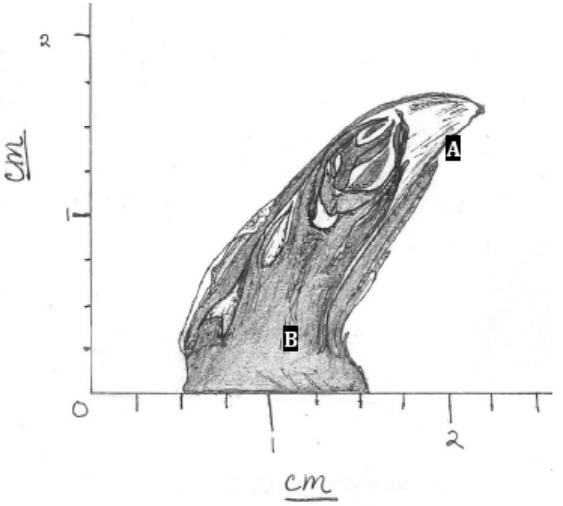

Figure 3: A longitudinal section of the developing stem bud. (A) Bracts protect the bud. The central stem (B) at this time shows undifferentiated cells elongating, and already displays the branched cladophylls. Vascular tissue is not yet visible.

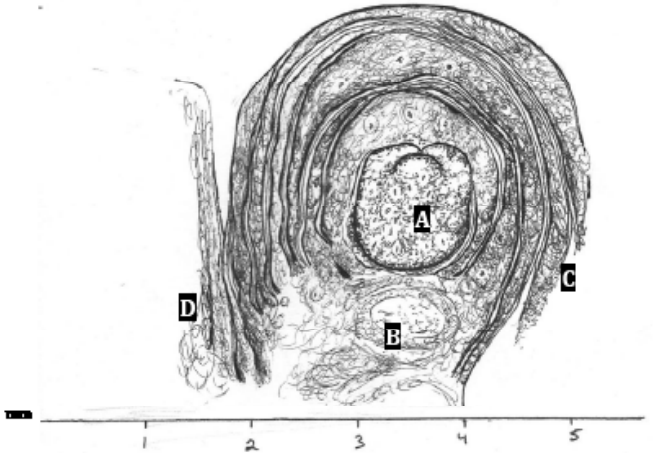

Figure 4: A stem bud, younger than the one depicted in Figure 3, in longitudinal section as it develops on the rhizome. The tip of the shoot primordia (A) looks like that of most apical plants at this point. However, the other branches are already beginning to be represented. The central stem (B) is now undifferentiated and most resembles a meristem. The outer layers of tissue are the protecting bracts (C). The rhizome body (D) continues off the illustration.

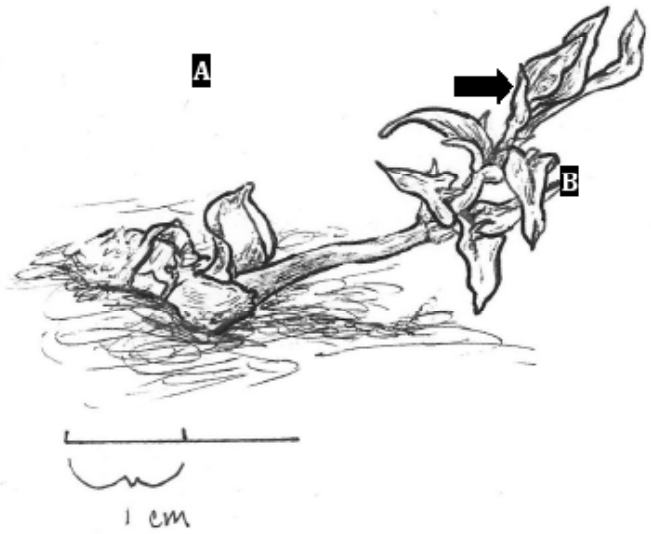

Figure 5: A young stem emerging from a bud on a rhizome (A). Note that 8 immature branches (cladophylls) are present, each with a single leaf (B). At the base of each branch is a structure analogous to a leaf bract (arrow), but its genesis requires further study. The floral structure is barely visible at this point, but will develop as the stem matures.

Communications

Weber State Studio 76's 14 Weeks of Summer

Author: Paul Castleberry Jr.
Mentor: Andrew Tyler

Abstract

Student producers with the newly branded Studio76 at Weber State University undertook a study to determine what kinds of content would increase viewership on its YouTube channel. Uses and Gratification Theory predicts multiple, varied uses for media entertainment (Katz et al., 1973; McQuail, 1983). About its application to YouTube, Guoshon Shao (2009, pp. 7-25) says that viewers of YouTube are "stressed individuals [who] can go there for relaxing clips while bored individuals can visit for excitatory materials, and through this method individuals can bring their physiological arousal and affect back to optimal, comfortable levels." To understand what students would like to see on a weekly basis, we created fourteen "exciting" activity videos over the course of the fourteen weeks of the summer semester. By analyzing which videos generated the most online viewing, we learned what kind of content is most likely to appeal to the student body. The long term purpose of this study was to map the media consumption habits of the student body that can be most readily tapped by Studio76. Our analysis found that creating visually exciting videos helped to create an engaging experience for the student body, one in which we gained 7,000 views on YouTube, with more subscribers and followers on Facebook gained in the 14-week period of this study when compared with the studio direction of the summer prior.

Another unexpected and positive finding is that the summer videos helped to increase the brand awareness of Studio76 at an accelerated rate, giving us an effective platform to show off our work to the student body for the fall semester.

Introduction

In order to rebrand the studio, we first had to answer the question, "What content will increase viewership on Studio76's YouTube channel among the student body?" We have conducted interviews among a sample of the student body to find out what type of programming they are interested in, and a majority of them would like to see something more entertaining than news alone. Illinois State University holds what they call "Preview Week" which allows for incoming freshman to walk the halls of the university, participate in various activities, and view programming of their choice on the campus television station (Fabich, 2012). This is done to not only allow students to view the content that will be released, but also to see what content will be successful with the given demographic. Devin Graham is a videographer in Provo, Utah that has succeeded in both creating great content in a timely fashion and driving up viewership on his personal YouTube channel, thus generating a large following (Graham, 2011). We wished to emulate both of these entities for not only the upcoming school year but to blaze the trail for years to come.

The objective was to produce content to which the students at Weber State University could relate and find entertaining. Beyond that, the research project hoped to create content that future students would find interesting and entertaining, and that they wish to be a part of as well. This project would fund one of our key ideas: coordinate with the Student Involvement and Leadership office to create 14 weeks of summer fun. The idea was to have one big weekly activity on or around campus planned and implemented by myself and the volunteers of the research project. Studio76

would come in to film the activity and edit it in such a way that looks appealing and fun for the audience. A series of videos were produced for the 14 week summer semester, or for each of the two, seven-week blocks.

Methods

The first step in the project was to brainstorm the 14 different activities to be filmed. Each event would take place between Thursday and Friday of the week during the summer semester, to be edited the following day and shared the following Tuesday. The project started the week of May 7, 2012 as to coordinate with the start of the summer semester and ended August 8, 2012, the conclusion of the same semester. After each event had taken place for the week, promotion started through various social networking mediums for the event that followed the next week.

The next step, after the events were planned and placed on the calendar, was to assemble the staff assigned to film and edit the video that coincides with the event. These team members discussed which shots to take and where. They also discussed and brainstormed what the final product would look like as well as how it should translate to the student body. Storyboards were created to make sure the feel and style of the particular video are met.

The third step was filming the event. To do this, staff members were assigned certain tasks such as filming, handling equipment, and coordinating team members to their assigned responsibilities. The team then took inventory on all equipment that was planned on being utilized, as well as made sure all equipment involved was in working order. If any additional equipment was required for the shoot, adjustments were made accordingly. The team then took the equipment to the activity site, set up in all planned locations according to the storyboard, and started rolling video to capture all of the action.

The final step in the process was to digitize all video

to a computer with the necessary software, and go through which shots were to be used. After the video was edited, it was distributed through different social networks such as YouTube, Twitter , Facebook, and any other Studio76-run websites. We encouraged students to get involved with this aspect of the project to help spread the word about the content that was produced in hopes of creating a following.

Results

After creating 14 videos over the course of the summer semester, our results were eye opening. Through the use of YouTube's built-in analytic tools, it was discovered that we pulled in 6,391 views over the 14-week semester, as shown in figure 1.1.

Figure 1.1

We also gained 21 new subscribers, had 89 overall likes, 10 dislikes, 22 comments, 78 shares and 7 favorite interactions.

These numbers are a significant increase to the summer before when the studio operated under the name of Weber State News (WSN), which mostly produced news content. As shown in figure 1.2, we see when the studio operated as WSN that the overall views for the summer were only 4,394. Most of those views came from a single highlight video of

Tim Toone, a Weber State football player that was drafted by the Detroit Lions that year.

Figure 1.2

The number of likes for WSN's channel for the 14-week semester was 23 with 0 dislikes, 10 overall comments, 14 shared videos, and a gain of 4 subscribers. It is important to note that WSN was not actively producing videos during this time.

When comparing the numbers from the two summers, we see a significant change in the traffic and overall viewership. Weber State News YouTube channel brought in only 4,394 views compared to Studio76's channel with 6,413; a difference of 2,019 views. The number of subscribers that Studio76 gained versus WSN was 17 for the 14-week block and the number of likes increased by 66. Overall shares between the channels was huge with Studio76 totaling 78 and WSN with zero. As for number of comments made through the summer semester run, Studio76 led the way with 22 over WSN's 10, a difference of 12. Where WSN took the lead was the number of videos favored at 14 and Studio76 having only seven.

If we take a closer look at the overall span of WSN's summer run, we see that the number of views peak at 87. For Studio76, the different content produced brought upwards of 430 views. Something else that is noted by the given

data is that the viewership on Studio76's YouTube channel is constant whereas WSN seems to be more sporadic throughout the summer semester as seen in figure 1.3.

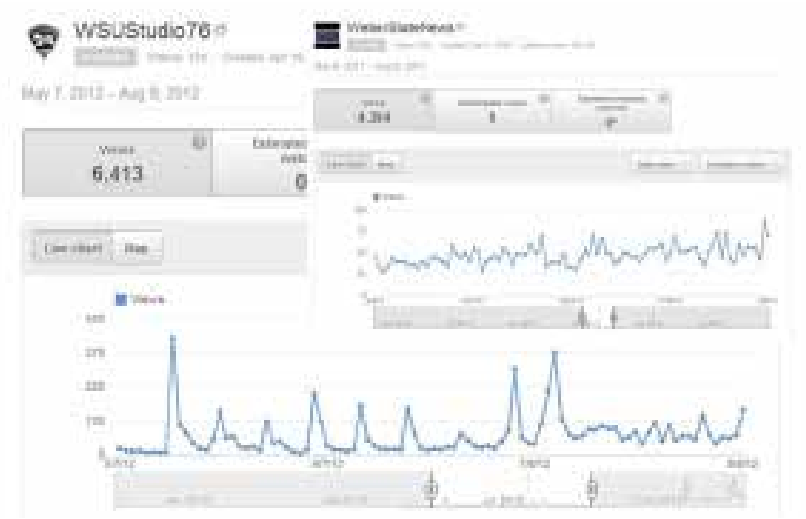

Figure 1.3

In summation, we can state that the overall project was a success in answering the question "What content will increase viewership on Studio76's YouTube channel among the student body?" We can see that we not only increased the overall number of views on Studio76's channel itself but the overall video's themselves with their different content pulled in a significant amount of views. Before, WSN could only bring in on a single video a grand total of 87 views while Studio76 brought in a total of 430. That data alone tells us that we succeeded in bringing in more viewers to watch our content.

Another unforeseen effect of producing these summer videos was that it built a launch pad of sorts for the following fall semester. By having an array of fun videos to show for welcome back week, it allowed us to show students the different content that we are capable of producing; this resulted in increasing our Facebook likes to well over 200 in

three short days; something that took the previously designed studio and its content an entire year to accomplish. It also resulted in doubling the amount of students taking the courses involved with creating content for the studio from 15 to 30.

Conclusion

Studio76 set out to create a new name for itself in the summer of 2012. With Weber State News becoming a show that the studio only produces for The Signpost, we now have the freedom to allow for students to have a more creative outlet for production of content of their choosing. When it comes to the content that the student body wishes to see, we simply found that anything outside of news broadcasts is acceptable among the population at Weber State University. We now have eight different shows that are produced and released every other week. This has helped increase the class size and student participation and is helping create the new Studio76 brand.

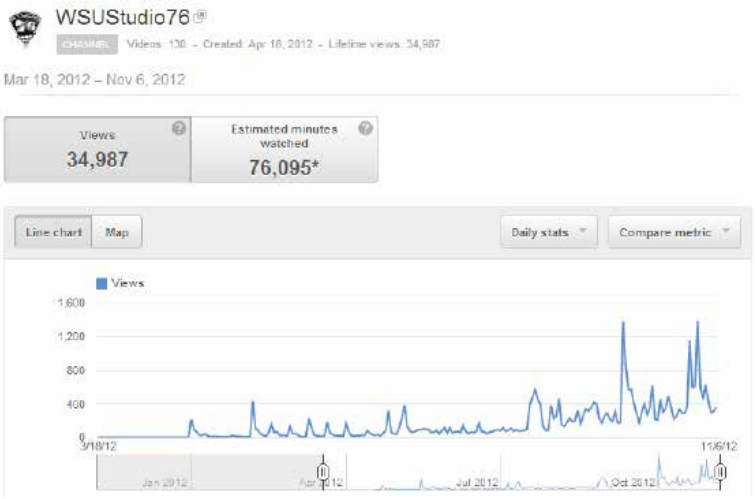

Figure 1.4

As you can see in figure 1.4, branching off into producing new content has increased Studio76's overall lifetime views

to 34,987 views in only 6 months. By producing the 14 weeks of summer videos, we were able to create a platform for students to see the type of work Studio76 is capable of producing, much like what Illinois State News does at the start of every semester. By merging Weber State News with The Signpost, those seeking to have a more creative outlet to produce content outside of newscasts now have the chance to do so. Furthermore, Studio76 now has a baseline of what students at Weber State University want to see when it comes to video content.

