Missouri Journal of Health, Physical Education, Recreation and Dance

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Editorial Policy

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NOTE: The Missouri Journal of Health, Physical Education, Recreation and Dance began using volume numbers with the 1991 issue, which was designated volume 1. Earlier issues do not bear a volume number.
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Scholar Address

The Scholarship of Teaching: Why I Teach – And How I Got Here

Marilyn Grechus

Teaching is why we are here. In some form or another, each of us is attending this conference because we are affiliated with teaching. Why do you teach? Is it for the recognition? The money? The reasons we got into this profession are as varied as the people attending! When was the last time you took the time to seriously think about what this career means to you? Join me for a look into teaching from my perspective and then reflect on your own influences. You may come out with some altered ideas of how your world has stimulated and inspired you!

Being a MOAHPERD Scholar of the Year is quite an honor. But, it has also been a huge challenge for me to create a scholar’s address to present to my friends and colleagues who have done many more scholarly activities than I have. I’m not into research. Therefore, I can’t write about hypotheses, methods, and results . . . My articles and presentations have always been about practical things that teachers can implement into their programs immediately. For a few years, I wrote articles for Healthy Child Care which is designed for child care workers. I have also presented health teaching methods at State, District, and National conferences for AAHPERD and other organizations. But, my biggest accomplishment is the book that I wrote titled, “Innovative Tools for Teaching Health,” published by Human Kinetics in 2010. It is actually a compilation of many of the presentations that I have done over the years. Several of my friends and colleagues encouraged me to put my creations into a book . . . And it became a reality! Thank you to those who encouraged me.

So, here we are . . . You are waiting for me to present my scholarly address, and I’m wondering just how scholarly I can be! So, I decided to make my presentation an essay on the scholarship of teaching. This is about what I’ve learned in my time as a teacher and how I got here. I hope that through my experiences, you will pick up some ideas on how you might become a more effective scholar/teacher in your own life.

My Scholarly Address – My Fifteen Minutes of Fame?

Fifteen minutes of fame. We’ve heard this phrase used by people whose ‘fame’ was only a flash in the pan. Is this what the time I spend teaching is? Fifteen minutes of anything is not much – let alone for fame and
recognition. So, what is my time teaching really worth?

Fame – notoriety, recognition, accolades, celebrity, renown . . . Are these things that all people want or need? Maybe we don’t ‘need’ it, but everyone likes to be recognized for something. So, is that what we want as teachers? Just some recognition – a compliment once in a while? Do we teach to strive for fame at the end of the day? (At least we know that we aren’t doing this just for the money!)

So, here I am today – receiving recognition from my colleagues from across the state. I am enjoying my fifteen minutes of fame in front of you right now. Is this why I chose this profession? So that I could take time out of my schedule to put together another presentation over a topic that is probably of little interest to anyone? Is this really the kind of notoriety that encourages us to be better teachers? Is this what we are striving for in our quest to be teachers?

My colleague and good friend, Scott Strohmeyer, and I have often discussed why we do what we do. Basically, Scott’s response (and I agree) has been: The money makes it possible . . . the recognition we receive occasionally makes it fun . . . but the bottom line is that we want to help our students. We will feel like we are successful if (or when) our students receive recognition for the good jobs they are doing. Our ‘fame’ comes from knowing that we played a small part in creating teachers who are more accomplished than we.

Let me tell you why I teach.

I have known since I was a small child that I wanted to be a teacher. My father acquired two huge blackboards from a school that was being torn down and put them up in our basement. With an endless supply of chalk, I spent countless hours pretending that my dolls and stuffed animals were my students. I sometimes brought in the neighborhood kids and shared my wisdom with them! I look back today and wonder why at that age, I knew that I wanted to be a teacher. I can’t imagine that I was aware of what kind of accolades could come my way in this profession. I didn’t realize anything except that I loved doing this. At that point in time, my fifteen minutes of fame came when my ‘students’ listened intently and I felt like I was the most important person in the world – or at least my basement!

So, if it is not the money or the quest for our fifteen minutes of fame that helps us all endure the endless hours of sitting in class in our preparation for receiving our teaching certificates – what is it that makes us the teachers we are today? Have you ever thought about it?

Of course, we will all have different stories of where we came from – but sometimes we don’t even recognize our most significant influences until much later in life. So, I want to tell you a little of my story so that maybe it will inspire you to identify where your earlier encouragement came from.

Let me tell you where I learned the skills I feel are important in being the teacher I am today.
Everything I Learned About Teaching I Learned From My Hairdresser
– My Mother!

My mother worked as a hairdresser for several years after she was married. But, when I was four years old, she succumbed to the throes of polio. She spent 2 years in hospitals and when she finally came home, she was totally paralyzed. Her days were spent in a wheelchair and nights on a rocking bed to keep her breathing. Since I was just six and my brother eight when she came home, we had no concept that this was not the way life was supposed to be. The main thing was that our mom was home from the hospital.

There were many lessons learned from the experiences I had as a child and later as a teenager and young adult in this household. Although my mother could not move about on her own, she was the best teacher that anyone could ask for. I would like to share some of the lessons I learned from this remarkable woman.

First and foremost, my mother taught me to take care of others. My time was not always my own because I often was needed to help take care of her. We had help in the early years, but my needs were usually put on the back burner while my mother was being cared for. As I grew, I often helped to feed her in the mornings before I went to school and came home to chores such as cleaning and cooking the evening meal. Because of the responsibilities I had as a young person, I learned that doing for someone else was more important than worrying about my own needs. I firmly believe this helped me become a good teacher because I recognize that my students have needs which necessitate being met – which is more important than my feelings. In my years of teaching, I have tried to teach my students the importance of reaching out to their future students and making lessons real and important in their future students’ lives. The lessons are not about what is easy to put together for the teacher, but the lesson should impact the student’s lives. My students must learn to recognize that this world is bigger than them! Their students should be more important than them.

Along with taking care of others, I also learned that every job must be done without complaining and completed to the best of my ability. When I was young and doing household chores, I had a ‘supervisor’ in the form of my mother sitting beside me in her wheelchair. She kept me on task and made sure that my jobs were done as efficiently and completely as required. I knew it did no good to complain about the constant critiques because if I didn’t do it right the first time – I would continue to repeat the chore until it was done right. Therefore, I quickly became very efficient and thorough the first time through so that I didn’t have to repeat it. With my students I try to instill in them the habit of thinking through a project before they even start so they can do it right the first time. The online classes that I teach are set up for the students to redo their assignments when not correct instead of just giving them a low score and moving on.
'Do-overs' are an important part of the learning process. I firmly believe that students learn more from giving more thought – even a third or fourth time – to an assignment than just being scored once and forgotten.

As I grew, my mother taught me patience. I learned how to cook, clean, and sew – all while she sat and talked to me. Just imagine trying to teach a child how to mop a floor or clean the kitchen while sitting several feet away with your hands resting heavily in your lap. It often required a lot of patience because she usually had to repeat her instructions over and over as these jobs had to be repeated at regular intervals. Do you ever feel like you repeat the same message over and over? We all do . . . but, looking back now, I understand just how important it is for young people to learn the skills they need in life and it takes PRACTICE (and sometimes a LOT of practice) to really learn something. Patience is an important part of teaching. Our students will never learn something unless we give them the opportunity to repeat the activity. Many students enjoy this repetition – like the 2-year-old who wants the same story read every night for months on end. Only a good teacher – or a parent – can withstand this type of replication day after day!

My mother was good at describing actions and ideas. Not being able to demonstrate what she was trying to convey made her rely on her ability to explain the procedures required to perform the skills. And this was not just a once in a while scenario. Because she could do virtually nothing, under her guidance I learned how to do all of the cleaning around the house and eventually the cooking. She also taught me how to sew, how to cut and color hair, how to bake pies; the list is endless. And through it all she presented her information in a quiet, loving tone that showed that she understood how frustrating it sometimes was for me to follow directions without the benefit of a demonstration. But, from this quiet demeanor, I learned how to ‘talk someone through’ most any type of activity. I learned from her how to describe things in terms that the listener would understand. My children benefited from this as I would allow them to do things while watching and ‘helping’ from afar. This is also an important skill that has benefitted me as a teacher. I try to teach in a manner that students learn to do things themselves instead of having someone else always taking over to complete the job more quickly!

The skill of talking someone through something seems to becoming a lost art. Maybe it is time to bring this back into our teaching repertoire so that our students truly understand the intricacies of the skills we try to teach them. Talking someone through a skill means that you need to think it through first. It is important to recognize the steps so that you can break a difficult task down into manageable bites that are often skipped when we just demonstrate and tell our students to copy that! This skill has also helped me and my students to break down information into parts and to ‘think through’ something thoroughly before actually doing it. Too many young people today have no idea how to ‘think through’ a situation that could arise in their teaching. My mother never realized what a great
Another lesson I learned from my home situation was that life is not always fair. As I grew to be a teenager, I soon became extremely frustrated because of the extra duties I had as the designated ‘mother-sitter.’ Being the younger sibling, I was generally the one who had to stay home while my dad and older brother did other things. It was a rough time for me because I really felt imposed upon. (Sound like a typical teenager complaint??) Eventually, I figured out that as frustrated as I was during that time, I was also very blessed because I had a mother at home who was always there to listen to me and teach me about life. Unfortunately, that is a lesson that many young people do not have the privilege to experience. Since so many children do not have the ‘stay-at-home’ mom that I had, I have become aware just how important it is to have a positive role model in one’s life. This is what I aspire to be to my students.

Having an invalid in a wheelchair in my family, I also discovered that there were many things that we could not go to because of my mother’s condition. We were able to travel some with a portable iron lung to aid Mom’s breathing, but often could not take her into see many of the attractions because of stairs or other surfaces that could not handle a wheelchair. But, we did not complain because we accepted this as just the way it was. I did not grow up with a sense entitlement because of our circumstances. Today, I believe that this has helped me be more compassionate toward my students because of what issues may be going on in their lives.

I am concerned that our students are growing up today with a very real ‘me’ complex. Many young people truly believe that the world revolves around them. When they discover that it doesn’t – it can be quite devastating. Hopefully, as teachers and parents, we can help young people recognize that there are many people in the world with much less than they have – but yet with more peace and hope. Family and friends should be more important than material things. Others’ needs should come first. These are the final important messages that I learned from my mother that I try to incorporate into my teaching.

Teaching is not an easy profession. It takes passion and patience, caring and understanding. Of course knowledge is important – but that is easily gotten from books (or the internet!) The real lessons to be learned about teaching come from the experiences in our lives. Have you ever given any thought to the influences that have made you who you are today? My hope with this presentation is that you will take a few minutes to reflect on your past – on the lessons you learned from your parents, family, and friends throughout the years. Have they shaped you into the best teacher you can be? If not – can you recognize and overcome those lessons which could be harmful to your students if you followed them?

Now that I have lived my dream of becoming a teacher – and even a teacher of teachers – I look back on the innocence that I once had of how great this profession can be. I have taught college students most of my
career – although I have subbed in public and parochial schools for about every grade and subject and have taught all grade levels at church and church camps. After all these years and all of these experiences, I still love teaching. Have I accomplished what I have set out to do? I think so. Have I achieved my fifteen minutes of fame? I think so. I have been recognized for my teaching over the years. I have been asked to present at conferences over and over. I personally know some ‘famous’ people in the health education field from across the United States. I have had a book published.

Am I a scholar? The jury is still out on that one! To me – I’m just a teacher. I love what I do and it’s all I ever wanted to do. Do my book and long list of presentations make me a scholar? I am honored to be here. This title of MOAHPERD Scholar of the Year that you – my colleagues – have bestowed on me this year is probably more celebrity status than I deserve. Honestly, though, I can say that yes – this is my best *Fifteen Minutes of Fame.*
Currently, numerous Americans are affected by obesity. Obesity is defined by The National Institutes of Health as a body mass index (BMI) of 30 or above (National Institutes of Health, 2012). A BMI of 30 is approximately 30 pounds overweight (National Institutes of Health, 2012). With nearly one in three obese American adults (Flegal, Carroll, Ogden, & Curtin, 2010), it is not surprising Americans of all ages search for weight loss strategies. Rather than practicing safe weight loss methods such as combining a sensible diet with adequate exercise, many individuals adopt unhealthy dieting methods. In addition, a substantial percentage of women and men identify their personal weight status incorrectly (Chang & Christakis, 2003). These errors in classifying personal weight status could possibly be due to a number of factors including social and cultural factors (Chang & Christakis 2001; and Chang & Christaks, 2003), and media influences (Malinauskas, Raedeke, Aeby, Smith, Dallas 2006). Furthermore, the issues of unhealthy dieting practices and the misclassifications of weight status have gained prevalence in the female population. For example, Ackard, Croll, and Kearney-Cooke (2002) noted female participants dieted more frequently when their ideal body size was smaller than their current size or they perceived their current weight to be higher.

**Body Mass Index**

A widely accepted method of assessing the appropriateness of one’s weight is body mass index (BMI), and is calculated with the following equation: $\text{BMI} = \frac{\text{weight (kg)}}{\text{height}^2 \text{ (m)}}$. According to the Centers for Disease Control (2011), BMI is a good alternative for direct measurements of body fat. Furthermore, the use of BMI is recommended in clinical settings because of its capacity to assess increased body fat in individuals (Daniels, 2009). BMI also serves as a useful screening tool when attempting to identify potential weight related health problems (CDC, 2011). By calculating BMI, individuals can be placed into weight categories. The Centers for Disease Control and Prevention (CDC, 2011) identifies the weight categories as underweight (<18.5 kg/m$^2$), healthy weight (18.5-24.9 kg/m$^2$), overweight (25.0-29.9 kg/m$^2$), and obese (>30 kg/m$^2$). BMI is a useful method for the assessment of population or group weight.
Therefore, BMI is often used in studies with a large sample size because of its easy calculation and low cost.

**Body Weight Perception**

Despite the accuracy and simplicity of calculating BMI, individuals routinely assess themselves based on their ideal body weight perception. Previous research notes the inaccuracy of an individual’s weight perception when compared to actual BMI measures (Desmond, Price, Gray & O’Connell, 1986; Strauss, 1999; Dorsey, Eberhardt, & Ogden, 2009), meaning individuals either place themselves in a lighter or heavier weight category. The results from Harring, Montgomery, and Harding (2010) indicated more than 36% of participants perceived themselves as overweight or obese, yet only 31% were actually in these weight categories. There are also variations in self-perception of weight between different weight categories. Chang and Christakis (2001) noted healthy weight and underweight individuals were more likely to overestimate their weight, whereas overweight individuals underestimated their weight.

Research indicates individuals in a given weight category commonly perceive their weight differently than those in other weight categories, and also notes variation in the self-perception of weight between genders (Connor-Greene, 1998; McCreary & Sadava, 2001; Kuchler & Variyam, 2003; Talamayan, Springer, Kelder, Gorospe, & Joye, 2006). Although these studies suggest both men and women have inaccurate weight perceptions, they also indicate women are more likely to overestimate their weight than men (Connor-Greene, 1998; McCreary & Sadava, 2001; Kuchler & Variyam, 2003; Talamayan et al., 2006). In the study of Kuchler and Variyam (2003), 59% of males were classified either overweight or obese, however only 44.2% identified themselves in those categories. In contrast, while 50.5% of females were either overweight or obese, 60.1% placed themselves in those categories (Kuchler & Variyam, 2003).

These studies identify potential inaccuracies of body weight perception and variations in the self-perception of weight between weight categories and genders. They also suggest body weight perception should be examined when identifying how individuals select their particular dieting strategies (Desmond et al., 1986; and Strauss, 1999).

**Body Weight Perception and Dieting Practices**

Research demonstrates a strong correlation between an individual’s self-perception of weight and weight control behaviors (Desmond et al., 1986; Strauss, 1999). These correlations suggest individuals potentially select dieting practices based on their personal body weight perceptions rather than standardized weight categories. Because individuals commonly select their dieting practices based on personal perceptions of weight and these perceptions are potentially inaccurate personal perceptions of weight, they have an increased risk of using inappropriate dieting practices.

The study of Wharton, Adams, and Hampl (2008) found women with inaccurate weight perceptions were two times more likely than those with accurate perceptions to engage in inappropriate dieting behaviors. Furthermore, in an earlier study conducted by Ackard, Croll, and Kearney-
Cooke (2002), the dieting frequency of female participants had an inverse relationship with the participants’ ideal body size and direct relationship with their current self-perceived size. These relationships suggest if a participant’s ideal body size was smaller than her current size or if she perceived her current weight to be higher, she dieted more often than females who did not have these perceptions about their weight (Ackard et al., 2002).

If, as stated by previous research (Chang & Christakis, 2001), healthy and underweight individuals tend to overestimate their weight, whereas overweight and obese individuals tend to underestimate their weight, various negative health outcomes can occur in those in the different weight categories. For example, if an underweight or healthy weight individual overestimates her weight she may lose weight based on her inaccurate self-perceptions, and potentially reach extreme levels of underweight. According to the research of Flegal, Graubard, Williamson, and Gail (2005), increased mortality is associated with underweight. Conversely, if an overweight or obese individual underestimates her weight and feels she is an appropriate weight, she may be less likely to attempt weight loss. Long-term overweight and obesity can result in negative health consequences such as an increased risk of developing hypertension, Type 2 diabetes, and cardiovascular disease (Pi-Sunyer, 1993). In addition to inaccurately perceiving their weight, the research of Lowry, Galuska, Fulton, Wechsler, Kann, and Collins (2008), noted that female college students are highly susceptible to engaging in a number of unhealthy dieting strategies to lose weight.

Purpose of the Study

Research in this area has been conducted with high school students (Brener, Eaton, Lowry, McManus, 2004; Talamayan et al., 2006) and students attending large universities (Wharton, Adams, & Hampl, 2008); however, current research for students attending smaller, Midwestern universities is lacking. The purpose of this study was to investigate whether female students attending a small, Midwestern university had accurate body weight perceptions when compared to their BMI. For this study, the investigator defined body weight perception as an individual’s personal attitude toward her current body weight and its appropriateness, independent of medical definitions, actual BMI, and the opinions of others. Additionally, the investigator also examined whether females in different weight categories had accurate perceptions compared to those in other weight categories. Lastly, this study investigated if there were relationships between the following variables: personal body weight perception and dieting practices, and BMI and dieting practices.

Methodology

A 41-item survey developed specifically for this study received Institutional Review Board (IRB) approval. The survey was a compilation of questions written by the investigator and modified questions selected with approval from the primary investigator of Project EAT II – Survey for Young Adults (Neumark-Sztainer et al. 2004) and the Project EAT III
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Survey (Neumark-Sztainer et al. 2009). Eleven questions assessed the students’ personal body weight perceptions and weight management goals, five questions examined eating habits, 20 questions determined the dieting or weight management behaviors of the participants, one question identified past eating disorders, and four were demographic items (e.g., sex, age, year in school, and ethnicity).

As a pilot test, the survey was administered in two separate sessions to approximately 50 students. The students were instructed to complete the survey and note any unclear or ambiguous questions. After reviewing the students’ comments, the survey was revised and re-approved by the university’s IRB committee.

Participants were recruited from a list of all students obtained from the university’s Information Technology Services. Emails were sent to students inviting them to participate in the study and explaining the available incentives for participation. The sample for this study was 69 female students (aged from 18-23 years old) from a small Midwestern university. Participants were given the opportunity to enter a drawing to win a gift card for $10, $15, or $20. Additionally, they could select a t-shirt and granola bars after participation.

In scheduled sessions, participants reported to the university’s Human Performance Laboratory for height and weight measurements performed by the researcher, and survey completion. To ensure confidentiality, each participant was assigned a number and had her measurements taken discretely by the researcher. The same measurement equipment was used throughout data collection; heights were measured using a stadiometer, and weights were measured on a digital scale. Following the participants’ measurements, they completed the survey labeled with their corresponding number. After survey completion, they entered their name into the gift card drawing and select incentives.

The survey consisted of ordinal data (body weight perceptions and body mass index) and nominal data (dieting habits). To assess the dieting practices of the participants, all dieting practices of each participant were compiled into two indices: the past dieting index and the current dieting index. These two indices were created by totaling the number of past and current dieting practices reported on the survey. The past dieting index ranged from 0-29 dieting practices, and the current dieting index ranged from 0-17 dieting practices. Personal body weight perceptions were quantified by adding the participants’ responses to three survey questions and then creating a Likert scale (see Table 1). Each potential response was assigned a number from one to five; one was most negative and five was most favorable. The participants’ responses to the three questions were totaled to create an overall personal body weight perception for each participant. The personal body weight perception of each participant ranged between 3-15. A score ranging from 3.00-5.99 was defined as very negative, 6.00-8.99 was described as negative, 9.00-11.99 was listed as positive, and a score of 12 or more was identified as very positive.

Descriptive statistics and a series of linear regressions were used for data analyses. Using descriptive statistics, the investigator examined the differences between the students’ personal body weight perceptions and their BMIs, and determined if their perceived weight categories were
accurate. Linear regressions were calculated to determine the presence and strength of relationships between the following variables: personal body weight perceptions and dieting practices; and BMI and dieting practices.

Table 1. Questions Used to Quantify Personal Body Weight Perception

<table>
<thead>
<tr>
<th>Survey Questions</th>
<th>1</th>
<th>2</th>
<th>Responses</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>How Satisfied are you with your current weight?</td>
<td>Very</td>
<td>Dissatisfied</td>
<td>Neither Satisfied nor Dissatisfied</td>
<td>Satisfied</td>
<td>Very Satisfied</td>
<td></td>
</tr>
<tr>
<td>How does your weight make you feel?</td>
<td>Very Unattractive</td>
<td>Unattractive</td>
<td>Neither Unattractive nor Attractive</td>
<td>Attractive</td>
<td>Very Attractive</td>
<td></td>
</tr>
<tr>
<td>I find myself consistently preoccupied with or worried about my weight.</td>
<td>Strongly Agree</td>
<td>Agree</td>
<td>Neither Agree nor Disagree</td>
<td>Disagree</td>
<td>Strongly Disagree</td>
<td></td>
</tr>
</tbody>
</table>

Results

Overall, 69 female students responded to the survey. The mean age of the participants was 20.3 years ($SD = 1.4$). The majority (75.4%) of the respondents were Caucasian, while 11.6% were African American, 8.7% were Asian or Asian American, and 4.3% were Latino or Hispanic. These percentages were not proportionate to the racial composition of the university’s female population (Caucasian 81%, African Americans 4%, Hispanic 3%, Asian 2%, and 9% “Other”).