Referring back to the Uses and Gratifications theory as it relates to user-generated content: I would assert from this research that while trying to gain an understanding of how and why consumers partake of user-generated content, such as YouTube and Facebook, the producer of such content will come to a self-actualization of what they wish to produce. Rather than trying to find out what a particular audience might want to view, an organization, such as a broadcast station or other university student ran media group like Studio76, will gain an understanding of what content they are capable of producing that might also appeal to a certain audience. Other organizations in similar situations could apply this study to help gain an understanding of what their capabilities are when it comes to producing content. The positive side to our approach in this study is that one can experiment with what they would like to produce while attempting to gain the attention of their prospective audience. The negative side to this approach is that one might not produce content that the particular audience they are trying to reach will like.

With regards to the content, we can conclude that producing anything outside of a traditional newscast grabs the attention of the student body at Weber State University. While we did not pinpoint if it was producing content that was newsworthy, related to fashion, funny, or scary that drew in more viewers, we can conclude that content other

than traditional newscasts grabs the attention of the student body at Weber State University, and brings in more traffic to our social media websites.

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Microbiology

Isolation and Characterization of Novel Bacteriophage from the Great Salt Lake that Infect Halomonas

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Mentor: Michele Culumber, Matthew J. Domek & Craig Oberg

Abstract

Bacteriophages in aquatic environments play a significant role in bacteria population control, as well as recycling nutrients. The bacterial genus Halomonas is commonly found in the Great Salt Lake (GSL), but very little is known concerning its population dynamics. This euryhalophilic genus is highly versatile concerning its ability to grow in a wide range of substrates and environmental conditions including salt concentration. To better understand GSL microbial ecology, seven strains of Halomonas were isolated from the GSL and identified using 16S rRNA. Samples of South Arm GSL water were filtered twice through a 0.2 µm filter, and tested against these Halomonas strains using soft agar overlays to detect Halomonas phages. Four strains exhibited plaque formation indicating the presence of phages. Halomonas phage isolates produced very small plaques, sometimes barely visible. Individual phages were isolated by vortexing agar plugs taken from single plaques in sterile saline then filtering the solution through a 0.2 µm filter. From host range streak plates, a single phage isolate (LJ17) appears to infect four closely related Halomonas strains. Electron micrographs of LJ17 phage indicate it has a small icosahedral head and perhaps a very

short tail. There also appears to be a satellite phage that may be associated with LJ17. There are no reports of Halomonas phages isolated from the Great Salt Lake (GSL), although there are phages found for marine Halomonas strains. Successful isolation and characterization of novel GSL Halomonas phages, besides being critical for development of host/phage models, will also allow studies of GSL microbial ecology.

Introduction

The Great Salt Lake (GSL) is a naturally occurring hypersaline environment containing a wide diversity of halophilic microorganisms (Post, 1977). The lake has a high concentration (from 12-26% depending on location and season) of salts with sodium chloride (NaCl) predominating, along with a high concentration of nutrients, which allow for high concentrations of halophilic microorganisms. These microorganisms make a significant contribution to the lake's natural ecological balance by forming the base of the food chain, acting as decomposers, and helping to recycle basic nutrients (Dyall-Smith, 2005). Even though these organisms can play an important role in determining the microbial ecology of the GSL, not many have been isolated and characterized. The GSL is a unique environment for scientific discovery. Consequently, knowledge of its microbiota is critical for the continued understanding of this system.

The bacterial genus Halomonas is commonly found in the GSL (Baxter et al., 2005). Halomonas are gamma-proteobacteria that are highly versatile in terms of their ability to grow successfully in a wide variety of saline environments. Halomonas are gram-negative, rod-shaped bacteria that are motile utilizing either polar or lateral flagella (Lee et al., 2005). It has been thought that this bacterial genus could be used to produce industrially important compounds, since they metabolize starch-derived materials as substrates (Quillaguaman et al., 2005). Bacteriophage are viruses that exclusively infect bacteria

and are ubiquitous in the environment. There are currently no reports of bacteriophage (phage) isolated from the Great Salt Lake (GSL) that infect Halomonas. Bacteriophages play an important role in controlling bacterial populations, while also allowing for lateral gene transfer. Phage control of bacterial populations is important in the GSL since there are no known protozoal grazing (Post 1977), and because phage predation modulates bacterial host populations which can affect nutrient availability, which keeps the microbial community diverse.

The purpose of this research is to isolate and morphologically characterize bacteriophage that infects Halomonas previously isolated from the GSL. Phage isolates will be used in the development of the host/phage model systems that could be used in ecological studies, and used to compare other marine isolates.

Methods

Media Preparation

A Halophile agar (HB agar) was prepared using the following formula: 50 g NaCl; 25 g MgSO4•7H2O; 5 g casamino acids; 5 g yeast extract; 2.5 g proteose peptone; 3 g trisodium citrate; 2 g KCl; 15 g agar per liter of distilled water (Atlas, 1993). A Halophile broth (HB) was prepared with the same formula, without agar. For soft agar, the agar concentration was changed to 0.5%. The pH for all media was brought to 7.2 ± 0.2 before it was sterilized.

Culture Identification- 16S rRNA Gene Sequencing

DNA was extracted from the isolates using the MoBio Ultra Clean Microbial DNA Extraction Kit (MoBio, Carlsbad, CA). The 16S rRNA gene was amplified using bacteria specific primers (27F 5' AGA GTT TGA TCM TGG CTC AG 3' / 1492R 5' ACG GYT ACC TTG TTA CGA CTT 3'). The reaction mixture contained 200 nM of each primer, 200 μm of the dNTPs, 1U DNA Taq Polymerase and the diluted reaction

buffer (Promega Corp., Madison, WI). The amplification parameters were 94˚C for 3 min., followed by 25 cycles of 94˚C for 45 sec., 50˚C for 1 min., 72˚C for 2 min., and a final extension step at 72˚C for 7 min. Sequencing was done by the Idaho State University Molecular Research Core Facility (Pocatello, ID). The sequences were compared to the GenBank database using the BLAST search tool.

Bacteriophage Isolation

Water from the South Arm of The Great Salt Lake was taken and filtered twice through a 0.22 µm filter. A 50 mL sample of the filtered water was put into a 250 mL flask containing 100 mL broth solution and inoculated with 1.0 mL of fresh Halomonas culture. This was done 6 times for the 6 strains of Halomonas; 23, 25, 26, 31, 32, and 34. The flasks were stored in a shaker at 30°C. A 2.0 mL sample of each flask was taken after 48 hours and filtered through a 0.22 µm syringe filter.

Host Range Determination

The filtrate was tested for bacteriophage by creating a spread plate of each Halomonas strain and spotting each of the 6 phage filtrates onto each plate. Plates were incubated at 30°C for 48 hours and checked for zones of clearing (plaques) indicating bacterial lysis due to phage infection. The plates that exhibited phage activity had agar plugs taken from the plaque's center and put in an 8% saline solution and stored for 24 hours at 5°C. The saline solution was then filtered through a 0.22 µm syringe filter and kept in a microfuge tube at 5°C.

Enrichment of Bacteriophage

Phage enrichment was performed by combining 50 mL of 2X HB broth, 1 mL of Halomonas host culture, and 50 mL of previously filtered saline solution suspected of containing phage into a sterile 250 mL flask. This was done for each of the hosts where a plaque had been formed in the initial

isolation. These flasks were kept incubated in a shaker at 30°C for 48 hours. The samples were then filtered twice through a 0.22 μm filter and refrigerated.

Phage Purification

Phage were purified by combining 30 mL of phage stock with 7.5 mL of 20% PEG-8000. The mixture was incubated on ice for 30 min and centrifuged at 11,000 x G for 20 min. The supernatant was removed and the tubes were centrifuged 2 more times to remove all of the PEG solution. The pellet was resuspended in an appropriate volume (500-1000 μl) of STE (Sambrook et al., 1989), transferred to a microfuge tube, and centrifuged at 14,000 x G for 10 min. The supernatant was then transferred to a new microfuge tube and stored for TEM samples or for DNA isolation (Sambrook et al, 1989).

Imaging of Bacteriophage LJ17

The LJ17 enrichment filtrate was dispensed on a formvar copper grid and treated with 3% uranyl acetate. Transmission Electron Microscopy (TEM) was performed by Dr. David M. Belnap at the TEM CORE facility at the School of Medicine, University of Utah.

Results

After carefully examining all potential phage isolates, a single bacteriophage was confirmed. This phage (LJ17) infected four strains of Halomonas (Figure 3). The relatedness of the infected and uninfected strains of Halomonas are compared phylogenetically (Figure 1). The sequences suggest that we are working with several subspecies of Halomonas saccharevitans, Halomonas denitrificans, Halomonas ventosae, and Halomonas alkaliphilia (Figure 1). The hosts that became infected with the bacteriophage were SA23, SA25, SA26, and SA31 (Figure 3). According to the 16s rRNA sequence, SA34 and SA26 appear to be the same organism, however SA34 was not infected by LJ17,

while SA26 was infected by LJ17. This is not uncommon as previous work in our laboratory showed that nearly identical strains of Idiomarina isolated from the GSL each hosted a separate phage that did not infect the other 3 strains.

At the beginning of the project, a 12% NaCl concentration was used in all media. Under this condition, LJ17 plaques appeared as very small pinpoint plaques. When the salt concentration was adjusted to 5%, the plaques became larger and more visible (Figure 4).

Electron micrographs of LJ17 phage indicate it has a small icosahedral head and perhaps a very short tail. Several micrographs of LJ17 also showed that there may be a smaller satellite virus (30 nm or smaller) associated with a larger virus of approximately 40 nm (Figure 2). Other micrographs only show an icosahedral shaped particle in the 40 nm range.

Discussion

This is the first report of multiple strains of Halomonas isolated from the GSL and compared phylogenetically. It is also the first report of a phage isolated from the GSL that infect halophilic Halomonas isolates. While other icosahedral-shaped phage have been isolated from the GSL that infect Salinivibrio (Savage et al., 2009), this phage is smaller and does not appear to have a long tail representative of previously imaged phage. Since the plaque size increased in diameter after lowering the media's salt concentration, this would suggest that salt concentration either has an affect the host receptor site, or affects the bacteriophage's pathogenicity in some way. Additional studies are needed in order to conclusively determine how changes in salt concentrations affect plaque size. This is particularly relevant since variations in salt concentration are found within the South Arm of the GSL.

Bacteriophage, such as LJ17, are likely important for controlling the population sizes of halophilic microorganisms in the GSL (Rodriguez-Brito, et al., 2010). Other than brine

shrimp (Artemia salina), GSL microorganisms have few predators, so phage are likely important for the recycling of nutrients stored in the microbial biomass. The development of another host/phage model that utilizes a very common halophilic bacteria from the GSL will certainly make possible future studies of the microbial ecology of the lake and provides an unique new phage for comparative studies with marine phage that infect Halomonas.

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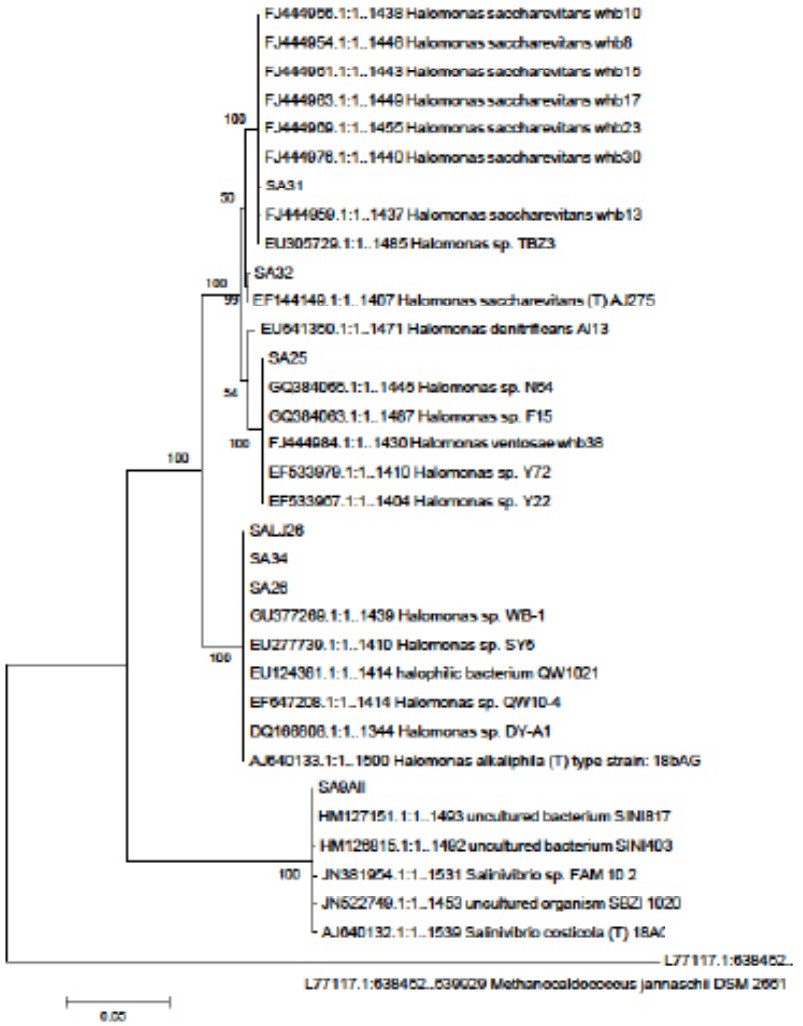

Figure 1: The phylogenetic tree showing relatedness of Halomonas strains.