The mean BMI of all the participants was 23.68 kg/m$^2$ ($SD = 4.11$). This BMI would be considered the healthy weight for individuals. The lowest BMI recorded was 17.05 kg/m$^2$ and the highest BMI recorded was 37.73 kg/m$^2$. Overall by BMI, 4.3% of participants were underweight, 68.2% were healthy weight, 17.4% were overweight, and 10.1% were classified as obese (see Table 2). In contrast, when asked to describe their weight, 52.2% of participants classified themselves as healthy weight or about the right weight, 37.7% classified themselves as somewhat overweight, 7.2% classified themselves as somewhat underweight, and 2.9% classified themselves as very overweight or obese (see Table 2). Using the medical standards for weight, 22 of the participants (31.9%) misclassified their weight category.

Among the underweight participants, 66.7% correctly identified
themselves as underweight, and 33.3% incorrectly identified themselves as healthy weight (see Table 3). Of the healthy weight participants, 72.3% correctly identified themselves as healthy weight, whereas 6.4% identified themselves as underweight, and 21.3% identified themselves as overweight. Among the overweight participants, 83.4% correctly identified themselves as overweight, but 8.3% identified themselves as a healthy weight, and 8.3% identified themselves as obese. Of the obese participants, only 14.3% correctly identified themselves as obese, whereas 85.7% incorrectly identified themselves as a healthy weight.

Table 2. Comparison Between Actual and Perceived Weight Categories

<table>
<thead>
<tr>
<th></th>
<th>% of Participants in Each Weight Category</th>
<th>% Self-Classification by Personal Body Weight Perception</th>
</tr>
</thead>
<tbody>
<tr>
<td>Underweight</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Healthy Weight</td>
<td>4.3</td>
<td>7.2</td>
</tr>
<tr>
<td></td>
<td>68.2</td>
<td>52.2</td>
</tr>
<tr>
<td>Overweight</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Obese</td>
<td>17.4</td>
<td>37.7</td>
</tr>
<tr>
<td></td>
<td>10.1</td>
<td>2.9</td>
</tr>
</tbody>
</table>

Table 3. Percent of Misclassifications Due to Inaccurate Personal Body Weight Perception

<table>
<thead>
<tr>
<th></th>
<th>% Underestimated</th>
<th>% Overestimated</th>
<th>% Correctly Identified</th>
</tr>
</thead>
<tbody>
<tr>
<td>Underweight</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Healthy Weight</td>
<td>0.0</td>
<td>33.3</td>
<td>66.7</td>
</tr>
<tr>
<td></td>
<td>6.4</td>
<td>21.3</td>
<td>72.3</td>
</tr>
<tr>
<td>Overweight</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Obese</td>
<td>8.3</td>
<td>8.3</td>
<td>83.4</td>
</tr>
<tr>
<td></td>
<td>85.7</td>
<td>0.0</td>
<td>14.3</td>
</tr>
</tbody>
</table>

The mean personal body weight perception score for all participants was 9.16 (SD = 2.62). Using the investigator’s personal body weight perception scale, this score was considered a positive score. However, when examining the mean personal body weight perception scores of the different weight categories, as weight increased the personal body weight perception of participants became more negative. The underweight group had the highest mean (12.33, SD = 0.58) or most positive personal body weight perception (see Table 4). The mean personal body weight perception score of the healthy weight group was 9.85 (SD = 2.48), the mean score for the overweight group was 7.25 (SD = 1.66), and the mean perception score of the obese group was 6.43 (SD = 0.79). See Table 4.

Using linear regression, BMI and the past dieting index had a moderately strong positive relationship (r = 0.488, p = 0.000) with one another (see Table 5). This was statistically significant at the 99.9% confidence interval, indicating the females with a higher BMI were more likely to have tried a greater number of different dieting practices in the past. Although
there was a significant, moderately strong positive relationship between BMI and the past dieting practices, there was no statistically significant relationship between the females’ BMI and current dieting index (see Table 5).

The personal body weight perception of the participants was more closely associated with the past and current dieting practices indices. The perceptions of students had a strong, negative relationship \( (r = -0.621, p = 0.000) \) with the students’ past dieting index (see Table 5). This relationship was statistically significant at the 99.9% confidence level. Furthermore, this relationship was slightly stronger than the relationship between personal body weight perception and the current dieting index. The personal body weight perceptions and current dieting index had a strong, negative relationship \( (r = -0.398, p = 0.001) \) and was statistically significant at the 99% confidence level (see Table 5). Both of these relationships suggest the more negative the body weight perception students had towards their weight or shape, the more dieting practices they likely used in the past or were currently using.

**Table 4. Average Personal Body Weight Perception Among Weight Categories**

<table>
<thead>
<tr>
<th></th>
<th>Underweight</th>
<th>Healthy Weight</th>
<th>Overweight</th>
<th>Obese</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean Personal Body Weight Perception</td>
<td>12.33 (± 0.58)</td>
<td>9.85 (± 2.48)</td>
<td>7.25 (± 1.66)</td>
<td>6.43 (± 0.79)</td>
</tr>
</tbody>
</table>

**Table 5. Linear Regression: Relationships Between BMI and Dieting Practices, and Personal Body Weight Perception and Dieting Practices**

<table>
<thead>
<tr>
<th></th>
<th>Past Dieting Index</th>
<th>Current Dieting Index</th>
<th>r</th>
<th>Sig</th>
</tr>
</thead>
<tbody>
<tr>
<td>BMI</td>
<td>0.488</td>
<td>0.179</td>
<td>0.000*</td>
<td>0.142</td>
</tr>
<tr>
<td>Personal Body Weight Perception</td>
<td>-0.621</td>
<td>-0.398</td>
<td>0.000*</td>
<td>0.001*</td>
</tr>
</tbody>
</table>

Note. * \( p \leq 0.001 \)

Since perception was so strongly related to the both the past and current dieting behaviors of all participants, linear regressions were run among the separate weight groups to determine the strength of relationships between the personal body weight perception and dieting practices of each weight group. Among the underweight participants, there were no statistically significant relationships between their personal body weight perceptions and both past \( (r = -0.596, p = 0.593) \) and current \( (r = -0.500, p = 0.667) \) dieting indices. Refer to Table 6. For the healthy weight individuals, perception was strongly related to both past \( (r = \)
-0.528, \( p = 0.000 \)) and current \((r = -0.455, \ p = 0.001)\) dieting indices (see Table 6). These relationships were statistically significant at the 99.9% confidence interval. Among the participants in the overweight category there was no statistically significant relationship between personal body weight perceptions and both past \((r = -0.479, \ p = 0.115)\) and current \((r = -0.398, \ p = 0.686)\) dieting indices. Refer to Table 6. Lastly, among the obese participants there was not a statistically significant relationship between their personal body weight perceptions and past dieting index \((r = 0.212, \ p = 0.648)\). However, there was a statistically significant relationship between their personal body weight perceptions and current dieting index \((r = 0.898, \ p = 0.006)\). This relationship was statistically significant at the 99% confidence interval. Refer to Table 6.

### Table 6. Relationship of Personal Body Weight Perception and Indices of Dieting Practices Among Weight Categories

<table>
<thead>
<tr>
<th>Weight Categories</th>
<th>( r )</th>
<th>Sig</th>
</tr>
</thead>
<tbody>
<tr>
<td>Underweight</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Healthy Weight</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Past Dieting Index</td>
<td>-0.596</td>
<td>0.593</td>
</tr>
<tr>
<td>Current Dieting Index</td>
<td>-0.500</td>
<td>0.667</td>
</tr>
<tr>
<td>Past Dieting Index</td>
<td>-0.528</td>
<td>0.000*</td>
</tr>
<tr>
<td>Current Dieting Index</td>
<td>-0.455</td>
<td>0.001*</td>
</tr>
<tr>
<td>Overweight</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Obese</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Past Dieting Index</td>
<td>-0.479</td>
<td>0.115</td>
</tr>
<tr>
<td>Current Dieting Index</td>
<td>-0.398</td>
<td>0.686</td>
</tr>
<tr>
<td>Past Dieting Index</td>
<td>0.212</td>
<td>0.648</td>
</tr>
<tr>
<td>Current Dieting Index</td>
<td>0.898</td>
<td>0.006**</td>
</tr>
</tbody>
</table>

Note. \( * \ p < 0.001; ** \ p < 0.01 \)

### Discussion

This present study compared female university students’ personal body weight perceptions to their actual body mass index. The researcher also investigated whether there were relationships between the following variables: body weight perception and dieting practices; or body mass index and dieting practices. The findings of this study aligned with the results of previous literature in that many participants were inaccurate in their self-perception of weight (Desmond, Price, Gray & O’Connell, 1986; Strauss, 1999; Dorsey, Eberhardt, & Ogden, 2009; Harring, Montgomery, & Harding, 2010). For example, in the research of Harring et al. (2010), 31% of participants were by medical standard overweight or obese, yet more than 36% incorrectly perceived themselves to be in these categories. Of all participants in the study, 28% had inaccurate weight perceptions (Harring et al., 2010). In the current study, approximately 32% of participants incorrectly identified their weight groups.

Although, nearly one-third of all participants in this study incorrectly identified their weight category, the obese category had the highest occurrence of incorrect categorizations; 85.7% of obese participants underestimated their weight. In contrast, the overweight category had
the highest occurrence of correct categorizations. Over 83% of overweight participants correctly identified their weight category. The incorrect identification of weight status among the obese weight category could possibly be explained by the wording of the survey question used to assess this matter. The question read “How do you describe your current weight?” with the following possible responses: “very underweight,” “somewhat underweight,” “about the right weight,” “somewhat overweight,” and “very overweight.” The obese participants may have truly been aware of their weight status as obese (very overweight) but did not feel comfortable selecting the response of “very overweight” and instead selected “somewhat overweight”. However, it is plausible they simply were not aware of their obese weight status. Additionally, the participants’ responses to this question indicate there were variations in self-perception of weight between the weight categories. Among the underweight and healthy weight groups, there were more instances of weight overestimation, and in the obese weight group there were more instances of underestimation of weight.

Finally, the results of this study suggest a strong relationship between personal body weight perceptions and the selection of dieting practices. This relationship is similar to those found in previous literature (Desmond et al., 1986; Strauss, 1999; and Ackard, Croll, & Kearney-Cooke 2002). The studies of Desmond et. al (1986) and Strauss (1999) noted that there is a correlation between an individual’s self-perception of their weight and his or her weight control behaviors. These correlations suggest that a potential factor in the selection of weight control methods is the self-perception of weight. Additionally, the research of Ackard et al. (2002) found that the dieting frequency of female participants was positively associated with their current self-perceived size. This relationship suggests that female participants who perceived their weight to be higher dieted more frequently. The current study notes there were strong negative relationships between the females’ personal body weight perception and both past and current dieting indices. These relationships indicate the more negative the participant’s personal body weight perception, the more dieting practices she had used or was using at the time of the study.

Regarding the relationships between personal body weight perception and dieting practices among the different weight categories, the investigator has no explanation as to why the personal body weight perception of the healthy weight group had statistically significant relationships with both dieting indices or why these relationships were not seen among overweight participants. Based on the results seen in this study, it is logical to assume since the overweight weight group had a more negative personal body weight perception (7.25), both dieting indices would be associated with their personal body weight perceptions. Yet, these results demonstrate a different outcome. Further research should investigate why perception in the healthy weight group was more strongly related to this group’s dieting practices. Additionally future research should investigate why the perceptions of the overweight participants were positively associated with their selection of current dieting practices. This relationship contradicts the previous relationships seen in this study; it indicates the more positive the participants’ personal body weight perceptions, the more dieting
practices they were likely to have been using at the time of this study.

Limitations
There were several limitations to this study which should be noted. This study used a volunteer, convenience sample, and was not a true random sample. Additionally, the sample was relatively small in size and the ratio of ethnicities was not representative of the university’s female population. A final limitation of this study was the participants were able to see their weight before they completed the survey. Seeing their actual weight could have either positively or negatively influenced participants as they subsequently answered the survey questions (i.e., if they had unknowingly gained or lost weight).

Conclusion
Despite its limitations, the results of this study coincide with results demonstrated in previous studies (Desmond et al., 1986; Strauss, 1999; Chang & Christakis, 2001; and Ackard, Croll, & Kearney-Cooke 2002). The personal body weight perceptions of individuals in the current study were more associated with their selection of dieting practices than their BMIs. Additionally, this study supports the similar observed variations between the perceptions of different weight categories noted in another research study (Chang & Christakis, 2001). Many individuals in the underweight and healthy weight categories overestimated their weight, whereas those in the obese category underestimated their weight. These variations in perception can have different health outcomes for the females in the different weight categories. Women who are healthy weight by BMI but decide to lose weight based on their inaccurate body weight perceptions are at an increased risk for reaching an unhealthy weight. Conversely, women who overweight or obese by BMI and decide not to lose weight due to their inaccurate weight perceptions have an increased risk for long-term health consequences such as diabetes, heart attack, and stroke. These results emphasize the need for campus health educators and wellness program coordinators to implement health programs for women focused on using appropriate dieting practices to achieve healthy weights. These programs may assist female university students in selecting safe and healthy dieting practices while reducing the incidence of obesity among college students.

Acknowledgement
Sincere thanks are owed to Dianne Neumark-Stzainer, PhD, MPH, RD, principal investigator, of the Project EAT (Eating Among Teens) for permission use questions from Project EAT – Survey for Young Adults and the Project EAT III Survey. Additionally, Dr. Janice Clark is thanked for her mentorship and guidance throughout the duration of this research study.
References


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Refereed Paper

Relationship Between Athletic Aggression, Drive for Muscularity, Masculinity, and Injury in Collegiate Football Players

William D. Russell and Megan Reynolds

American football has the highest injury rate in collegiate sports (Hootman, Dick, & Agel, 2007) and a contributing factor may be tolerant attitudes of injury tied to masculinization (Young, McTeer & White, 1994; Messner, 1992). Collision sports like football may be vulnerable to norms that athletes accept risk, play through pain, and subject their bodies to danger as indicators of a “true” athlete (Coakley, 2009). Since more masculine attitudes may be associated with higher sports violence rates (Liston, Reacher, Smith, & Waddington, 2006) and collision-sport athletes have higher inherent injury risk, athletes with more masculine attitudes may be exposed to social norms putting them at greater risk for injury. The purpose of this study was to examine the relationship between male athletes’ masculinity perceptions, aggression attitudes, drive for muscularity, and self-reported athletic injury. A sample of NCAA Division II and III male football players (N = 227) was assessed on their athletic injury history over a one-year period and on their athletic aggression attitudes, drive for muscularity, and masculinity. MANOVA indicated a nonsignificant effect between injury status for the 12-month period on aggression, drive for muscularity, and masculinity (Wilk's Lambda =.987, F(3,223) =.995, p>.05). Since normalization of athletic injury may occur over an extended time period, and may be more prominent at higher competitive levels (Curry, 1993), future research should examine this relationship in higher-skilled, more experienced athletes in their sport such as NCAA Division I level athletes.

Key Words: Aggression, athletic injury, masculinity, sport, muscularity, football

Collision sports (e.g. rugby, American football) have higher inherent risks for injury than noncontact sports (Dekker, Kingma, Groothoff, Eisma, & Ten Duis, 2000; Hootman, Dick, & Agel, 2007), and collision sports such as football, have the highest injury rates in college sports. For example, concussion rates and anterior cruciate ligament (ACL) injuries have significantly increased, and in collegiate football the vast majority
of severe injuries (10 or more days of activity time loss) are due to knee and ankle injuries from direct player contact (Dick et al., 2007; Hootman et al., 2007). Rates of disabling injuries are high enough in many sports to constitute a serious health issue. For example, Dick et al. (2007) noted that in college football, 27% of fall game injuries, 25% of fall practice injuries, and 34% of all spring practice injuries could be classified as severe. Less is known, however, regarding influences of athletes’ attitudes towards masculinity and athletic aggression upon athletic injury.

Aggression is defined as “any form of behavior directed toward the goal of harming or injuring another living being who is motivated to avoid such treatment” (Barron, 1977, p. 7), and is considered a behavioral outcome (Anshel, 2012). Unsanctioned aggression is often viewed as illegal and unsportsmanlike, but there are social situations in which aggression in sport is encouraged and may even be perceived as appropriate. For example, when aggression occurs in connection with enforcing norms or overconforming to widely accepted norms, it may be viewed as necessary to preserve order, reaffirm social values, or for entertainment (Coakley, 2009). Violence involving overconformity to norms is more likely to be seen as entertaining and may be used by athletes as a mark of one’s status, especially in football, where putting one’s body on the line for the team is viewed as a sign of dedication (Mills, 1997; Young, 1993). Sport sociology research has examined sports deviance within the framework of the “sport ethic”, which comprises a set of interrelated norms that often guide actions within what have been called “power and performance” sports (Hughes & Coakley, 1991; Coakley, 2009). Included in these interrelated norms are the notions that: (1) athletes are dedicated to “the game” above all else, (2) athletes strive for distinction, (3) athletes accept risk and play through pain, and (4) athletes accept no obstacles in pursuing success (Coakley, 2009).

The norm that highly skilled athletes accept risks and play through pain is of particular concern as it relates to injury. According to this norm, athletes are expected to endure pressure, pain, and fear without backing down from competitive challenges; both male and female athletes learn this norm through organized sports participation (Curry, 1993; Malcom, 2006; Pedersen, 2007). This mindset indicates that athletes should embrace the risk for pain, injury, and disability while subjecting one’s body to danger and experiencing pain is the mark of a “true” athlete (Coakley, 2009; Young, McTeer, & White, 1994). The ‘sport ethic’ is linked to deviance because overconformity to its norms is expected in many sports, and behaviors associated with the sport ethic may lead to injuries that damage athletes’ health and well-being. Athletes most likely to engage in deviant overconformity are male athletes who link their identities as athletes and men so they become one in the same in their minds (Coakley, 2009). For these individuals, sport becomes viewed as a context for expressing masculinity, where violence and athletic injury are legitimized (Curry, 1991; Young, 1993). Support also exists for the relationship between athletes’
masculine attitudes and sport violence. For example, Young et al. (1994) examined how participation in physically demanding sports, with injury potential, reinforces dominant masculinity norms. Research with hockey players indicates that sport practices which emphasize forceful notions of masculinity are highly valued and view serious injury as a masculinizing experience (Weinstein, Smith, & Wiesenthal, 1995).

While not limited to males, sport violence may be best understood in terms of gender ideology (Messner, 1992). Male athletes tend to report more risk-taking behaviors related to injury than females (Cobb, Cairns, Miles, & Cairns, 1995) and “high-risk” contact sports have become important ways to prove masculinity (Ingham & Dewar, 1999); Male athletes often learn that they are evaluated in terms of their ability to exhibit violence in combination with their sport skills (Lance, 2005) and this process often begins in youth sports (Coakley, 2009). When gender is viewed in these terms, the ability to exhibit violent behavior becomes a “cornerstone of masculinity” (White & Young, 1997, p. 9).

Athletes in contact sports often learn to use intimidation, aggression, and violence as competitive strategies, and male athletes readily accept certain forms of violence which increase the rate of resultant injuries (Shields & Bredemeier, 1995; Weinstein, Smith, & Wiesenthal, 1995; White & Young, 1997). Athletes invariably maintain perceptions of the role and appropriateness of aggression within their sport. Sports traditionally categorized as more “masculine,” for instance, are also more aggressive, and perceived legitimacy for aggression in both male and female college athletes has been shown to be highest in collision sports.

No research that the authors are aware of has examined the relationship between masculinity, attitudes toward athletic aggression, and sports injury prevalence. An important step in athletic aggression research is examining possible links between masculinity attitudes, athletic aggression attitudes, and resultant injuries that may occur as a result of favorable attitudes toward aggression in that sport. In addition, since research shows that greater masculinity is related to more positive attitudes toward playing with pain and injuries (Coakley, 2009; Curry, 1993; Nixon, 1992; 1996; Young et al., 1994), a stronger masculine identity may be related to higher injury prevalence, especially in collision sports. Given that stronger masculine attitudes in male athletes are related to higher rates of sports violence (Young, et al., 1994; Liston et al. 2006) and collision sports have a higher injury risk (Hootman et al. 2007), male athletes with more masculine attitudes may be more vulnerable to social norms putting them at risk for sport-related injury. Thus, the purpose of this study was to examine the relationship between attitudes toward athletic aggression, drive for muscularity, perceptions of masculinity, and athletic injury prevalence among intercollegiate football players. The first hypothesis was that football players who reported incurring a football-related injury would be higher in their athletic aggression, drive for muscularity, and perceptions of masculinity than uninjured athletes. The
second hypothesis was that athletic aggression, drive for muscularity, and masculinity would be predictive of football-related athletic injury over a 12-month period.

Method

Participants
Upon approval from institutional review boards and university athletic departments, a convenience sample of 227 NCAA Division II (n=105) and Division III (n=122) male football players, ranging in age from 17 to 27 years (M=19.77 years, SD=1.56) was surveyed. The current sample of athletes reported an average of more than nine years of competitive football experience (M=9.27 years, SD=3.19). The athletes were administered an inventory that included questions about their injury history due to football within the previous 12 months.

Measures
A brief survey was developed for this study to examine the incidence, timing, type, and severity of athletes’ injuries, length of rehabilitation from injuries, as well as emotional reactions to injuries.\(^1\) In order to classify injury status, participants were asked, “Within the last 12 months, have you experienced an injury that was directly related to your sport (either during performance or while training for that sport)?” Survey packets also included a measure of athletic aggressiveness and anger (the Competitive Aggressiveness and Anger Scale (CAAS), Maxwell & Moores, 2007), a measure of muscularity attitudes (the Drive for Muscularity Scale (DMS), McCreary & Sasse, 2000) and a measure of masculinity and femininity (Bem Sex Role Inventory (BSRI), Bem, 1974). Of the overall sample, 135 players (59.4%) reported incurring a football-related injury in the previous 12 months. Injured athletes were asked to indicate, on a scale from 1-10 (10 being the most severe) the perceived severity of their injury. In addition, injured athletes were also asked to indicate the amount of competition they missed (ranging from none to five or more games), due to their injury. Injured athletes were also asked to report the degree to which they felt they were currently recovered from their injury (0% - 100% recovered). Finally, athletes who reported an injury were asked to indicate their motivation level during rehabilitation (1=not at all motivated to 10=extremely motivated). Table 1 displays means and standard deviations from injured athletes on self-reported injury severity, rehabilitation length, injury recovery status, and motivation during rehabilitation.