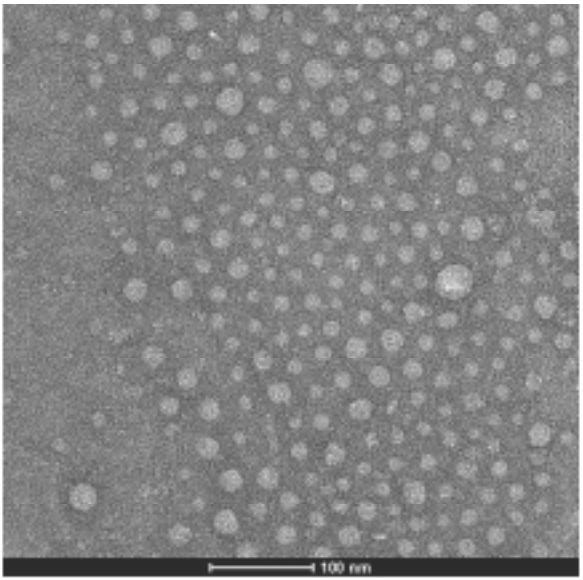

Figure 2: A TEM micrograph of LJ17 and possible associated satellite virus.

Figure 3: A plate showing infection in hosts 23, 25, 26, and 31 (top 3 and bottom left, in that order).

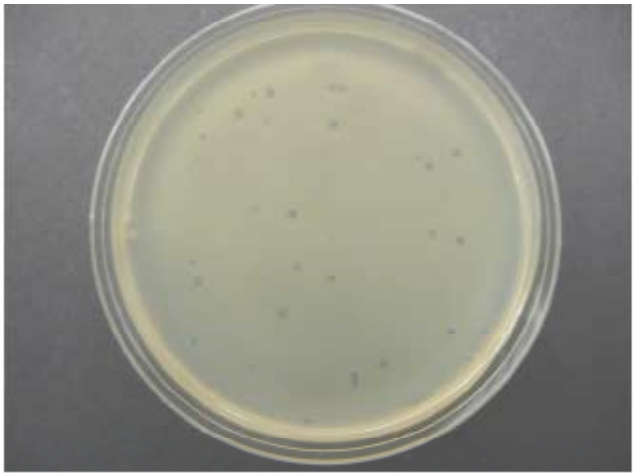

Figure 4: LJ 17 Plaque formation in a 5% NaCl overlay agar.

Occurrence of Bacteria on Fomites in a University Athletic Setting

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Abstract

Fomites serve as transmission vehicles to spread disease-causing microorganisms among individuals. Student-athletes who participate in contact sports, like football, are particularly at increased risk for acquiring Staphylococcus, respiratory, enteric, and even MRSA infections. A variety of surfaces that student-athletes come in contact with on a day-to-day basis were tested for total bacterial load, along with Staphylococcus and coliforms. Surfaces included taping and treatment tables, muscle stimulation pads, ultrasound heads, weight lifting equipment, tape cutters, keypads, ice machines and helmets. VJ agar was used to isolate staphylococci, EMB agar to isolate coliforms, and TSA agar was used to obtain total bacterial counts. A 5 x 5 cm area was swabbed, diluted, and plated on each media, with solid surfaces also sampled using Rodac contact plates. All plates were incubated at 37°C for 72 hours. Coliform counts increased on taping and treatment tables during use each day until cleaning was done that evening. Very few organisms could be isolated from muscle stimulation pads, even after 10 individual uses. Footballs, door keypads, tape cutters, weight bars, and helmets had the highest recovery of organisms including coliforms. Staphylococcus was recovered from tape cutters, helmets, keypads and

footballs. Items generally overlooked for regular cleaning had higher microbial loads including potential pathogens. Results suggest that targeted cleaning of fomites routinely handled by student-athletes could reduce transmission of pathogens, and suggest microbial screening of high use fomites and locations be performed to establish more effective cleaning procedures.

Introduction

Fomites are surfaces or objects that can become contaminated with pathogenic microorganisms, thus serving as transmission vehicles to spread these organisms among individuals. There is now growing evidence that fomites contaminated with pathogenic microorganisms play a key role in the spread of infections (Reynolds et al., 2005; Boone and Gerba, 2007). Causes of reported outbreaks among athletes include Staphylococcus aureus, herpes simplex virus, Streptococcus pyrogenes, and several fungi (Rihn et al., 2005). The overall spread of Staphylococcus, respiratory infections, and enteric infections have steadily increased over time, including in athletic settings (Cohen, 2005).

Athletes participating in contact sports have a higher risk of acquiring methicillin-resistant Staphylococcus aureus (MRSA) and other pathogenic bacteria, and football players have been shown to carry S. aureus more frequently than control groups (Oller et al., 2010). Clusters of cases in various athletic teams have been reported since 1993 in the Unites States and more recently in Canada (Benjamin et al., 2007). Despite a recent increase in reported outbreaks of community-acquired MRSA (CA-MRSA) in athletic teams, very little screening or preventative measures have been instituted (Rihn et al., 2005). Miller and Diep (2008) found that besides the common nasal aerosol transmission route, skin-skin and skin-fomite contact represent important and alternative routes of acquisition of CA-MRSA. Recommendations for control include good hygiene, prompt identification of infections, limited exposure to infected

persons and contaminated objects, and proper treatment combined with close follow-up of infected athletes (Benjamin et al., 2007).

Risk factors associated with student-athletes include frequent antibiotic use, direct skin contact, frequent contact with shared items (footballs, weight bars, tape cutters, treatment tables, etc.), and lack of personal hygiene. This study provides information on the occurrence of potential pathogens on fomites in an athletic setting. It also examines the occurrence of antibiotic resistant Staphylococcus aureus among commonly shared objects among student-athletes.

Methods

Treatment/Taping Tables

Samples were taken from two treatment tables and two taping tables using Tryptic Soy Agar (TSA) and Eosin Methylene Blue Agar (EMB) Rodac plates. The agar surface area for a Rodac plate is 25 cm2. Prior to testing, tables were thoroughly cleaned with alcohol. Initial samples were taken from three different locations on each table representative of anatomical locations (top-head, middle-buttocks, and bottom-feet). Samples were then taken at these same locations four hours after cleaning, eight hours after cleaning, and 24 hours after cleaning. Total CFUs were counted and then compared for each time interval. Two replicates were done for the two training tables, but only one replicate for the two taping tables.

Muscle Stem Pads

The presence of bacteria on muscle stem pads was examined for individual pads after 0, 5, or 10 uses. Following the requisite number of uses, pads were stomached for four minutes at 260 rpm in 99 ml of saline solution in a Sewell Stomacher. Plate counts were done by plating one ml of the resulting diluent for both EMB and TSA pour plates. In addition, 0.3 ml of diluent was put onto each of three Vogel

and Johnson agar (VJ) pour plates with the number of CFUs on the three plates added together for a total count per 1 ml of diluent. This was done to accurately sample the lowest dilution possible. Samples were plated in duplicate.

Fomite Sampling

Helmets, keypads, tape cutters, shoulder pads, weights, and a steam pack were tested for the presence of S. aureus and, more specifically, for MRSA. Samples were taken from these items using TSA, EMB, and VJ Rodac plates, as well as by swabbing using 3M™ Quick Swabs. The swab solution (1.0 ml) was diluted into 9 ml sterile distilled water dilution blanks. This diluent solution (0.1 ml) was spread on TSA, EMB, and VJ plates in triplicate.

Isolation and Characterization of Staphylococcus

Representative colonies from the VJ Rodac plates and VJ spread plates were streaked for individual colony isolation onto VJ agar plates. Isolated colonies were gram-stained and gram-positive coccal isolates were used for the reminder of the testing. A coagulase test was then performed on these isolates by mixing a single colony, removed by a sterilized loop, in a sterile tube with 2 ml of coagulase reagent. Following this, the isolates were streaked onto Mannitol Salt Agar (MSA) plates to determine if they were salt tolerant, mannitol fermenters, indicative of S. aureus. A BD Sensi-Disc™ Methicillin Resistance screening of Staphylococcus isolates was performed using antibiotic discs. Finally, A Penicillin-Binding Protein (PBP2') Latex Agglutination test (Oxoid Inc.) was then performed following the manufacturer's protocol on the S. aureus positive colonies to identify methicillin-resistant (potential MRSA) organisms.

Results

The muscle stimulation pads did not show a significant increase in bacterial load based on the number of uses. Very

few organisms could be isolated from muscle stimulation pads, even after 10 individual uses (Table 1). Bacteria, including coliforms, were recovered from both treatment tables sampled. Bacterial counts increased throughout the day, unless routine cleaning was performed as seen on Treatment Table 1 (Table 2). Coliform counts increased on taping and treatment tables during use each day until cleaning was done that evening (Figure 1). The taping tables that were sampled also showed an increase in bacterial load over time. Coliforms, however, were difficult to isolate even after prolonged use (Table 3). Footballs, door keypads, tape cutters, weight bars, and helmets had the highest recovery of organisms including coliforms when either Rodac plates (Table 4) or swabs were used for testing (Table 5). Staphylococcus was recovered from various items including tape cutters, helmets, shoulder pads, keypads, footballs, and weight bars (Figures 2 and 3). Fomites that received regular cleaning had reduced microbial loads, but counts increased with use during the day. Three isolates of methicillin-resistant Staphylococcus (MRSA) were isolated from shoulder pads, a football, and a weight bar (Figures 3 and 4). Each isolate was coagulase negative. The zone of diameter indicative of antibiotic resistant, coagulase negative Staphylococcus for oxacillin is greater than or equal to 17mm. The zones were measured at 24mm for the shoulder pads, 13mm for the weight bar, and 23mm for the football. The latex agglutination test showed positive results for the latex binding protein.

Conclusions

This study found that potential pathogens could be isolated from a wide variety of fomites that student-athletes routinely utilize. Training and taping tables that received regular cleaning had reduced microbial loads, but their microbial load increased with use during the day. Fomites generally overlooked for regular cleaning, such as tape

cutters, had higher microbial loads including the presence of potential pathogens. Our results suggest that targeted cleaning of fomites routinely handled by student-athletes could reduce possible transmission of pathogens. In addition, microbial screening of high use fomites and locations should be routinely performed to establish, and then confirm, more effective cleaning procedures.

Staphylococcus aureus can cause serious infections in student-athletes and these infections can spread from one athlete to another. MRSA bacteria pose a larger threat due to the resistance of the bacteria to many antibiotics, making these infections more difficult to treat (Benjamin et al., 2007). Our results show the presence of MRSA bacteria in a typical athletic setting. Based on these results, trainers and student-athletes should take precautions to clean all equipment and surfaces used by student-athletes as well as having student-athletes regularly wash hands and observe good personal hygiene in order to prevent infection and the spread of organisms between student-athletes. These suggestions reinforce and expand those of Benjamin et al. (2007) who suggest that universal education is needed for all athletes and personnel who provide care in the athletic setting to help control this increasing health problem.

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Table 1: Bacterial Analysis of Muscle Stimulation Pads Using Selective Media (CFU/pad)

Number of Uses	TSA	EMB	VJ
0	6	0	0.67
5	6.3[a]	1[a]	0[a]
10	7.25[b]	0.33[b]	0.08[b]

[a] average of 2 pads
[b] average of 4 pads

Table 2: Bacterial Analysis of Treatment Tables Using Selective Media

Treatment Table 1								
	Initial		12:30 PM		4:30 PM		8:30 AM	
	TSA	EMB	TSA	EMB	TSA	EMB	TSA	EMB
Top	0*	0	11	1	0	0	5	1
Middle	0	5	7	4	0	0	8	0
Bottom	0	0	>300	3	0	0	6	1
Treatment Table 2								
	Initial		12:30 PM		4:30 PM		8:30 AM	
	TSA	EMB	TSA	EMB	TSA	EMB	TSA	EMB
Top	0	0	12	2	>300	17	5	3
Middle	0	0	7	2	18	10	10	9
Bottom	0	1	12	17	32	23	4	2

*CFU count per Rodac plate (plate area = 25 cm²)

Table 3: Bacterial Analysis of Taping Tables Using Selective Media

Taping Table 1								
Sample Location	0 hours		4 hours		8 hours		24 hours	
	TSA	EMB	TSA	EMB	TSA	EMB	TSA	EMB
Middle	0*	0	1	0	2	0	26	0
Bottom	0	0	2	0	24	0	13	2
Taping Table 2								
Sample Location	0 hours		4 hours		8 hours		24 hours	
	TSA	EMB	TSA	EMB	TSA	EMB	TSA	EMB
Middle	0	0	2	0	22	0	13	0
Bottom	0	0	0	0	0	0	2	2

*CFU count per Rodac plate (plate area = 25 cm^2)

Table 4: Bacterial Analysis of Selected Athletic Fomites Using Rodac Plates1 containing Selective Media.
-Averages of two helmets, two locations on icebox, and three weights.