Competitive Aggressiveness and Anger Scale. The CAAS (Maxwell & Moores, 2007) is a 12-item instrument consisting of two subscales (athletic aggression and anger) and is designed to measure these related concepts in competitive athletes. Items on the CAAS are set to a likert scale (1=almost never to 5=almost always) and measure an athlete’s frequency of anger-related behaviors and aggressiveness in athletic situations. An example of an anger subscale item is “I show my irritation when frustrated during a
game”. An example of an aggressiveness subscale item is “It is acceptable to use illegal physical force to gain an advantage”. Internal consistency coefficients of .87 to .91 have been reported, and test-retest correlations (.88) also support the reliability of the CAAS (Maxwell & Moores, 2007).

**Drive for Muscularity Scale.** The DMS (McCreary & Sasse, 2000) is a 15-item measure of the extent to which people desire to have a more muscular body. Items on the DMS represent a combination of attitudes and behaviors and are scored on a 6-point Likert scale ranging from 1 (very much like me) to 6 (not at all like me). All items are reversed-coded so that higher scores reflect a greater drive for muscularity. The DMS produces an overall score by asking participants to respond to items such as, “I feel guilty if I miss a weight training session” and “I think I would feel more confident if I had more muscle mass”. Support for convergent validity for the DMS has been found with its significant correlation with psychological indicators of body image disorders (e.g., higher depression, lower self-esteem; McCreary & Sasse, 2000). Cafri and Thompson (2004) reported 7 to 10 day test-retest correlations of .93. Finally, McCreary (2007) reported scale reliability coefficients ranging between .85 and .91 with males.

**Bem Sex Role Inventory.** The BSRI (Bem, 1974) was used to measure masculinity traits in the current sample. The BSRI consists of two subscales: Masculinity (BSRI-M) and Femininity (BSRI-F), made up of 20 adjectives each. Example adjectives include “acts as a leader” and “tender” for the BSRI-M and –F, respectively. Respondents rate the extent to which they identify with each of the adjectives on a scale ranging from 1 (never or almost never true) to 7 (always or almost always true). Item ratings are averaged for each subscale, with higher scores reflecting greater endorsement of the subscale trait. Original reliability test resulted in Cronbach alphas of .86 for BSRI-M and .80 for BSRI-F items, and test-retest reliability of .90 for both subscales. More recently, Hermann and Betz (2004) reported Cronbach alphas of .87 for BSRI-M and .86 for BSRI-F items. For the purpose of this study, only the BSRI-M subscale was used.

**Procedures**

After obtaining project approval from university Institutional Review Boards, the first author contacted athletic administrators and coaches who agreed to make football players available for voluntary participation in the study without compensation. All surveys were administered prior to a regularly scheduled team practice. Coaches and other team staff were not present at any time during the data collection period. Participants took approximately 10 minutes to complete the survey packet. Surveys were number coded for anonymity and participants were informed that their data would be kept confidential. In addition, in accordance with IRB, they were allowed to not participate or to discontinue their participation in the study at any time without negative repercussions.
Data Analysis

All analyses were conducted using SPSS 17.0 for Windows (SPSS Inc., Chicago, IL). Multivariate analysis of variance (MANOVA) was computed to determine differences between injured and uninjured college football players on their athletic aggression, drive for muscularity, and masculinity. Injury status for the 12-month period (injured, uninjured) was used as the independent variable and athletic aggression (CAAS total score), drive for muscularity (DMS total score), and masculinity (BSRI-M score) were dependent variables. Logistic regression was also computed to determine whether athletic aggression, drive for muscularity, and masculinity were predictive of football players’ injury status over a 12-month period. All differences were considered significant at \( p < 0.05 \) level.

Results

Descriptive Data

Means and standard deviations for athletic aggression, drive for muscularity, and masculinity traits, by injury status, are displayed in Table 2. Concussions (\( n=14, 10.4\% \)) and ankle sprains (\( n=13, 9.6\% \)) were the most frequently reported injuries within the previous 12 months (Figure 1) and data mirrored previous NCAA football injury data (Dick et al., 2007) that indicates the most frequently reported injuries (75.8\%) are from knee internal derangements, ankle ligament sprains, concussions, and hamstring pulls. Among players reporting an injury, 22 players (16.3\%) reported their injury occurred in the off-season, 35 (25.9\%) reported the injury occurrence in the pre-season, 67 (49.6\%) reported their injury occurred mid-season, and 11 (8.1\%) indicated they suffered their injury at the end of the season. In terms of competition missed from injury, 104 (78\%) reported missing one game (or less).

Quantitative Analyses

Results from a one-way MANOVA examining injury status on athletic aggression (CAAS total score), drive for muscularity (DMS), and masculinity (BSRI-M) were nonsignificant, Wilk’s Lambda =.987, \( F(3,223)=.995, p=.40 \). These results indicated that athletes’ self-reported injury status (injured, not injured) for the 12-month period did not differentiate injured from non-injured athletes on their athletic aggression, drive for muscularity, or masculinity. In addition, logistic regression results, conducted to determine whether athletic aggression, drive for muscularity, and masculinity traits were predictive of football players’ injury status over a 12-month period, were also nonsignificant (Model \( X^2 \) (3) =3.04, \( p=.39 \)), indicating none of these variables were significant predictors of 12-month injury incidence in this sample of athletes.
Table 1. Self-Reported Injury Severity, Rehabilitation Length, Injury Recovery Status, and Motivation During Rehabilitation

<table>
<thead>
<tr>
<th></th>
<th>M</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Injury Severity (1-10)*</td>
<td>5.84</td>
<td>2.05</td>
</tr>
<tr>
<td>Rehabilitation Period**</td>
<td>5.10</td>
<td>2.81</td>
</tr>
<tr>
<td>Recovery Status (0-100% recovered)</td>
<td>85.85%</td>
<td>19.60</td>
</tr>
<tr>
<td>Motivation During Rehabilitation^</td>
<td>8.30</td>
<td>2.28</td>
</tr>
</tbody>
</table>

*1 = not at all severe; 10 = very severe. **Responses coded: 1=“<3 da” 2=“3-7 da” 3=“1-2 wks” 4=“2-3 wks” 5=“3-4 wks” 6=“4-5 wks” 7=“5-6 wks” 8=“6-7 wks” 9=“7-8 wks” 10=“>8 wks”. ^1 = not at all motivated; 10 = extremely motivated.

Table 2. Athletic Aggression, Drive for Muscularity, and Masculinity by 12-Month Injury Classification

<table>
<thead>
<tr>
<th></th>
<th>Injured (n=135)</th>
<th>Not Injured (n=92)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAAS Total</td>
<td>32.50 (7.63)*</td>
<td>31.46 (7.63)</td>
</tr>
<tr>
<td>DMS Total</td>
<td>52.50 (14.03)</td>
<td>53.75 (14.06)</td>
</tr>
<tr>
<td>BSRI-M Score</td>
<td>5.16 (.79)</td>
<td>5.05 (.69)</td>
</tr>
</tbody>
</table>

*Standard deviations are in parentheses.

Discussion

The purpose of this study was to compare football players who sustained an injury during the previous 12 months with their non-injured peers on attitudes toward athletic aggression, drive for muscularity, and perceptions of masculinity. The first hypothesis was that athletes who reported incurring an injury within the previous 12 months would have significantly higher athletic aggression, drive for muscularity, and masculinity than uninjured athletes. This hypothesis was not supported in that no significant differences were observed based athletic aggression attitudes, drive for muscularity, and masculinity, based on injury status. The second hypothesis, that athletic aggression, drive for muscularity, and masculinity would be predictive of football-related athletic injury over a 12-month period, was also not supported.

Since the normalization of athletic injury may occur over extended time periods and may be more salient at higher competitive levels (Curry, 1993), this relationship may be more evident at the NCAA Division I level or in professional football players, who have greater competitive experience than the current sample of NCAA Division II and III athletes. Higher-level athletes demonstrate greater aggression than lower-level athletes (Butt & Cox, 1992), and it may be that potentially higher aggressive attitudes which drive aggressive behaviors might be associated with greater injury rates only at more elite, competitive levels of the sport.
Related to the notion of higher competitive levels is the concept of athletic identity, or “the degree to which an individual identifies with the athlete role” (Brewer, Van Raalte, & Linder, 1993, p. 237). Athletes who identify more strongly with aggressive standards are more likely to demonstrate such behaviors in competition (Maxwell & Visek, 2009), and with increased experience and competitive levels, athletes are more likely to identify with the athletic aspect of their self-identity (Brewer & Cornelius, 2001; Murphy, Petitpas, & Brewer, 1996). Evidence of this relationship exists with high school athletes, as those athletes with greater experience and at higher competitive levels demonstrate higher athletic identities (Wiechman & Williams, 1997). Athletes whose athletic identity is connected to their masculinity may also be those athletes most likely to engage in deviant overconformity (Coakley, 2009). Therefore, athletic identity may be a mediating variable between athletic aggression, masculinity, and resultant athletic injuries. Since the current sample was limited to lower division college athletes (Division II and III), their athletic identities may have been lower compared to Division I football players, whose higher athletic identities could be related to higher masculinity and athletic aggression and, in turn, be associated with greater injury rates. While this contention is speculative (athletic identity was not measured), future research should examine whether athletic identity is an important variable in the aggression-injury relationship, and whether this relationship is more salient in Division I or professional football players.

Athletes with higher skill and stronger athletic identities are also associated with more professionalized attitudes (Visek & Watson, 2005), or the extent to which emphasis is placed on winning rather than skill development and fair play (Webb, 1969). Higher competitive level athletes are also more likely to legitimize unsanctioned, aggressive sport behavior (Bloom & Smith, 1996; Conroy, Silva, Newcomer, Walker, & Johnson, 2001). Maxwell and Visek (2009) recently found that higher levels of aggressiveness and professionalism in rugby players were associated with greater likelihood that players would use aggressive force for the sole purpose of causing injury.

While muscularity has been linked with athletic identity in college football players (Steinfeldt, Gilchrist, Halterman, Gomory, & Steinfeldt, 2011) and negative outcomes such as eating disorder symptoms (Olivardia, Pope, Borowiecki, & Cohane, 2004), it has also been suggested that football players’ drive for muscularity might also be functional, in that increased muscularity can serve as a protective factor to prevent potential injuries (Steinfeldt et al., 2011). Specifically, Division II football players have cited reasons in their desire for muscularity that were related to athletic performance and injury prevention (Steinfeldt et al., 2011), supporting the notion that muscularity in football may serve functional purposes of minimizing injuries (Matthews & Wagner, 2008). While qualitative data on players’ individualized beliefs about muscularity was not obtained in the current study, the lack of relationship between DMS and injury rates could
have been explained by athletes’ views that muscularity served to protect against football-related injury. Thus, if athletes viewed muscularity in this sense, football-related injuries may have been lessened because players viewed their muscularity from a functional perspective rather than the perspective of developing the body for injurious purposes. While this contention is also speculative, future research should obtain qualitative data of athletes’ view of muscularity as it relates to injury perceptions, as well as objective information regarding athletes’ in-, pre-, and off-season strength-training routines (e.g. volumes, frequency).

This study has several limitations that should be noted. First, the experience and perceptions of football players in this sample may not generalize to other college football players from different regions, backgrounds, or higher competitive levels (e.g. NCAA Division I). Second, the results would have been strengthened by providing comparison groups from other non-collision sports (e.g. basketball, baseball, tennis) to provide a comparison of whether football players’ athletic aggression attitudes, muscularity, and masculinity differed from other college male athletes. Third, the exclusive use of self-report inventories could be considered a limitation, as use of an objective measure of aggression or ratings from teammates or coaches on resultant football injuries may have provided a stronger context for this relationship. In addition, information regarding athletic injury was from self-report data and it is acknowledged that data generated from athletic trainers may have been more objective. Finally, the Division III football players from this sample were from a faith-based, liberal arts college, and it is possible that their attitudes towards aggression may have differed from football players at other non faith-based institutions.

In conclusion, while the current investigation did not find a relationship between football players’ masculinity perceptions, aggression attitudes, drive for muscularity and self-reported athletic injury, continued research examining athletic injuries in high-risk sports and their relation to psychosocial variables remains critical. As athletic injury rates continue to increase in collision sports, attitudinal tendencies toward aggressive behavior may make certain athletes more vulnerable to athletic injury. Since normalization of athletic injury may occur over extended periods of time and may be more salient at higher competitive levels, future research should examine this relationship in higher skilled, more experienced Division I athletes.

Footnotes. 1 The author may be contacted for a copy of the instrument used in this study.
Figure 1. Most frequently reported injuries from 12-month self-report period.

*Percentage of all self-reported injuries (n=135) are in parentheses.
References


willingness to participate and perceived risk of injury. *Perceptual and Motor Skills*, 104, 201-211.


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Relationship of Anthropometric Dimensions to 1-RM Bench Press and NFL-225 Test in College Football Players

Benjamin R. Brown, Troy Williams, Katherine L. Randolph, and Jerry L. Mayhew

The purpose of this study was to assess the relationship of selected anthropometric dimensions to 1-RM bench press and the NFL-225 test in NCAA Division II college football players. Players ($n = 40$, Age = 21.2 ± 1.3 yrs, Ht = 71.8 ± 2.7 ins, Wt = 221 ± 35 lbs) volunteered to be evaluated during the summer off-season heavy-resistance training programs for 1-RM bench press and NFL-225 repetitions. Seven of 12 NFL-225 prediction equations currently available produced estimated means which were not significantly different from the actual 1-RM ($296.5 \pm 38.8$ lbs), with high correlations between predicted and actual 1RM ($ICC > 0.962$). The remaining 5 equations overpredicted by an average of $12.4 \pm 15.2$ lbs despite high correlations ($ICC > 0.960$) between predicted and actual 1-RM values. The best equation was the Hetzler et al. anthropometric equation developed on Division I players with a technical error of measurement of 9.9 lbs or 3.3%.

The one-repetition maximum (1RM) bench press technique has been the premier choice for measuring upper-body dynamic strength in most sports (Sawyer, Ostarello, Suess & Dempsey, 2002). In football, it is often the only measure employed to assess strength since it may be considered somewhat safer than the 1RM squat. When performed correctly, the bench press requires the player to begin the lift at full-arm extension, lower the weight slowly to touch the chest, and return it to full extension without arching the back. Maximal strength can be assumed when the player is able to perform only one repetition in this fashion (Ratamess, 2012, 271-272).

However, many college teams have begun to follow the model of the National Football League and employ the NFL-225 test. This test uses a weight of 225 lbs that is lifted as many times as possible before fatigue halts the action. While often termed a measure of upper body strength, the NFL-225 test is more appropriately a measure of absolute muscular...
endurance. However, several studies have noted high correlations between NFL-225 repetitions and 1RM performance and have developed prediction equations to estimate 1RM from the number of successful NFL-225 repetitions completed (Allenheilegen, 2003; Chapman, Whitehead & Binkert, 1998; Hetzler, Schroeder, Wages, Stickley & Kimura, 2010; Mann, Stoner & Mayhew, 2012; Mayhew, Ware, Bemben, Wilt, Ward, Farris, et al., 1999; Mayhew, Ware, Cannon, Corbett, Chapman, Bemben, et al., 2002; Mayhew, Jacques, Ware, Chapman, Bemben, Ward, et al., 2004; Slovak, Ward, & Mayhew, 1999; Whisenant, Panton, East & Broeder, 2003).

Despite the high correlations between NFL-225 repetitions and 1RM, some concern may exist over the amount of error associated with the prediction. In an attempt to reduce the prediction error, some investigators have incorporated anthropometric dimensions with the repetitions to estimate 1RM. Whisenant et al. (2003) were the first to suggest that the addition of variables such as fat-free weight and height would reduce the prediction error associated with estimating 1RM from repetitions alone. A subsequent study noted that anthropometric dimensions did not reduce the prediction error from NFL-225 repetitions (Mayhew et al., 2004). Most recently, Hetzler et al. (2010) indicated that such measures as arm circumference, chest circumference, and arm length improved prediction of 1RM when added to NFL-225 repetitions.

The differences noted in the studies that have included anthropometric dimensions in the prediction of 1RM from NFL-225 repetitions suggest that some controversy may exist over which variables, if any, can aid in reducing prediction error. If an NFL-225 equation is used to estimate 1RM and that 1RM value is used to establish workloads for training, large errors are possible for training loads and repetitions. Thus, it would benefit coaches, players, and strength and conditioning specialists to determine the degree to which anthropometric dimensions might aid in the prediction of 1RM bench press performance when using the NFL-225 tests.

Methods

Subjects. NCAA Division II football players (n = 40) volunteered to be measured at the conclusion of the summer off-season conditioning program. The tests were part of the routine evaluation of players prior to the start of the competitive season and hence provided an excellent atmosphere for achieving maximal performance. The study was approved by the university Institutional Review Board, and each player completed a written consent form prior to being tested. Physical and performance characteristics of the players are shown in Table 1.

Test protocols. The 1RM bench press procedure followed the widely used “touch-and-go” protocol in which the bar was required to be lowered slowly to touch the chest before being pressed immediately to full arms’ extension (Brown & Weir, 2001). During testing, each player was allowed to warm up according to personal preferences using several sets with light weights (50% - 75% of estimated 1RM). When testing began, the experience of the players allowed them to select a weight close
to their 1RM with which to perform one repetition (Brown & Weir, 2001). Following each attempt, a minimum of five minutes rest was given before the next attempt. Most players reached their 1RM within three to five attempts. Standard Olympic bar and plates were used for all lifts, and the player used a grip that was slightly wider (approximately 15-35 cm) than shoulder width.

During the week following 1RM testing, each player performed the NFL-225 test by completing as many repetitions as possible with an absolute load of 225 lbs. Players followed a similar warm-up as previously noted. The hand position on the bar was the same as used for the 1RM. No cadence was used for the repetition tests, but each player was encouraged to maintain a constant pace with no more than a two-second pause between each repetition. The bar was required to touch the chest on each repetition but was not allowed to bounce the bar off the chest. Only repetitions that touched the chest and returned to full-arm extension were counted by the certified strength and conditioning specialist.

Anthropometric protocols. Five skinfolds were measured using Harpenden calipers as described in Lohman, Roche and Martorell (1988, 55-80). Each site was measured 3 times, and the average used for analysis. Percent fat (%fat) was predicted from the sum of the five skinfolds based on previous dual-energy X-ray absorptiometry analysis. Three muscle circumferences were measured with a flexible vinyl tape at the maximum flexed arm of the dominant limb, maximum flexed forearm, and chest at midexpiration (Lohman et al., 1988: 39-54). Upper limb lengths were measured with a metal anthropometer for the arm from the acromion process to olecranon process and for the forearm from the olecranon process to styloid process (Lohman, et al., 1988: 21-23). Maximum arm span was measured from finger tip to fingertip with the player facing a wall on which had been secured a measuring tape.

A repeated measures analysis of variance was used to determine the validity of 12 NFL-225 prediction equations for estimating 1RM bench press (Table 2). Intraclass correlation coefficients (ICC) were used to evaluate the agreement between predicted and actual 1RM performances. Multivariate analysis of variance, with appropriate univariate and Tukey post hoc follow-up tests, was used to determine differences among groups that were correctly predicted and overpredicted.

Results

The correlations of physical and performance characteristics with the NFL-225 tests and 1RM are shown in Table 1. The only demographic variables that were significantly related to strength performances were those indicating muscle mass. While regional muscle measures had higher correlations with strength performances than overall muscle mass (LBM), the differences in the correlation coefficients were not significant (p>0.05).

All 12 NFL-225 prediction equations produced high correlations with actual 1RM (Table 3). Seven of the available equations produced predicted values that were not significantly different from the actual 1RM. The Hetzler et al. equation (2010) using two anthropometric dimensions with NFL-225 repetitions produced the highest percent of players (60%)
within ±10 lbs (3.4% error) of their actual 1RM. Applying those variables to the present sample indicated that NFL-225 repetitions, arm length, and air circumference contributed 97.0%, 2.7% and 0.3%, respectively, to the explained variance of the 1RM. Stepwise multiple regression on the current players selected NFL-225 repetitions and arm length to predict 1RM with no loss of accuracy from the Hetzler et al. equation (Hetzler et al., 2010) [1RM (lbs) = 308.3 + 6.29 Repetitions – 2.30 Arm Length (cm), R = 0.94, SEE = 13.9 lbs, %CV = 4.7%]. In this equation, the NFL-225 repetitions accounted for 98.1% of the variance in 1RM, leaving only 1.9% accounted for by arm length. Therefore, eliminating arm length did not diminish the prediction accuracy substantially [1RM (lbs) = 220.8 + 6.33 Repetitions, R = 0.93, SEE = 14.6 lbs, %CV = 4.9%].

Table 1. Anthropometric Dimensions and Strength Performance of College Football Players (n = 40).