	TSA	EMB	VJ
Helmet - Ear	27.33	0.67	0.5
Helmet - Forehead	11.5	0.5	0.75
Icebox	0.33	0	0
Weight	11.67	0.33	4.67

[1] CFU count per Rodac plate (plate area = 25 cm^2)

Table 5. Bacterial Analysis1 of Selected Athletic Fomites Using Swabs and Selective Media.
-Averages of two helmets, two keypads, two tape cutters, two shoulder pads, one steam pack, two medicine balls, one icebox, one football, one weight bar, and three weights.

Item Swabbed	TSA	EMB	VJ
Helmet-Ear	16	0	4.5
Helmet-Forehead	0.75	0.5	0.25
Helmet-Chin	69.5	0.5	0
Keypad	129.67	23.5	4.67
Tape Cutter	>300	24.6	>300
Shoulder Pads	>300	0	77
Steam Pack	1	0	0
Medicine Ball	8	0	0.33
Ice Box	0	3	1
Football	>300	73	6
Weight Bar	31	0	2
Weight	25	0	0

[1]CFU/10 cm[2]

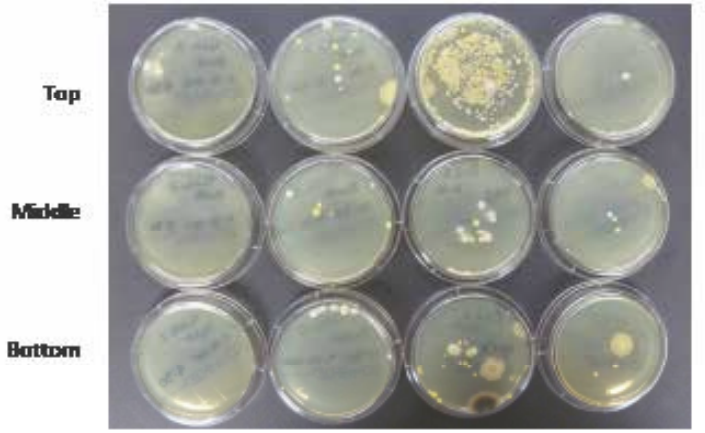


Figure 1: Representative Rodac Plates from Treatment Tables.

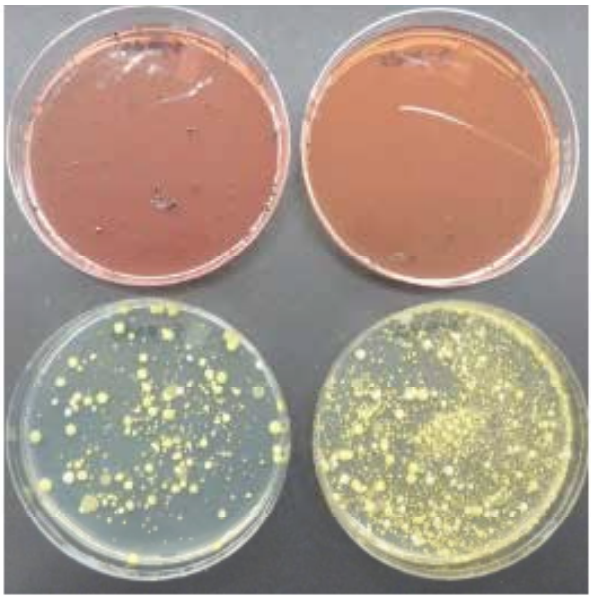


Figure 2: TSA and VJ Agar Plates of Swab samples taken from Shoulder Pads. Staphylococcus isolates appear as black colonies on VJ agar (top 2 plates).

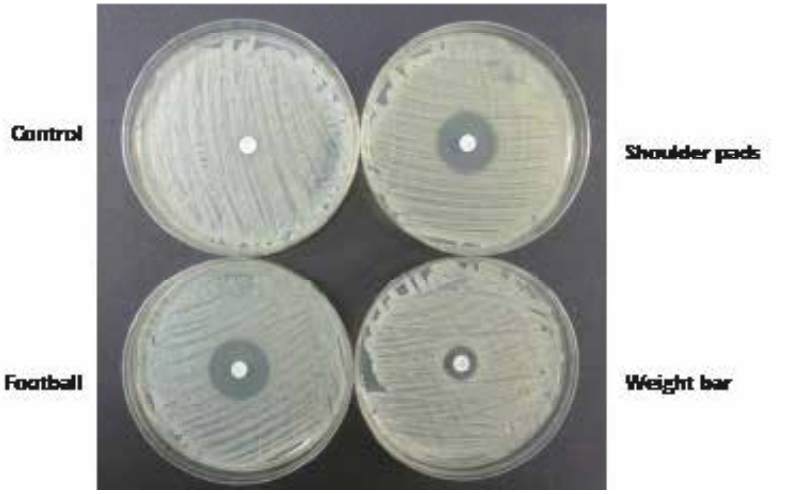
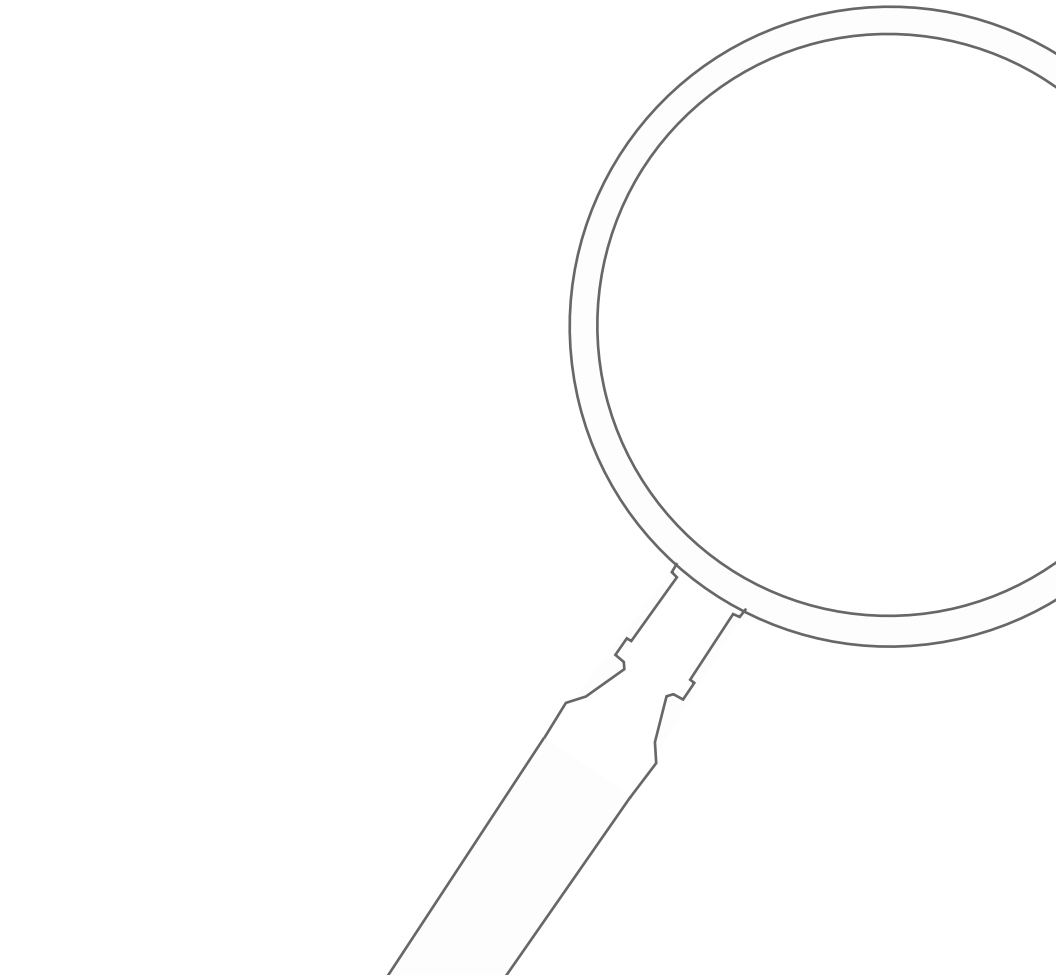


Figure 3: Sensi-disc oxacillin resistance screening of Staphylococcus isolates. Zones of clearing indicate increased sensitivity to oxacillin. Diameter of zones: shoulder pads = 24mm, weight bar = 13mm, and football = 23mm.

Figure 4: Latex Agglutination Test to confirm MRSA isolates (agglutination alongside negative control shows a positive result). SC = shoulder pads control, ST = shoulder pads test, FC = football control, FT = football test, CC = control control, CT = control test, WC = weight bar control, WT = weight bar test.



Medical Laboratory Science

Erythrocyte Sedimentation Rate and C-Reactive Protein Ordering among Physicians

Authors: Annie Banz, David McAdams & Taylor Norton
Mentor: Travis Price

Abstract

The aim of this research is to determine the factors that influence physicians' decisions when ordering tests for inflammatory response. Currently, two common methods used to measure inflammation are the C-reactive protein assay (CRP) and the Erythrocyte Sedimentation Rate (ESR). There appears to be a lack of consistency in the ordering of these tests by physicians of multiple specialties. The primary goal of this study, therefore, is to identify the source of these apparent inconsistencies.

Emergency Room, Urgent Care, and Primary Care physicians will be surveyed to determine what their ordering practices are and why they follow those practices. In order to receive comparable data the survey will be standardized with Likert scale-type questions. Identifying which factors influence physicians' decisions when ordering inflammatory tests and using these to design an ordering protocol could help eliminate extraneous testing and save the patient time and money.

Introduction

Inflammation is a physiological response to tissue injury and infection. Cells at the site of injury excrete chemical messengers, called cytokines, which form chemical gradi-

ents. These concentration gradients cause leukocyte extravasation, where white blood cells move out of circulation and into the damaged tissue. These immune cells phagocytize bacteria, produce antibodies, remove harmful stimuli, and alter the environment to promote healing. This movement of cells and fluid results in the redness, warmth, swelling, and pain typically associated with inflammation.

Inflammation occurs in a variety of disease states, infections, and illnesses. It can be measured to assess the presence and extent of disease as well as monitor the response to medication. Many different laboratory tests have been used to quantify inflammation. Currently, two common methods used to measure inflammation in patients are the C-Reactive Protein assay (CRP) and the Erythrocyte Sedimentation Rate (ESR). Laboratory technicians perform the tests ordered by physicians and report the results to the ordering physician.

The traditional Westergren method of performing the ESR measures how red blood cells settle out of plasma over the course of an hour. Inflammation causes a change in the concentration of certain acute phase proteins, which allows greater erythrocyte aggregation. This aggregation forms clumps of cells and rouleaux which settle more quickly than individual cells and give an increased measurement.

In contrast to the ESR, which measures the combined effect of many acute phase proteins, the CRP assay quantifies one specific protein. This C-reactive protein is an acute phase protein produced by the liver. It binds to phosphocholine on dying cells and bacteria, which activates complement and enhances phagocytosis. The assay can be performed on an automated analyzer relatively quickly.

Among studies comparing the CRP assay and the ESR, there is some disagreement. While both are nonspecific indicators of inflammation, it has been proposed that the CRP is better at identifying the presence of inflammation. The ESR, however, is considered by some to be a better

measure of the severity of inflammation (International Committee for Standardization in Haematology (Expert Panel on Blood Rheology, 1988). Some studies suggest that the two tests should not be routinely ordered together since the results almost always correspond and any apparent discrepancies may lead to unnecessary procedures and cost (Colombet, 2010). These suggest that since either test is acceptable for indicating inflammation, only one need be ordered. Still other studies identify advantages of one test over the other (International Committee for Standardization in Haematology (Expert Panel on Blood Rheology, 1988) (Colombet, 2010) (Husain, 2002). These differences are often specific to the specialty or disease being considered. In such cases, the choice between ordering a CRP assay, an ESR, or both should be based on the situation.

In our laboratory experience in the Northern Utah area, we have noticed an apparent lack of consistency in the ordering of inflammation tests. These differences led us to question what factors, if any, influence the physician's choice when ordering inflammatory tests. We seek to understand the motivation behind their choices to see if the tests are being ordered unnecessarily or arbitrarily. If either test is acceptable, it saves resources to order only one. In cases where the tests may provide different information, we seek to determine what factors are taken into consideration. We will measure how different factors influence the choice of test through a survey distributed to local physicians. If there is no significant pattern in the ordering practices, we suggest that the implementation of an ordering protocol be considered.

Materials and Methods

To investigate the factors that influence inflammatory test ordering we surveyed Emergency Room, Urgent Care, and Primary Care physicians. In order to receive comparable data we standardized the survey using the Likert scale. We

suspected that some factors influencing the ordering include the length of time since the physician finished their residency, how frequently they read scientific journal articles, the suspected diagnosis or patient symptoms, professional habit, original medical training, and turnaround time of the test. With the hope that more physicians would be willing to fill out a shorter survey, we formatted the survey so that the six questions fit on one printed page. The first two questions were demographic in nature and helped us sort and compare the data. The next two questions established the ordering practices of the physician. The remainder of the survey determined how influential each of the chosen factors was when ordering inflammatory tests.

After reviewing and editing the survey, we had a physician and other professionals examine it and make suggestions. Once the survey was complete, we distributed copies to clinics and hospitals in our area. We later returned to collect the completed surveys. We felt that by physically taking the surveys to the locations we would receive a greater response.

For analysis, we used a Chi squared test to see if there were areas where the responses did not follow an even distribution. Those areas with the greatest variation from the expected were then analyzed. Also, the factors marked as influencing the greatest percentage of physicians were analyzed.

Results

Chi squared analysis of the survey results indicated that all factors considered have a significant influence ($P<0.01$) on which inflammation test physicians order. Further comparison revealed that the two factors that most influenced the decision were diagnosis/symptoms of the patient, marked by ninety- three percent of physicians, and original medical training, marked by eighty-eight percent of physicians as either very much or somewhat influencing

their decision.

Of the physicians still in residency and those who have been out of residency for less than fifteen years, all indicated that their medical training influenced their decision. These indicated that age of the patient and hospital protocol had the least impact on their ordering. Seventy-two percent of physicians who finished residency fifteen or more years ago also indicated that training influenced their decision. These indicated that personal habit and hospital protocol had the least impact on their decision.

Discussion

The purpose of this research was to determine what influenced physicians' test ordering practices when dealing with suspected inflammation. The results from the physicians surveyed support our hypothesis that the ordering of inflammation testing is based on various factors and may benefit from standardization. Benefits from establishing new guidelines on test ordering in other circumstances have maintained consistent results while lowering the number tests ordered and the cost to patients (Mancuso, 1999).

The importance of training on the physicians' ordering practices suggests that implementing a standard protocol during training could be an effective method of affecting this change. The majority of physicians also indicated that the cost to the patient at least somewhat influences their decision. It has been shown that displaying the charges for diagnostic tests to ordering physicians significantly reduced the number of tests they ordered (William M. Tierney, 1990). The inclusion of test cost to requisition forms or programs could potentially decrease excess inflammation test orders.

Turnaround time is especially relevant for patients admitted to the hospital. Often, physicians rely on laboratory values as an indication that a patient is ready to be discharged. If inflammation is being routinely measured, a quicker turnaround time decreases the time a patient

spends waiting. For clinics and routine visits where results are not read immediately, this factor plays a smaller role.

The nineteen percent of physicians that routinely order both a CRP and ESR together was lower than we expected. Our hypothesis was that the majority of physicians were routinely ordering both tests together, resulting in unnecessary cost to the patient. Since the majority of physicians surveyed indicated that they base their decision on patient symptoms, at least some of these dual orders may be justified by the specific case. It appears that the routine, arbitrary ordering of both a CRP and an ESR is not as significant a problem as suspected.

Conclusion

Many factors are considered when physicians order tests for inflammation. The results of this survey show that these factors are weighed differently by individual physicians. Studies have found that changing hospital protocol and displaying cost to physicians when ordering tests have shown promise in reducing cost and waste while maintaining quality patient care. We suggest that establishing an ordering protocol based on the factors in our survey could homogenize inflammation test orders and minimize the cost to the patient.

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The purpose of this survey is to investigate discrepencies in the ordering of tests for inflammation.

purpose of this survey is to investigate discrepancies in the ordering of tests for inflammation. Thank you in advance for taking a minute or two to answer these questions.

1. **What is your primary specialty?**

   a) Emergency Medicine
   b) Family Practice
   c) Pediatrics
   d) Other_____

2. **How many years has it been since you finished medical residency? _____years (0 if still in residency)**

3. **How do you stay current in your field?**

   ☐ Attend conferences (how many did you attend last year?_____)
   ☐ Read journal articles (how many did you read last month?_____)
   ☐ Continuing education programs (how many hours of CE last month?_____)
   ☐ Other_____

4. **When a patient presents with potential inflammation or infection you:**

   ☐ Only order C-reactive Protein (CRP) assay
   ☐ Only order Erythrocyte Sedimentation Rate (ESR)
   ☐ Order both CRP and ESR
   ☐ Sometimes order CRP, sometimes order ESR
   ☐ Don't usually order inflammatory marker tests
   ☐ Order another test: Name of test _____

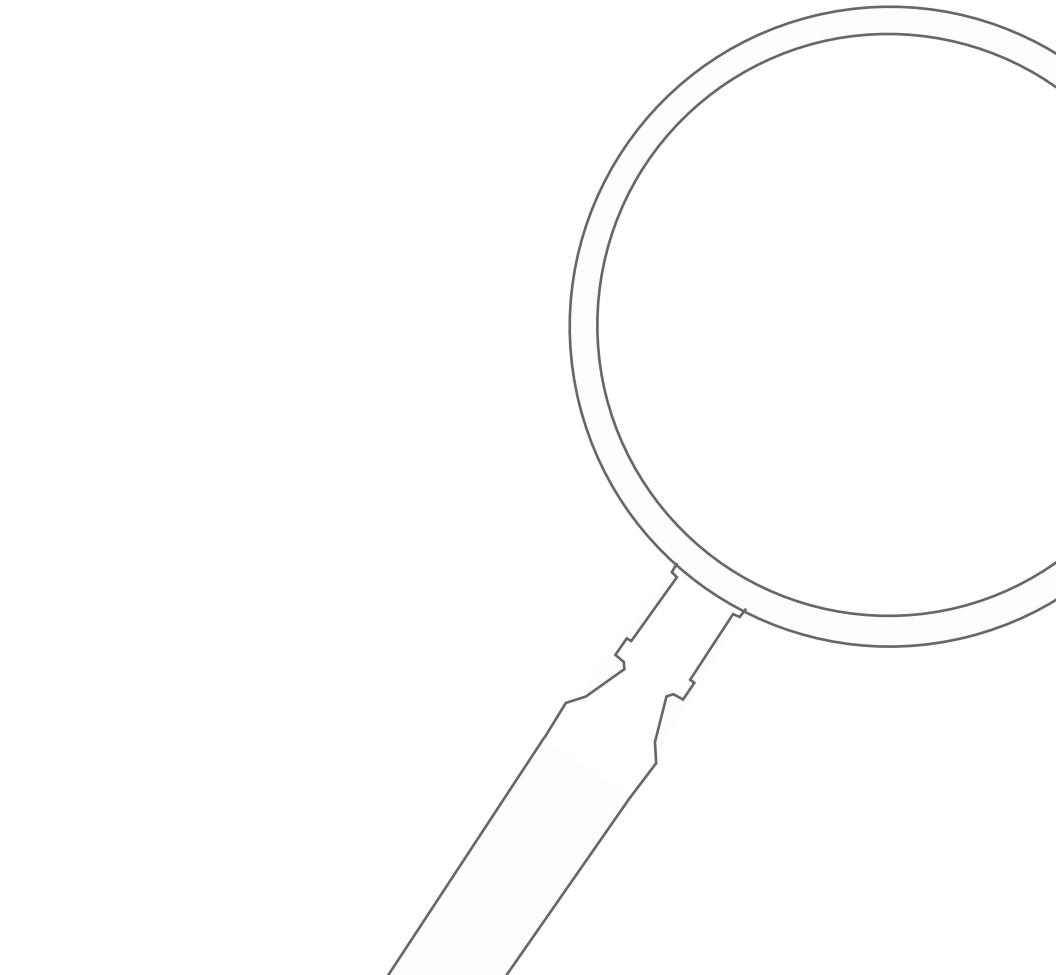
5. **In your opinion, what is the most significant difference between ESR and CRP?**

   ☐ One is better at measuring short term inflammation
   ☐ One is more sensitive (better able to detect a positive)
   ☐ The length of time required to get results
   ☐ The differences are not significant enough to influence ordering preference
   ☐ There is no difference

   Other difference _____

6. **Place a check mark in the box that best describes how much the following factors influence your decision when ordering tests for inflammation:**

	Very much influences my decision	Somewhat influences my decision	Slightly influences my decision	Does not influence my decision	Not applicable
Cost to the patient					
Turn-around Time					
Current literature					
The way I was trained					
Hospital protocol					
Age of the patient					
Habit of ordering test(s)					
Diagnosis and symptoms					
Familiarity with result interpretation					



Incorporation of Dietary Docosahexaenoic Acid with Dark Chocolate to Reduce Blood LDL Levels

Authors: Kenton Cummins, Ben Saxey & Anthony Zenger
Mentor: Leonard Gary

Abstract

The typical North American female diet contains very little fish, resulting in a deficiency of omega-3 fatty acids. Docosahexaenoic acid (DHA), an omega-3 fatty acid found in fish, has been associated with many beneficial effects. Women are encouraged to consume DHA partially due to the role it plays in fetal development. One mild disadvantage of DHA supplementation is a tendency for LDL levels to slightly increase, especially in hyperlipidemic subjects. Cocoa, the main component in dark chocolate, may reduce LDL cholesterol levels. This study determined if the LDL level increases caused by the ingestion of increased amounts of DHA can be counteracted by the effects of cocoa in females. Female participants were placed in either a group taking DHA supplement pills, or a group that took DHA supplement pills along with dark chocolate. Fasting whole blood samples were obtained and analyzed for triglyceride levels at specific intervals during our study. By measuring serum triglycerides of all the participants we can statistically correlate the effects of supplementing DHA with cocoa.

Introduction

North American female diets consist of a large amount of omega-6 fatty acids while having very little omega-3 fatty

acids. The typical ratio in these diets can be as high as 20:1 (omega-6: omega-3) when the recommended ratio is 2:1 (Mahan and Escott-Stump). In order to obtain enough DHA, women would need to consume at least 3 oz. of sardines or salmon every day. While omega-6 fatty acids are essential to a healthy diet, an excess has been associated with increased heart disease, obesity, and thrombotic strokes. DHA, an omega-3 fatty acid, has been associated with beneficial effects such as higher brain function, reduction of coronary heart disease, and serves as an important factor in neural development (Lein).

Although there are a plethora of benefits from DHA supplementation, some mild disadvantages are an increase in LDL oxidation susceptibility and a tendency for LDL levels to slightly increase, especially in hyperlipidemic subjects (Egert, et al, 2007). Early atherosclerosis has been linked to the formation of fatty streaks that form as a result to the uptake of oxidized LDL by macrophages and smooth muscle cells within the vasculature (Baba, et al., 2007). Cocoa in dark chocolate contains flavanols which are antioxidants that protect LDL particles from oxidation thus helping to prevent atherosclerosis (Fernandez-Murga et al, 2011). Cocoa has also been found to reduce levels of LDL as well as increase HDL cholesterol in normo- and hyperlipidemic subjects (Baba, et al., 2007). This study addressed the question of whether or not the intake of cocoa would counteract the increase of LDL levels caused by dietary supplementation of DHA in females.

Materials and Methods

Materials

The source of cocoa was a Brix (Napa Valley, CA) chocolate bar with 70% cacao content. The source of the DHA was the supplement “Brainstrong Adult” from i-Health (Cromwell, CT). This supplement contains 900mg per serving of a vegetarian DHA that is produced by the

microalgae Crypthecodinium cohnii.

Subjects

Thirty women were recruited from the campus of Weber State University in Ogden, Utah. All participants were healthy females with no history of disease. All were nonsmokers, had no or low alcohol consumption (< 2 drinks/day), had no previous gastrointestinal surgery, and had no current inflammatory disease. The study was approved by and performed under the guidelines of the Institutional Review Board. Informed consent was obtained from each of the subjects after oral and written information about the nature, purpose, possible risks, and benefits of the study were presented.

Experimental Design

Participants were randomly placed into two separate groups consisting of 15 women each. Group 1 was instructed to consume six DHA pills, totaling 1.8 g (Fernandez-Murga et al, 2011) every day. Group 2 was instructed to consume the six DHA pills along with approximately 38 g (Baba et al, 2007) of dark chocolate with 70% cacao. Participants in Group 2 were instructed to consume the dark chocolate at any time throughout the day, and to avoid dairy consumption within 3 hours of ingesting to maximize flavanol absorption. All participants were instructed to consume DHA pills postprandially. They were also instructed to maintain their normal diet for breakfast, lunch, dinner, and incidental foods but were advised to avoid fish and any foods that contain DHA and dark chocolate.

Measurement of Lipid Concentrations in Serum

Twelve-hour fasting serum samples were collected at 3 separate time points with a baseline at week 0, and the others at weeks 2 and 4. Samples were refrigerated and sent to the Intermountain Healthcare reference lab in Utah within

1-3 days. Samples were assayed for total triglycerides, total cholesterol, LDL, and HDL levels using an automated system. Two participants from Group 1 discontinued the study one week after baseline samples were taken, but neither reported adverse effects from the study.

Statistical Analysis

All statistical analyses were carried out using Microsoft Excel. A two-tailed unpaired t-test was used to compare the serum levels of LDL between the groups. Significance was determined at $P < 0.01$.

Results

Twenty-eight of the 30 recruited participants finished the study. Of the final fasting whole blood draw, 2 samples of the final 28 were unable to be processed. All samples were reported as fasting samples. The results of the triglyceride panels are shown (See figure 1). LDL levels increased in members of the chocolate group by an average of 7 mg/dL per two week period. LDL levels did not fluctuate in the non-chocolate group (See Figure 2). The results of the t-Test are that the calculated t-value (1.305) is less than the critical t-value (2.639). There is no statistically significant difference in the levels of LDL between the group taking the chocolate and the levels of the non-chocolate group. We were unable to find a significant correlation between the supplementation of dark chocolate, dietary DHA, and levels of LDL.