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean ± SD</th>
<th>Range</th>
<th>Correlation with NFL-225 Test</th>
<th>Correlation with 1-RM Bench Press</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (y)</td>
<td>21.2 ± 1.3</td>
<td>18.7 – 23.2</td>
<td>0.37</td>
<td>0.34</td>
</tr>
<tr>
<td>Height (ins)</td>
<td>71.9 ± 2.7</td>
<td>65.2 – 77.5</td>
<td>0.11</td>
<td>0.02</td>
</tr>
<tr>
<td>Weight (lbs)</td>
<td>221.2 ± 35.3</td>
<td>174.0 – 294.8</td>
<td>0.39*</td>
<td>0.31</td>
</tr>
<tr>
<td>LBM (lbs)</td>
<td>174.4 ± 19.7</td>
<td>144.7 – 209.4</td>
<td>0.42**</td>
<td>0.38*</td>
</tr>
<tr>
<td>%fat</td>
<td>20.5 ± 5.4</td>
<td>11.5 – 31.0</td>
<td>0.23</td>
<td>0.11</td>
</tr>
<tr>
<td>Triceps SKF (mm)</td>
<td>10.4 ± 3.2</td>
<td>5.5 – 18.6</td>
<td>-0.07</td>
<td>-0.15</td>
</tr>
<tr>
<td>Midaxillary SKF (mm)</td>
<td>12.9 ± 4.9</td>
<td>5.7 – 21.7</td>
<td>0.24</td>
<td>0.12</td>
</tr>
<tr>
<td>Abdominal SKF (mm)</td>
<td>19.1 ± 5.8</td>
<td>8.2 – 31.6</td>
<td>0.35*</td>
<td>0.24</td>
</tr>
<tr>
<td>Chest SKF (mm)</td>
<td>9.0 ± 3.1</td>
<td>4.6 – 14.5</td>
<td>0.24</td>
<td>0.19</td>
</tr>
<tr>
<td>Calf SKF (mm)</td>
<td>10.6 ± 3.3</td>
<td>5.1 – 17.9</td>
<td>0.13</td>
<td>0.00</td>
</tr>
<tr>
<td>Arm CIR (cm)</td>
<td>40.7 ± 2.8</td>
<td>36.4 – 46.9</td>
<td>0.57**</td>
<td>0.50**</td>
</tr>
<tr>
<td>Forearm CIR (cm)</td>
<td>32.5 ± 2.0</td>
<td>28.0 – 36.3</td>
<td>0.64**</td>
<td>0.56**</td>
</tr>
<tr>
<td>Chest CIR (cm)</td>
<td>112.3 ± 7.9</td>
<td>95.9 – 131.2</td>
<td>0.60**</td>
<td>0.55**</td>
</tr>
<tr>
<td>Arm Length (cm)</td>
<td>37.8 ± 2.2</td>
<td>32.7 – 42.5</td>
<td>-0.05</td>
<td>-0.17</td>
</tr>
<tr>
<td>Forearm Length (cm)</td>
<td>30.4 ± 1.3</td>
<td>27.3 – 33.7</td>
<td>0.15</td>
<td>0.09</td>
</tr>
<tr>
<td>Arm Span (cm)</td>
<td>188.7 ± 8.2</td>
<td>170.0 – 205.8</td>
<td>0.08</td>
<td>0.02</td>
</tr>
<tr>
<td>Drop Distance (cm)</td>
<td>47.5 ± 3.6</td>
<td>41.0 – 54.5</td>
<td>-0.17</td>
<td>-0.06</td>
</tr>
<tr>
<td>NFL-225 Repetitions</td>
<td>12.0 ± 5.7</td>
<td>2 – 23</td>
<td>0.93**</td>
<td>0.93**</td>
</tr>
<tr>
<td>1RM Bench Press (lbs)</td>
<td>296.5 ± 38.8</td>
<td>225 - 375</td>
<td>0.93**</td>
<td></td>
</tr>
</tbody>
</table>

*p<0.05
**p<0.01

Five of the six remaining prediction equations that were not significantly different from the actual 1RM tended to slightly overpredict by an average of 1.3% to 4.2% (SD = 5.8% to 6.1%). Although the typical range on the
difference between predicted and actual 1RM values was -29 to 32 lbs, only five players had differences greater than -15 lbs and six players had differences greater than 15 lbs. This means that approximately 27% of this sample typically had greater than a 5% error in estimating 1RM. However, those players who were overpredicted by more than 15 lbs were not significantly different from players within ±15 lbs of their actual 1RM on any anthropometric dimensions. Furthermore, there was no difference between the two groups for NFL-225 repetitions, %1RM represented by the 225-lbs weight, or actual 1RM bench press.

Five NFL-225 prediction equations significantly overestimated actual 1RM values by average values of 12.4 ± 15.1 lbs. Sixteen players were overestimated by more than 5% or 15 lbs. Again, none of the anthropometric dimensions was significantly different between the overestimated players and the accurately measured player, except for drop distance. Ironically, the accurately predicted players (48.9 ± 3.0 cm) moved the bar through a 7% greater distance than the overpredicted players (45.6 ± 3.7 cm). Even when differences in LBM and height were held constant by analysis of covariance, the significant difference in drop distance still existed.

Table 2. NFL-225 Prediction Equations

<table>
<thead>
<tr>
<th>Source</th>
<th>Equation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Allenheilegen (2003)</td>
<td>1RM (lbs) = 220.1 + 7.49 Reps@225 lbs</td>
</tr>
<tr>
<td>Chapman et al. (1998)</td>
<td>1RM (lbs) = 223.1 + 6.67 Reps@225 lbs</td>
</tr>
<tr>
<td>Hetzler et al. (2010)</td>
<td>1RM (lbs) = 212.8 + 6.81 Reps@225 lbs</td>
</tr>
<tr>
<td>Mann et al. (2012)</td>
<td>1RM (lbs) = 227.7 + 6.78 Reps@225 lbs</td>
</tr>
<tr>
<td>Mayhew et al. (1999)</td>
<td>1RM (lbs) = 225.4 + 7.14 Reps@225 lbs</td>
</tr>
<tr>
<td>Mayhew et al. (2002)</td>
<td>1RM (lbs) = 226.7 + 7.1 Reps@225 lbs</td>
</tr>
<tr>
<td>Mayhew et al. (2004)</td>
<td>1RM (lbs) = 221.7 + 7.11 Reps@225 lbs</td>
</tr>
<tr>
<td>Mayhew et al. (2010)</td>
<td>1RM (lbs) = 219.3 + 6.75 Reps@225 lbs</td>
</tr>
<tr>
<td>Slovak et al. (1999)</td>
<td>1RM (lbs) = 221.8 + 7.17 Reps@225 lbs</td>
</tr>
<tr>
<td>Hetzler et al. 2 (2010)</td>
<td>1RM (lbs) = 141.66 – 0.86 Weight (kg) + 3.77 Arm CIR (cm) + 1.42 Chest CIR (cm) – 3.53 Arm Length (cm) + 5.47 Reps@225 lbs</td>
</tr>
<tr>
<td>Hetzler et al. 3 (2010)</td>
<td>1RM (lbs) = 299.08 + 2.47 Arm CIR (cm) – 4.60 Arm Length (cm) + 5.84 Reps@225 lbs</td>
</tr>
<tr>
<td>Whisenant et al. (2003)</td>
<td>1RM (lbs) = 307.909 + 5.21367 [Reps (225/FFW (lbs))] + 0.769843 FFW (lbs) – 2.99795 Height (ins)</td>
</tr>
</tbody>
</table>

Discussion

Most of the equations previously developed to predict 1RM performance from the NFL-225 test significantly overestimated the current sample of small-college players. Those equations were developed on Division I,
IAA, and II players (Allenheilegen, 2003; Mayhew et al., 1999; Mayhew et al., 2002; Mayhew et al., 2004; Whisenant et al., 2003) and had slopes for the regression lines of 1RM on repetitions that were generally steeper than for the current sample. The Chapman et al. equation (1993) may have worked as well as it did for the current sample because the slope (slope = 6.67) was closer to that found in the current players (slope = 6.75). Thus, the slope of the regression line for the small-college players indicated that for every repetition performed in the NFL-225 test, 6.76 lbs (3.07 kg) should be added to the basic weight (i.e., 225 lbs or 102.3 kg) to determine maximal performance.

Table 3. Accuracy of NFL-225 Prediction Equations for College Football Players (n = 40).

<table>
<thead>
<tr>
<th>Source</th>
<th>Predicted Mean ± SD</th>
<th>Constant Error Mean ± SD</th>
<th>TE</th>
<th>ICC</th>
<th>% within ± 10 lbs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Allenheilegen (2003)</td>
<td>309.6 ± 42.6**</td>
<td>13.1 ± 15.9</td>
<td>20.4</td>
<td>0.961**</td>
<td>43</td>
</tr>
<tr>
<td>Chapman et al. (1998)</td>
<td>302.8 ± 37.9</td>
<td>6.3 ± 14.6</td>
<td>15.7</td>
<td>0.963**</td>
<td>48</td>
</tr>
<tr>
<td>Hetzler et al. (2010)</td>
<td>294.2 ± 38.7</td>
<td>-2.3 ± 14.7</td>
<td>14.7</td>
<td>0.963**</td>
<td>48</td>
</tr>
<tr>
<td>Mann et al. (2012)</td>
<td>298.7 ± 38.5</td>
<td>2.2 ± 14.7</td>
<td>14.7</td>
<td>0.963**</td>
<td>45</td>
</tr>
<tr>
<td>Mayhew et al. (1999)</td>
<td>311.5 ± 40.4**</td>
<td>15.0 ± 15.1</td>
<td>21.2</td>
<td>0.962**</td>
<td>38</td>
</tr>
<tr>
<td>Mayhew et al. (2002)</td>
<td>310.5 ±40.5**</td>
<td>14.0 ± 15.1</td>
<td>20.5</td>
<td>0.962**</td>
<td>38</td>
</tr>
<tr>
<td>Mayhew et al. (2004)</td>
<td>306.7 ± 40.4**</td>
<td>10.2 ± 15.1</td>
<td>18.1</td>
<td>0.962**</td>
<td>43</td>
</tr>
<tr>
<td>Mayhew et al. (2010)</td>
<td>300.8 ± 38.4</td>
<td>3.6 ± 14.7</td>
<td>14.9</td>
<td>0.963**</td>
<td>45</td>
</tr>
<tr>
<td>Slovak et al. (1999)</td>
<td>303.2 ± 38.7</td>
<td>6.7 ± 14.7</td>
<td>16.0</td>
<td>0.963**</td>
<td>53</td>
</tr>
<tr>
<td>Hetzler et al. 2 (2010)</td>
<td>299.8 ± 40.4</td>
<td>3.3 ± 15.7</td>
<td>18.3</td>
<td>0.959**</td>
<td>43</td>
</tr>
<tr>
<td>Hetzler et al. 3 (2010)</td>
<td>295.4 ± 38.5</td>
<td>-1.1 ± 14.2</td>
<td>15.8</td>
<td>0.965**</td>
<td>60</td>
</tr>
<tr>
<td>Whisenant et al. (2003)</td>
<td>306.4 ± 41.5**</td>
<td>9.9 ± 15.6</td>
<td>14.0</td>
<td>0.961**</td>
<td>38</td>
</tr>
<tr>
<td>Actual 1RM (lbs)</td>
<td>296.5 ± 38.8</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Constant Error = Predicted 1-RM – Actual 1-RM
*Total error (TE = \( \sqrt{\sum [\text{predicted} - \text{actual}]^2} / n \))
*Intraclass Correlation Coefficient
*\( p<0.05 \)
**\( p<0.01 \)

Previous studies have indicated that the prediction error increases when >10 repetitions are performed in the NFL-225 test (Mayhew et al., 1999, Slovak et al., 1999; Mayhew et al., 2002; Mayhew et al., 2004). In the current sample, the Chapman et al. equation (1993) produced a significantly smaller difference between predicted and actual 1RM values (3.3 ± 20.0 kg) than the remaining equations (average difference = 8.8 to 13.6 kg) when >10 repetitions were performed. The same pattern was repeated when ≤10 repetitions were performed, with the Chapman et al. equation having the smaller difference between predicted and actual 1RM values (1.9 ± 15.6 kg) compared to the remaining equations (average
difference = 3.2 to 8.1 kg).