Table 1: Triglyceride Panel Results.

Baseline (Week 0)			
[redacted]	[redacted]	[redacted]	[redacted]
Chocolate	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]
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[redacted]	[redacted]	[redacted]	[redacted]
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[redacted]	[redacted]	[redacted]	[redacted]
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[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]
Non-chocolate			
[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]
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[redacted]	[redacted]	[redacted]	[redacted]
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[redacted]	[redacted]	[redacted]	[redacted]

Table 1: continued.

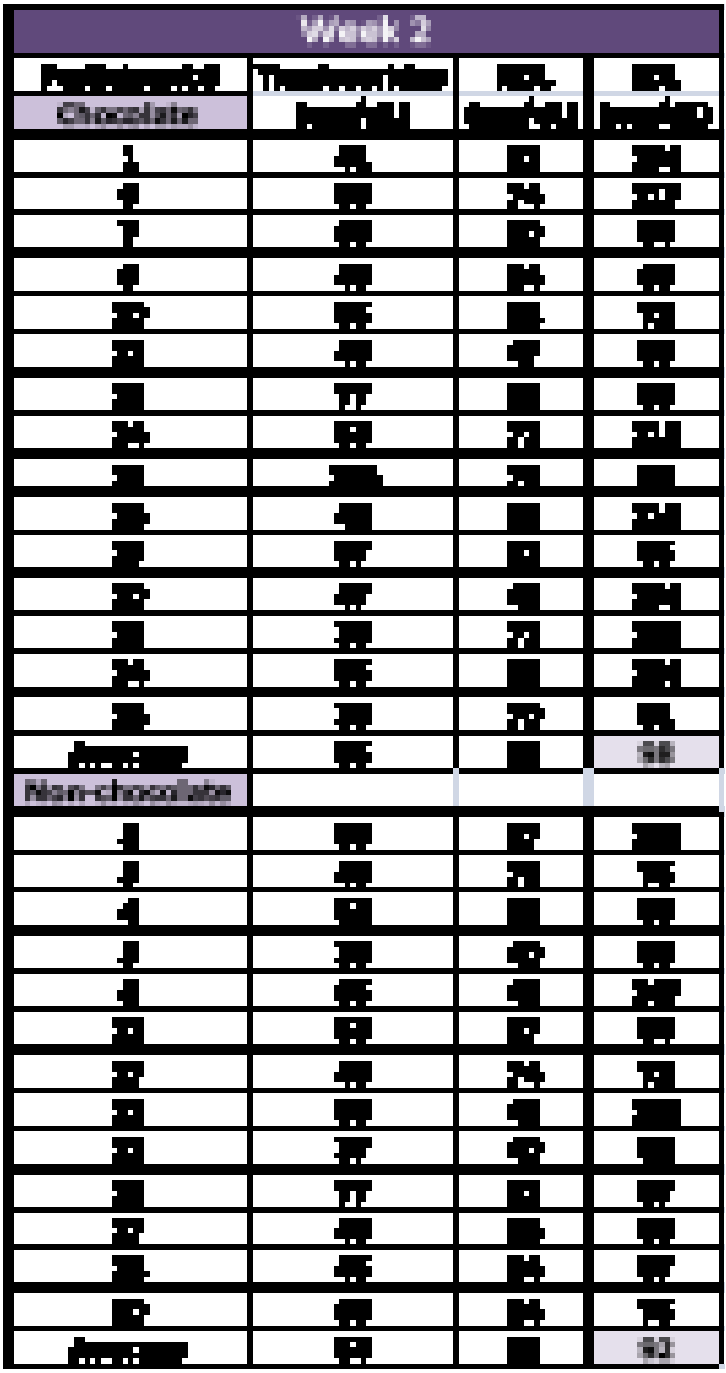

Table 1: continued.

Week 4			
[illegible]	[illegible]	[illegible]	[illegible]
Chocolate	[illegible]	[illegible]	[illegible]
[illegible]	–	–	–
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
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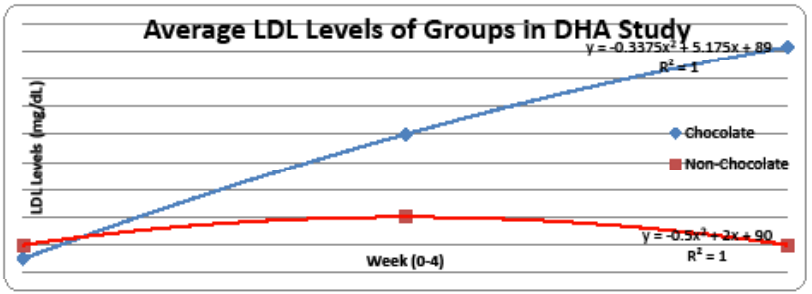

Figure 2: Average LDL Levels of Groups in DHA Study

Discussion

The results of this study showed that there were no statistically significant differences in the levels of plasma LDL of the participant group that was supplemented with DHA and the group that was supplemented with DHA and dark chocolate.

Contrary to previous studies, the levels of cocoa consumed did not reduce the plasma LDL concentration. We calculated that the intake of 38 g/d of dark chocolate would have been more than sufficient to correlate with other studies. A lack of correlation with previous studies could possibly be attributed to the facts that the participants of this study were non-hypercholesterolemic, and the four week supplementation period may not have been a sufficient length for significant results to become apparent. Extending the supplementation period of participant groups in this study may be a way to obtain results closer to that of previous studies. The source of cocoa may have also been a factor in our results. We used a dark chocolate bar where pure cocoa powder is the typical source, and this may have affected the bio-availability of the phenols from the cocoa. The most obvious limitation in this study was the small number of subjects, and the possibility that some participants were not diligent in fasting for 12 hours before blood draws. Evidence for this possibility was indicated from some of the individual participant results. One example is that participant #11 had

normal LDL level for the first two samples, but a high level for the third sample.

Future studies should take into account the need for larger sample sizes, as well as the possible need of a longer trial period. We would also suggest a murine study be conducted in order to validate the effects within a more controlled environment, to investigate the possible correlation between the elevation of LDL levels with DHA and chocolate supplementation, and to ensure subjects are truly fasting when 12-hour fasting blood samples are obtained.

Acknowledgments

We thank the Office of Undergraduate Research of Weber State University, and the Mr. and Mrs. Denkers Family Foundation from whom this research project was funded. We thank IHC laboratories, The Queen Bee, Best Buy, and the Faculty/Staff from the MLS department of Weber State University.

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Knowledge and Perceptions of Cord Blood Donation among Pregnant Women

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Mentor: Travis Price

Abstract

The purpose of this research is to determine the knowledge and perceptions regarding cord blood donation among pregnant women. Umbilical cord blood contains hematopoietic stem cells that can be used to treat malignant and non-malignant diseases, including hematological cancers and thalassemia. Transfusion with cord blood is an alternative treatment for those in need of a bone marrow transplant or peripheral blood stem cell transfusion. Not only is it easier and faster to find a tissue match through cord blood, the risk of the recipient's body rejecting the donation is smaller than traditional bone marrow transplants. The potential benefits of cord blood donation are hindered by the fact that very few women are familiar with the process. They are unaware that they can store their infants' cord blood through a private bank or it can be donated to a public bank to be used by others. Utah is an ideal place to conduct this research; according to the U.S. Census, the birth rate in Utah is 30% higher then the national average. The research study surveyed 341 expectant women in the Ogden area. The surveys were distributed to four different obstetric clinics over a period of three months. Similar published studies using smaller sample sizes have been conducted in other countries and some parts of the United States; it was discovered that a large percentage of those

surveyed had little or no knowledge of cord blood banking and donation.

Introduction

Umbilical cord blood has shown potential as a source of stem cells that can be used for the treatment of many diseases. Cord blood is collected from an infant's umbilical cord after delivery. This method poses no risk to the mother or infant since it is collected after delivery. Most often, the cells are discarded with the umbilical cord as biohazard waste. The first successful cord cell transplant from umbilical cord blood was accomplished in 1988. Since then the potential uses for cord blood has grown.

Umbilical cord blood contains hematopoietic stem cells that are very different from other types of cells in the body. These special stem cells have the ability to divide and renew themselves hundreds of times and are able to differentiate into all the cells of the body (National Institute of Health, 2009). Stem cells can be used to treat malignant diseases such as acute lymphocytic leukemia, chronic myelogenous leukemia, myelodysplastic syndrome, and neuroblastoma. Cord blood can also be used to treat a variety of non-malignant diseases including Fanconi's anemia, Hunter syndrome, Hurler syndrome, idiopathic aplastic anemia, thalassemia, and even osteoporosis.

Umbilical cord blood has been shown to have ten times the amount of hematopoietic stem cells compared to bone marrow (Gunning, 2005). Not only is it faster and easier to find a tissue match using cord blood, but also the risk of the recipient's body rejecting the donation is less than with traditional bone marrow transplants. The lymphocytes found in cord blood are less active than of those found in bone marrow, specifically the CD8+, or cytotoxic T-cell which is the cause of graft versus host disease (GVHD) (Gunning, 2005). Due to the lower risk of GVHD, cord blood does not have to be a perfect human leukocyte antigen match.

The potential benefits of umbilical cord blood are hindered by the lack of knowledge among pregnant women. Very few women are aware of the options for donating or banking cord blood. Another limiting factor is the fees associated with private banking. An initial start up fee is charged for collection and shipping of the cord blood to the facility, there is then a yearly fee required until the infant reaches the age of eighteen when it is then discarded. Cost for storage can range from a few hundred to several thousand dollars depending on the company used. Units stored in private banks are reserved for the child or immediate family members. Of those units, seventy percent will not be HLA matches and will never be used (Navarrete & Contreras, 2009).

Another option for cord blood banking is to donate to a public bank. Public donation has no cost to the donating family. The donated units can be used by anyone in need who meets the established criteria. This opportunity is only offered in limited locations. This curbs the amount of cord blood units that could potentially be donated.

Similar published studies conducted in other countries have shown the majority of surveyed women to have little knowledge of cord blood banking and donation. In a study conducted in Turkey, only 26% of surveyed women had information or knowledge about cord blood banking and donation. In that same study, 74% of women said they would donate to a public bank if given the opportunity (Dinc & Sahin, 2009).

Utah is an ideal place to survey pregnant women. The 2010 U.S. Census reported that the birth rate in Utah is 30% higher than the national average. Growth projections for the next fifty years predict that the rise in population will only be 0.05% while the state of Utah will more than double its population in the same timeframe (Day). There are currently 142 public cord banks and 25 private banks in the U.S. (McKenna & Sheth, 2011), none of which are located

in Utah. While it is possible in some areas to donate publicly to a bank in another state, Utah does not offer this option. It seems logical that a state with such a high birthrate should have a public cord blood bank.

Materials and Methods

The study was approved by Internal Review Board of Weber State University of Ogden, Utah. Socio-demographic information was collected from all participants to determine what socio-demographic factors influenced the mother's knowledge and perceptions regarding cord blood donation. Other topics included knowledge and opinions of private verses public cord blood banking as well as disposal of unused cord blood and its potential use in future research. As pharmaceutical companies frequently make a profit from their research, women were asked how comfortable they felt knowing that a profit could be made from an altruistic donation. Women were also asked how their religious beliefs would influence their decision of cord blood banking.

Five obstetrical clinics were surveyed in Ogden, Utah between February and March 2012. Clinic receptionists offered the survey to pregnant women who were at least eighteen years old. A total of 394 surveys were collected, any that were incomplete or completed by a participant under the age of eighteen were discarded. Signed consent forms were omitted from the study since no identifiable information was collected. The clinic's staff was offered a small incentive for collecting surveys. Completed surveys were analyzed using average mean differences and chi squared.

The survey included a brief description of the research objectives and a limited amount of information on the uses of cord blood. Also included were facts regarding the option to privately or publicly bank cord blood cells and the absence of public cord blood banking options in Utah. Women's knowledge of cord blood was then correlated to age, education, current stage of pregnancy, medical history,

and willingness to investigate independently the topic of cord blood banking and donation.

Results

Over the course of this research, three hundred forty-one surveys were analyzed. The range of ages among our participants was from 18 to 40, with the average age being 29. Most participants identified their education level as having "some college" (168/341 or 49%). The next largest group of participants identified their education level as having a "bachelor's degree" (80/341 or 23%). Income of surveyed subjects ranged from "less than 20,000" to "greater than 100,000" dollars per year. The average reported income was 40,000 to 60,000 dollars per year (96/341 or 28%). Just over half of participants (52%) were in their third trimester of pregnancy. In response to the question related to number of previous pregnancies, 31% of subjects responded that this was their first pregnancy. Another 31% responded that this was their second pregnancy.

Most respondents (313/341 or 92%) stated that they were aware that umbilical cord blood could be used for treatment of some diseases. Just over half of participants (201/341 or 59%) did not have a medical history significant for cancer or other genetic disorders. Of the 41% that did have a medical history significant for cancer or other genetic disorders, the overall majority (115/140 or 82%) stated that they were confident or had some knowledge. Two-hundred-twenty-five participants (66%) responded that their health care provider had not provided information regarding cord blood banking/donation. Approximately the same number of participants (206/341 or 60%) stated that they would not like their health care provider to offer information on this subject. However, 40% of participants stated in a later question that they would like to receive more information on subjects related to cord blood banking

An overwhelming majority of subjects (325/341 or 95%)

stated that neither they nor any of their family members had needed a bone marrow transplant. Approximately half of participants (194/341 or 57%) stated that they do not regularly donate blood product. Just over two-thirds of participants (230/341 or 67%) said that they had some knowledge of cord blood. Thirteen percent of subjects had received information regarding cord blood donation from multiple sources other than their health care provider. Fewer than half of participants (156/341 or 46%) stated that they would be willing to pursue information related to cord blood banking on their own.

When asked whether religion would influence their decision to donate cord blood, the majority of participants said that it would not (212/341 or 62%). Half of participants (172/341 or 50%) stated that they were not willing to pay more than two hundred fifty dollars as a start up fee for private cord blood banking. Also, 32% of participants said that they would not pay yearly to store their cord blood. However, 63% of respondents (213/341) said that they might pay to store blood from their child's umbilical cord.

Approximately one-third of respondents (131/341 or 38%) stated that they were "neutral" in relation to their feelings as to whether cord blood should be stored for only family members. Additionally, thirty-two percent stated that cord blood should be stored for family use only. One-third of surveyed women (111/341 or 33%) indicated that they were neutral regarding donating cord blood to a public cord blood bank even if it were made available in the state of Utah. Slightly more than half of participants (195/341 or 57%) stated that they would donate cord blood if given the opportunity. Similarly, one-third of participants (110/341 or 32%) agreed that pharmaceutical companies should be able to use cord blood for research. However, 26% (89/341) disagreed that such companies should make a profit from research, while 20% (68/341) agreed that they should make a profit. Thirty-three percent of participants stated that

they were neutral on this subject. When asked if cord blood should be destroyed if unable to be used for treatment, 21% of participants (73/341) disagreed. When asked if they would independently research further information concerning cord blood donation, seventy-one percent said that they would not.

Discussion and Conclusion

We found a correlation between education level and women's knowledge of cord blood banking. The majority of the women that had some knowledge had only some college education. There was a decline in knowledge as a woman's education rose, this is opposite of what we expected. We believe that this is due to the fact that the use of umbilical cord blood is a new science. Women that have recently taken college classes are gaining more exposure to the possibilities of cord blood donation while those that have not recently been enrolled in courses have not gotten the same exposure.

There was also a connection among the women who stated they had a personal or family history of cancer or genetic disease. Only a small percentage (18%) of surveyed participants said that they would pay to store cord blood if the price was reasonable while a little more than half (57%) of women stated that they would donate to a public cord bank. Despite the fact that Utah has a strong religious tradition, sixty-two percent of respondents said their religious beliefs would not play a role in their decision to donate or bank cord blood.

Due to the lack of a public cord bank in Utah, thousands of cord blood units are destroyed annually. This represents a huge loss of potential stem cells that could be used to treat disease. However, before a bank can be established here, there are some concerns that should be addressed. Seventy-one percent of women said that they would not be willing to research cord blood on their own. For a public bank to be successful in Utah, additional information will need to be

provided to pregnant women. The majority of the women in the study stated they would like to receive this information from their physicians. As the science of stem cell treatment evolves, the demand for stem cells will increase. Considering the facts of Utah's high birth rate and that almost half of the surveyed women would be willing to donate if given the opportunity, Utah is an ideal location for a cord blood bank.

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Thromboxane Reduction Due to Varying Doses of Omega 3 Fatty Acids

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Mentor: Yas Simonian

Abstract

Thromboxane A2 has been shown to be an agonist in platelet activation and aggregation, leading to blood clots in the body. Omega 3 fatty acids, found in fish oil, have been shown to reduce thromboxane levels. The intent of this study was to determine the impact of varying doses of fish oil on reducing thromboxane levels in healthy individuals. In order to determine these effects, 86 participants were placed into one of three groups. Two groups received a different dose of fish oil, while the control group received a daily dose of corn oil. Over the course of this 30 day study, both a baseline and a final urine sample were collected from each participant and sent over-night to a reference lab for analysis. Data indicated that there was a significant ($p<0.05$) decrease of thromboxane levels in participants taking 1600 mg EPA and 800 mg DHA per day. It was found that there was not a significant ($p<0.05$) decrease of thromboxane levels in participants taking 800 mg EPA / 400 mg DHA per day. There was, however, a significant ($p<0.05$) increase in the thromboxane level of the control group. Researchers concluded that the optimal dose of thromboxane levels is 1600 mg EPA / 800 mg DHA per day.

Introduction

Thromboxane A2 has been shown to be an agonist in platelet activation and aggregation, leading to blood clots in the body. Omega 3 fatty acids, found in fish oil, have been shown to reduce thromboxane levels. The intent of this study was to determine the impact of varying doses of fish oil on reducing thromboxane levels in healthy individuals. In order to determine these effects, 86 participants were placed into one of three groups. Two groups received a different dose of fish oil, while the control group received a daily dose of corn oil. Over the course of this 30 day study, both a baseline and a final urine sample were collected from each participant and sent over-night to a reference lab for analysis. Data indicated that there was a significant ($p<0.05$) decrease of thromboxane levels in participants taking 1600 mg EPA and 800 mg DHA per day. It was found that there was not a significant ($p<0.05$) decrease of thromboxane levels in participants taking 800 mg EPA / 400 mg DHA per day. There was, however, a significant ($p<0.05$) increase in the thromboxane level of the control group. Researchers concluded that the optimal dose of thromboxane levels is 1600 mg EPA / 800 mg DHA per day.

Blood coagulation is affected by many substances within the body. Whether or not blood will coagulate depends on a balance between substances that promote coagulation and those that inhibit it (Odle, 2006). Activated platelets produce Thromboxane A2 (TxA2), which is one of the substances known to affect blood coagulation (Hambert, Svenson, & Samuelson 1975, p. 2994). TxA2 acts as both a vasoconstrictor and platelet activator (Ellis, Oelz, & Roberts, 1976, p. 1135). In some cases, blood can coagulate within the body. These intravascular blood clots have the potential to flow to various areas of the body such as the heart or lungs. This can lead to life-threatening medical conditions depending on the resulting location of the blood clot. Possible resulting conditions include: pulmonary embolism,

heart attack, stroke, and peripheral vascular disease (Odle, 2006). Blood clots can also deprive cells of oxygen and nutrients, which often leads to tissue death.

Today, many doctors recommend that patients at risk for cardiovascular disease take low doses of aspirin (Awtry & Luscalzo, 2000, p. 1206), as it has been proven to lower TxA2 levels (Tohgi, Konno, Tamura, Kimura, Kawano, 1992, p. 1400). However, studies have shown that a percentage of people have resistance to the effects of aspirin (Gum et al., 2001, p. 230). In cases such as this, it is beneficial for both doctors and patients to find other methods of decreasing TxA2 levels. Omega 3 fatty acids, commonly found in fish oil, have been proven to reduce the production of TxA2 (von Schacky, Fischer, & Weber, 1985, p. 1626), thereby reducing the risk of cardiovascular disease in humans (Kris-Eherton, Harris, & Appel, 2003, p. 20).

Materials and Methods

The intent of this study was to determine the impact of varying doses of fish oil on reducing thromboxane levels in healthy individuals. After receiving approval from Weber State University's Institutional Review Board, participants for the study were recruited. Of the 105 volunteers from the university and surrounding areas who agreed to participate in this study, 86 successfully completed it. Participants ranged in age from 18 to 60. However, due to the fact that this study was conducted on the Weber State University campus, the majority of participants were college students between the ages of 18 and 30. An equal representation of males and females were included in the study. Only healthy individuals, who did not have any long-term diseases (i.e. diabetes, AIDS, cancer, etc.) were selected to participate. Any individual who had experienced an inflammatory event two weeks prior to the start of the study were excluded. Likewise, those that had ingested alcohol, NSAIDS, or other blood thinners in the past 48 hours were not allowed to participate. All participants

were issued an informed consent sheet.

TxA2 has a short half-life in the body and is rapidly hydrolyzed to Thromboxane B2 (TxB2). This TxB2 is then excreted in the urine. TxB2 was measured using urinary 11-dehydrothromboxane B2, an ELISA test. A first morning baseline urine sample from each participant was collected in 10 mL urinalysis tubes (Biomedical Products Corp. Mendham, NJ). Each tube contained a stabllur preservative tablet.

In order to further determine the effects of Omega-3 fatty acids on the body, an Arachadonic Acid: Eicosapentanoic Acid (AA:EPA) ratio was taken from some participants. The results of this test are a good indicator of cellular inflammation within the body (Masoon, Stark, & Salem, 2005, p. 2299). The higher this ratio, the more susceptible a person is to diseases linked to cellular inflammation. Examples include: cancer, Alzheimer's disease, and heart attack. Omega-3 fatty acids are later converted to EPA, resulting in a lowering of the AA:EPA ratio (Metherel, Armstrong, Patterson, & Stark, 2009, p. 23). To conduct this test, blood samples were collected and analyzed using gas chromatography-mass spectroscopy (Abu, & Oluwatowoiu, 2009, p. 189). In order to determine the AA:EPA ratio, a finger-stick blood sample was collected using the Protein Saver Snap Apart (WhatmanTM Westborough, MA). Due to the high costs associated with running this test, AA:EPA ratios were only determined for 30 participants, 15 from both the high and low dose group respectively.

Following collection, participants were then allowed to begin taking their pills. Urine and blood samples were sent overnight to Inflammatory Markers Laboratory (Marblehead, MA), where urinary 11-dehydrothromboxane B2 and AA:EPA ratio tests were run. Final samples were collected in the same manner as the initial urine and blood samples after 30 days of pill consumption. Urinary 11-dehydrothromboxane B2 and AA:EPA were also run on these samples. Results from

all tests were sent back to researchers at the conclusion of the study. Upon receiving the results of the tests performed, researchers analyzed the data using a paired T-Test.

Results

The initial average value of Thromboxane B2 for all 86 participants was 2188 pg/mg (SD 1043 pg/mg, Range 346-6290 pg/mg). The high dose group had an initial mean of 2457 pg/mg (SD = 1209 pg/mg, Range = 698-6290 pg/mg), and a final mean of 1940 pg/mg (SD = 821 pg/mg, Range = 609-4932 pg/mg). This represents an overall decrease of 517 pg/mg (21%). It was found that this decrease was statistically significant ($t(38) = 2.49$, $p < 0.05$).

The low dose group had an initial mean of 1910 pg/mg (SD = 850 pg/mg, Range = 428-3341 pg/mg), and a final mean of 2218 pg/mg (SD = 1037 pg/mg, Range = 399-5142 pg/mg). This represents an overall increase of 308 pg/mg (16%). It was found that this increase was not statistically significant ($t(29) = 1.63$, $p < 0.05$).

The control group had an initial mean of 2057 pg/mg (SD = 798 pg/mg, Range = 346-3096 pg/mg), and a final mean of 2405 pg/mg (SD = 928 pg/mg, Range = 896-4244 pg/mg). This represents an overall increase of 348 pg/mg (17%). It was found that this increase was statistically significant ($t(15) = 2.24$, $p < 0.05$). See Table 1.

Table 1: Change in Thromboxane B2 Levels Due to Omega-3 Fatty Acid Consumption.

	Control	Low Dose	High Dose
Initial TxB2	2057 pg/mg	1910 pg/mg	2457 pg/mg
Final TxB2	2405 pg/mg	2218 pg/mg	1940 pg/mg
Change	+348 pg/mg	+308 pg/mg *	-517 pg/mg

*Not Statistically Significant

The high dose group had an average initial AA:EPA ratio of 156 (SD = 88 pg/mg, Range = 22-300 mg/pg). The final average of the high dose group's AA:EPA ratio was 10 (SD = 3.83, Range = 5-19). The low dose group had an initial average of 138 (SD = 94, Range = 25-300). The final average

of the low dose group's AA:EPA ratio was 33 (SD = 50, Range = 7-170). The AA:EPA ratio of every participant tested decreased, and a paired T-test indicated that the results for both the high dose group ($t(14) = 6.04$, $p<0.05$) and low dose group ($t(14) = 3.98$, $p<0.05$) were statistically significant.

Discussion

The thromboxane levels of the placebo group increased over the course of the study. This is likely due to seasonal inflammatory events, such as a cold or flu. The low dose group was not taking what our study showed to be the optimal dose of fish oil, and therefore did not have a statistically significant change in thromboxane levels. The fish oil taken by the high dose allowed for a decrease in overall thromboxane levels, as anticipated. Due to the fact that the AA:EPA ratio in both the low and high dose groups decreased significantly, it can be concluded that a dose of at least 800 mg EPA and 400 mg DHA will lower AA:EPA ratios in a healthy individual.

Conclusion

It is advised that patients at risk for cardiovascular disease take at least 800 mg EPA and 400 mg DHA per day to lower AA:EPA ratios. Taking the recommended dose (1600 mg EPA and 800 mg DHA) will have a greater impact on lowering both thromboxane levels and AA:EPA ratios. The high dose of fish oil can be used in lieu of aspirin to lower thromboxane levels. However, the low dose is not recommended for this particular instance

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Vitamin D3 and the Severity of Inflammation Due to Asthma

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Abstract

Midtown Community Health Center (CHC) provides healthcare to underprivileged residents. Within that population, over 800 patients have a diagnosis of asthma. This study evaluated the correlation between levels of serum vitamin D3 and the severity of inflammation due to asthma. Previous research shows a correlation between vitamin D3 and decreased sputum eosinophil levels. This study utilizes the technology produced by Aerocrine to measure the fraction of exhaled nitric oxide (FeNO) associated with airway inflammation. Nitric oxide is selectively produced by airway inflammation but is unaffected by bronchoconstriction. Midtown CHC assisted in the recruitment of 20 patients between the ages of 8 and 69 with an asthma diagnosis who were also deficient in serum vitamin D3. Over the period of one year, participants were supplemented with vitamin D3 to obtain a target serum level of 50-80 ng/ml. Participants completed an asthma questionnaire and underwent three tests: FeNO and serum vitamin D3. Each test was repeated at six-month intervals. Nitric oxide was measured using Aerocrine's NIOX MINO. Blood samples were taken to Ogden Clinic to be tested for 25-hydroxyvitamin D3 (25-OHVitD) as measured by chemiluminescense. T-tests (p=.01) concluded that participants showed a statistically significant increase in

serum vitamin D3 levels between the initial and final sample collections (T value: 3.11, critical value: 2.87). T-tests for FeNO (T value: 1.35) did not prove to have a statistically significant change. There is a lack of statistical evidence supporting this hypothesis. The study has multiple limitations. For example, one limitation to the results is previous research suggests that vitamin D does not show physiological effects until blood levels are above 50 ng/mL. Only three participants reached that level.

Introduction

Asthma is a condition characterized by swelling and narrowing of the smooth muscle airways. Symptoms include wheezing, shortness of breath, chest tightness, and coughing. During asthma attacks the muscles surrounding the airway contract, reducing the amount of air that can pass. Limiting exposure to asthma triggers can reduce attacks and symptoms. Common triggers include dust, dander, mold, chemicals, and respiratory infections. Currently, treatment focuses on controlling airway inflammation and bronchoconstriction. Asthma is a considerable public health issue, with more than 300 million people affected worldwide (Sandhu, 2010; Litonjua A. A., 2009; Brehm, 2010).

Sympathetic and parasympathetic nervous systems regulate the lungs. The lungs also have a third regulatory nervous system. When activated, the non-adrenergic non-cholinergic (NANC) system causes a production of nitric oxide in the airways (Aerocrine, 2010). It is understood that nitric oxide is produced in the airways for regulatory functions throughout the body (Wilkins, Stoller, & Kacmarek, 2009). Nitric oxide production is increased when there is airway inflammation. Levels of exhaled nitric oxide are not affected by bronchoconstriction (Aerocrine, 2010).

Vitamin D3 is a pro-hormone that is actively involved in many processes of the body. Vitamin D3 metabolites have been linked to unlocking binding sites in the human genome (Bosse, 2009). Most binding sites are near genes

involved in major diseases of humans, such as asthma. There is evidence supporting its actions in immunity and inflammation (Hughes, 2009). Evidence also suggests that vitamin D3 deficiency is associated with increased airway hyper responsiveness, lower pulmonary functions, and worse asthma control (Sandhu, 2010). Lower vitamin D3 levels have recently been associated with higher risks for asthma exacerbations (Litonjua A. A., 2007).

Aerocrine developed the NIOX MINO, the only FDA approved portable device able to measure the fraction of exhaled nitric oxide (FeNO). FeNO is a measurement of how much nitric oxide is released in one entire breath. Measurement of FeNO is easy and noninvasive (Strunk, 2003). The procedure can be performed on children and adults. NIOX MINO uses an electrochemical sensor technology as the analytical method. This technology requires no calibration. Reliability of measured values is ensured by built-in controls and an external quality control procedure (Aerocrine, 2010).

Research shows that vitamin D3 supplementation improves asthma symptoms by decreasing the amount of inflammation. The exact mechanisms are unknown, but vitamin D3 has been noted to impact the function of inflammatory and structural cells.

The purpose of this research is to evaluate if vitamin D3 supplementation decreases the amount of nitric oxide produced in the airway of asthma patients. Research supporting vitamin D3 decreasing asthma symptoms is based on sputum eosinophil levels. If vitamin D3 decreases nitric oxide in the airway then supplementation could provide a useful and cost effective method assisting in the control of asthma inflammation. It is understood that supplementation will not replace medication.

Materials and Methods

Twenty participants were recruited from Midtown CHC in Ogden, Utah. As approved by the IRB committee,

participants must be classified as underprivileged by the health center, between 8-65 years old, and have a diagnosis of asthma. Gender was not an exclusion factor for this study. Participants above the age of 18 signed an informed consent outlining the project details. After being provided details of the project, informed consent was obtained from parents of participants under the age of 18. Participants completed a questionnaire used to evaluate their asthma symptoms, triggers, and treatments. The data collection took place over a period of one year.

Aerocrine's NIOX MINO and disposable filters, phlebotomy supplies with Serum Separator Tubes (SST), and 25-hydroxyvitamin D3 (25-OHVitD) chemiluminescence testing were used in the collection of data.

During the first month, participants performed the FeNO measurement as per Aerocrine's NIOX MINO operator's manual. A serum sample was collected from each participant. Samples were taken to Ogden Clinic to be tested for 25-OHVitD. All measurements were recorded and entered into an Excel spreadsheet. Participants were asked to take 4000 IU of the provided supplemental vitamin D3 daily. This process was repeated during months 6 and 12. After 25-OHVitD results were obtained in month 6, supplementation levels were adjusted to bring their levels into the normal range, 50-80 ng/mL. Above 50 ng/mL continued supplementation at 4000 IU vitamin D3, 20-49 ng/mL increased supplementation to 6000 IU, and less than 20 ng/mL increased supplementation to 8000 IU (See figure 1). Statistical analysis was performed using T-tests ($p=0.01$).

Results

The results of this project conclude that there is a lack of statistical evidence supporting the hypothesis of this study. T-tests concluded that the participants showed a statistically significant increase in the first and third vitamin D3 sample collections. T-tests for FeNO values did not prove to have a statistically significant change.

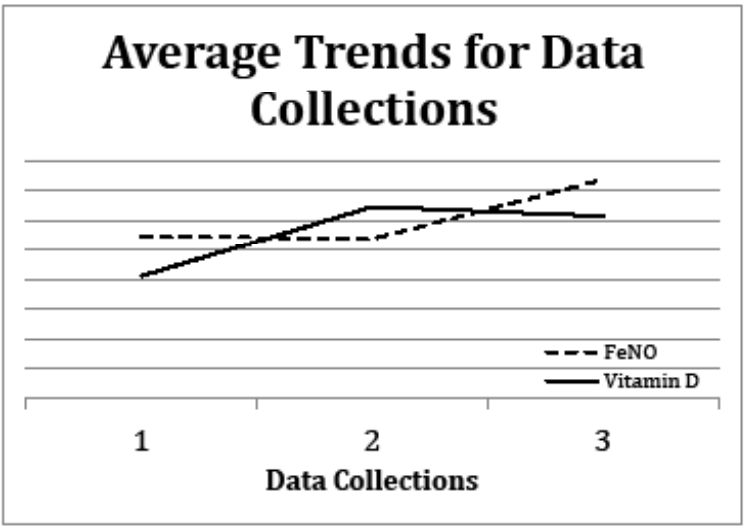

Figure 1: Average results for Data collected between 20 participants during Months 1, 6, 12.

Discussion

As indicated by the results, there is no evidence to suggest any correlation between vitamin D3 and the severity of inflammation due to asthma as measured by the NIOX MINO. Previous research indicates a limitation of the study by suggesting that vitamin D3 does not show physiological effects until blood levels are above 50 ng/mL (Vitamin D Council, 2010). Further research is needed to determine if serum levels of vitamin D3 above 50 ng/mL will decrease the amount of nitric oxide produced in the airway of asthmatics.

A second limitation is the level of compliance. Some participants admitted not taking the vitamin D3 as directed; therefore their blood levels did not have the chance to reach 50 ng/mL. Testing with the NIOX MINO can be challenging as obtaining a successful test is dependent upon the patient's ability to understand and follow instructions. Many participants had to repeat the test multiple times before correctly performing the test. This may potentially decrease the level of nitric oxide reported due to the extensive breaths exhaled from the failed tests.

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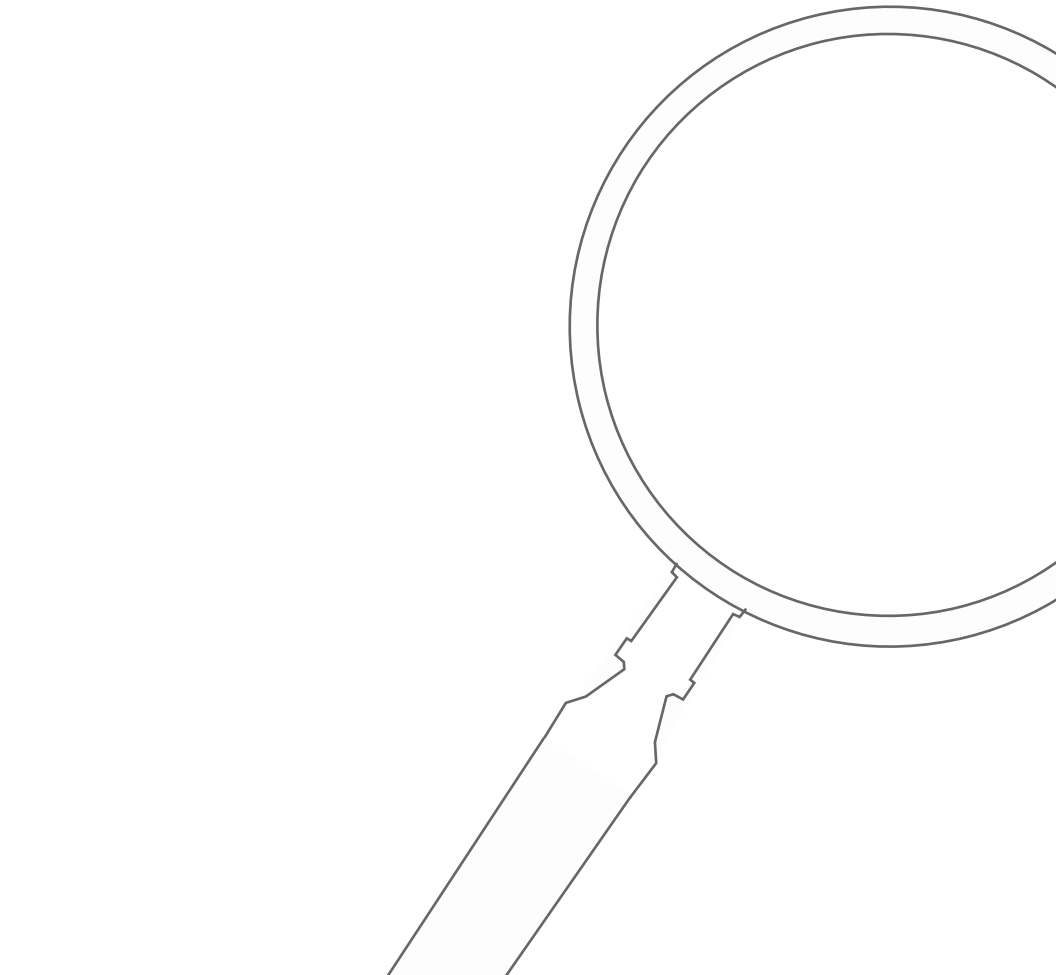

Dissemination of Research

Title: *Implementation of a Review Course: Improved Outcomes*
Author(s): **Nora Arias, Christa Schmid & Marianne Wilcox**
Mentor(s): **Kara Hansen-Suchy**
This research was presented at the American Society for Clinical Laboratory Science in Los Angelos, California, July 17-19, 2012

Title: *Creativity: Cooperating Across Disciplines*
Author(s): **ShayLynne Clark & Brett Cragun**
Mentor(s): **Mark Henderson**
This research was presented at the University of Texas Research Bazaar and the Central California Undergraduate Research Symposium in Austin, Texas & Fresno, California, April 13 & 18, 2012

Title: *Thromboxane Reduction Due to Varying Doses of Omega-3 Fatty Acids*
Author(s): **Amanda Devlin**
Mentor(s): **Yasmen Simonian**
This research was presented at the Annual Meeting of the American Society for Clinical Laboratory Science in Los Angelos, California, July 17-19, 2012

Title: *Dietary Protien Influences Growth Through a Complex Mechanism Coupling Proteolysis and Intestinal Peptide Transporter Expression*
Author(s): **Stephanie Hansen & Debbie Titmus**
Mentor(s): **Brian Chugg**
This research was presented at the 2012 Digestive Disease Week in San Diego California, May 20-23, 2012

Title: *Allies in Productive and Purposeful Preparation of Preservice Physical Education Teachers*
Author(s): **Carin Mann**
Mentor(s): **Geri Conline**
This research was presented at the Southwest District American Alliance for Health, Physical Education, Recreation and Dance in Oahu, Hawaii, June 13-16, 2012

Title: *Viola Etude Duet*
Author(s): **Christina Olson**
Mentor(s): **Michael Palumbo**
This research was presented at the International Viola Congress in Rochester, New York, May 30 - June 3, 2012

Title: *A Captive Mind*
Author(s): **Samantha Postma**
Mentor(s): **John Schwiebert**
This research was presented at the San Francisco Writers Conference in San Francisco, California, February 16-20, 2012

Title: *Characterization of a Novel Marinobacter and Related Phage Isolated From the Great Salt Lake, Uath*
Author(s): **Thomas Simon**
Mentor(s): **M.J. Domek, M.D. Culumber & Craig Oberg**
This research was presented at the American Society for Microbiology General Meeting in San Francisco, California, June 16-19, 2012