It was interesting to note that simple body size variables, such as body mass and BMI, or combination variables produced from simple variables made only slight contributions (<3%) to the known variance for the repetition prediction equations for 1RM in these players. The lack of contribution of size variables agreed with recent work on Division II players in which body composition and structural variables did not enhance the prediction accuracy of maximal strength beyond that achieved by the NFL-225 repetitions alone (Mayhew et al., 2004). Since the addition of these variables did not increase the variance accounted for substantially ($\Delta R^2 < 0.02$) nor reduce the SEE markedly (<0.5 kg), the decision to include them in any prediction equation appears more academic than practical.

The difference in repetitions and predictive accuracy among the prediction groups might be explained by differences in training programs or muscle fiber type. Most football resistance programs now follow a periodization model consisting of a hypertrophy phase, a strength phase, and a power phase. Goto et al. (2004) recently showed that a combination program (i.e., performing a single set of exhaustive repetitions at 50% of 1RM immediately after an exercise in the strength phase) produced greater gains in muscle strength than a standard-set program. In addition, the combination program also produced greater increases in muscle endurance as assessed by work volume (load x repetitions). Fry et al. (2003) have shown that powerlifters who perform resistance routines similar to football players have a higher percentage of type IIa muscle fibers and a lower percentage of type IIb fibers, offering them greater power capability than endurance. To our knowledge, no biopsy studies have been done on college football players; hence, we might speculate that those players who were able to perform more repetitions with an absolute load have a greater proportion of type IIa or type I muscle fibers. Hence, those players with more type IIa fibers might be underpredicted while those players with more type IIb fibers might be overpredicted.

Several studies (Black & Roundy, 1994; Sawyer et al., 2002) have stated that starting players at several football positions have significantly higher 1RM bench press values than nonstarters, while one study noted that 1RM bench press was a major factor predicting football playing ability (as assessed by coaches’ ranking) only for offensive linemen (Sawyer et al., 2002). Thus, it is possible that the bench press may be overrated as an evaluation of football performance.

Because of the actual or perceived contribution of greater upper body strength to football playing ability, it is likely that the bench press will remain an integral part of a testing profile for college football players. To that end, the discussion over whether to use the 1RM procedure or a multi-repetition submaximal procedure to evaluate muscular performance in football players is likely to continue. Proponents of the 1RM technique point to the very low injury rate when using this procedure (Risser, Risser & Preston, 1990; Mazur, Yetman & Risser, 1993) and conclude that it is the only true way to assess current strength performance (Bompa & Cirmacchia, 1998). Opponents indicate that the 1RM procedure requires excess time for evaluation, and other sources note that it may be subject to motivational variations (Zatasorsky, 1995; Giebring, 2005). For those
who are searching for other approaches to assessing muscle performance, muscular endurance repetitions may offer a quick, convenient, and reasonably accurate method. Overlaying the arguments concerning the best approach to assess muscle performance is the fact that many laboratory tests may not predict sports performance skills with a high degree of accuracy (Seiler et al., 1990; Miller et al., 2002). Perhaps further investigation of whether the physical component evaluated by a 1RM bench press test or by a multi-repetition test is more germane to football playing ability is required. Until such time, it appears that the choice of the best test may be left to the strength and conditioning specialist.

References


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Physiologic Change In Women Following A Resistance Or Concurrent Training Program

Trista Lynn Manikowske and Donna J. Terbizan

This study evaluated physiologic change in women after a 12-wk resistance training (RT) or concurrent (CT) program. Eighteen women (36-61 yr), randomized to a RT or CT group, trained 3 times per wk. Both groups participated in resistance workouts that included 30 min of upper and lower body exercises where fatigue occurred between 8-12 repetitions. The CT group then participated in 30 min of moderate intensity cardiovascular exercise during each training session. Pretesting and post-testing included: height; weight; resting blood pressure; body composition from skinfolds; arm, thigh, and waist circumference measurements; 3-repetition maximum (3RM) strength in bench press and leg press; and cardiovascular fitness using a Rockport walk test. Also measured were fasting serum glucose, total cholesterol, triacylglycerol, low-density lipoprotein cholesterol, and high-density lipoprotein cholesterol concentrations. FFM was calculated. MANOVA was used to evaluate group differences and time-related changes in all other variables. Several (2 x 2) repeated measures ANOVAs were used to compare dependent variable scores across time and between treatment groups. No significant differences between treatments or time by treatment interactions were found. Improvements in upper body strength, body composition, FFM, HDL cholesterol, LDL cholesterol, blood pressure, and cardiovascular fitness were observed; however, only increases in HDL cholesterol, FFM and bench press strength were significant (p = 0.03, p = 0.045, and p < 0.001, respectively). Results indicated that upper body strength and HDL cholesterol significantly increased after 12 wks in a RT or CT exercise program. While neither training modality (RT or CT) proved superior, it is possible that a longer training program and more participants would yield significant differences.

During the past 50 years, prospective and experimental studies on physical activity have consistently demonstrated a reduced incidence of cardiovascular disease (CVD) events in the most physically active subjects.
Data in the evidence has identified a causal relationship between physical activity and reduced risk factors for CVD. Research indicates that most active subjects have half the CVD rates compared to a sedentary group. Additionally, it appears there is a graded inverse relationship between levels of activity and CVD rates (Thompson et al., 2003).

In general, exercise decreases cardiovascular risk, but an optimal training program has yet to be identified. It is well established that obesity directly increases cardiometabolic risk and is also closely associated with development and progression of CVD (Schjerve et al., 2008). Obesity and physical inactivity appear to be associated with low aerobic capacity and impaired endothelial function, serving as strong independent risk factors of mortality from CVD and other metabolic diseases (Grundy et al., 1998). Adverse changes in abdominal obesity, dyslipidemia, glucose tolerance, hypertension, and insulin resistance become increasingly common with an increase in age. Additionally, insulin resistance has been shown to be a major factor in development of metabolic syndrome and type 2 diabetes, which are both risk factors for cardiovascular disease (Sillanpää et al., 2009). The metabolic effect of reduced muscle mass as a result of physical inactivity and normal aging contributes to the development of these risk factors. Significant reduction in cardiac risk occurs with even moderate weight loss and improvements in body composition (Meka et al., 2008). These adaptations are also, in part, mediated by reduction in body fat induced by exercise (Ballor & Poehlman, 1992).

There is compelling evidence to suggest that physical activity, particularly improving cardiovascular fitness and muscular strength, should be encouraged to manage and reduce risk for CVD (Gaesser, 2007). Physical activity both prevents and helps treat many cardiovascular risk factors including obesity, high-density lipoprotein (HDL) concentrations, triglyceride concentrations, glucose intolerance, and elevated blood pressure. In combination with weight loss, exercise has been shown to decrease low-density lipoprotein (LDL) concentrations more than simply diet alone (Thompson et al., 2003). Due to the different mechanisms that produce these changes, combined endurance and strength training (concurrent) may have synergistic benefits compared to either method alone. Combining these training methods (CT) may be more effective at improving body comp, fitness, and metabolic health than either method alone (Sillanpää et al., 2009). However, evidence also exists indicating CT may hinder some strength training benefits such as increased fat free mass (FFM) and strength (Kraemer et al., 1995; Sillanpää et al., 2008). Most of the studies investigating CT have been performed in men and little is known how prolonged strength and endurance training influences metabolic health in women (Sillanpää et al., 2009). The evaluation of combined cardiovascular and resistance training is important to examine when investigating reduction of risk factors. With obesity recently being added as a risk for CVD, it is imperative to look closer into the potential benefits of CT as it has been shown to improve body composition by decreasing
adipose tissue and increasing FFM (Meka et al., 2008).

It was hypothesized that individuals participating in a CT program would have significantly more positive change in CVD risk factors than those individuals only participating in RT. Considering antagonistic effects of CT on increases in FFM, it was also hypothesized that the RT group would have a greater increase in FFM and strength than the CT group. The purpose of this study was to evaluate physiological changes of cardiovascular disease risk factors in women following a CT or RT program. Specifically, change in strength, body composition, VO$_2$, blood pressure, total cholesterol, and HDL were evaluated.

Methods

Participants

Participants were recruited through an email listserv sent to the staff and faculty of an upper Midwest university. Eighteen women aged 36-61 years completed the training. The University Institutional Review Board approved the study. Informed consent and PAR-Q forms were completed prior to participation. If a participant answered “yes” to any of the six questions on the PAR-Q, additional physician’s consent was required for participation. Participants were excluded if they had any of the following: physical or psychological diseases which would hinder their abilities to perform requested strength and endurance training and testing, a previous cardiac event, or were unable to receive physician consent if required. All relevant medications were recorded.

Study Design

After signing informed consent forms and receiving physician’s consent if needed, participants completed pretest assessments. Participants were given precise instructions regarding these tests prior to coming to the testing facility and were asked not to engage in physical activity beyond their basic daily activities 24 hrs prior to initial testing. In addition, individuals were instructed to wear comfortable, loose fitting clothing consistent with testing, drink plenty of fluids to ensure proper hydration, avoid food, tobacco, alcohol, and caffeine for at least 3 hrs before testing, avoid exercise or strenuous physical activity the day of the test, and get an adequate amount of sleep (6-8 hrs) the night before the testing. Following pretesting, volunteers were randomized into either a control (RT) or intervention (CT) group. The intervention group engaged in CT consisting of 12 wks of progressive aerobic and RT 3 da/wk totaling 60 min per session. The control group participated in the same RT program, but without the aerobic exercise for a total of 30 min. During the study, participants’ workouts were supervised in the lab two days per week and were asked to do another day of exercise on their own. Workouts were tracked by the use of a journal sheet that was turned in at the end of the month, and missed workouts were made up before the end of the 12 wks.
The battery of assessments was taken prior to intervention and was then repeated after the 12 wks of training.

**Experimental Procedures**

**Session 1: anthropometric testing.** Height, weight, waist, arm, and thigh circumferences were conducted with participants wearing light clothing. Height was measured by a freestanding stadiometer, and weight by a calibrated electric scale (Detecto® DR450, Daugherty Webb City, MO). Circumference measurements were conducted using a non-elastic tape measure. Waist was measured halfway between the lower rib and iliac crest of the hip and each right and left arms and thighs were measured at the midpoint (Welborn & Dhaliwal, 2007). The same individual conducted all anthropometric measures. Systolic and diastolic blood pressure (BP) was measured using an automated machine (GE Dinamp Carescape v100, Waukesha WI) after lying supine for 5 min. This machine has been validated as an accurate measure of BP (Beaubien, Card, Card, Biem, & Wilson, 2002).

Body composition was measured by the same individual using a Lange skinfold caliper at the triceps, suprailiac, and thigh. The Jackson-Pollock three-site equation was used to calculate body density, with the Siri formula to calculate body fat percentage. Body composition as determined from skinfold measurement has been shown to correlate well with hydrostatically determined body density and to be both reliable and valid (Jackson & Pollock, 1980). Participants were asked to go to a local clinic to have their blood drawn. Fasting serum glucose, total cholesterol, triacylglycerol, LDL, and HDL concentrations were measured by Sanford Health Laboratory, Fargo, ND, and analyzed by an automated chemistry analyzer.

**Session 2: 3RM strength and aerobic testing.** A three repetition-maximum (3RM) protocol to measure upper and lower body strength was chosen due to the age and fitness level of participants. The 3RM method has been shown to be valid and reliable at estimating 1RM strength (Wood, Maddalozzo, & Harter, 2002). Participants performed a 5-minute light treadmill warm-up and were instructed on the 3RM strength assessments. Upper body strength was tested with a barbell bench press, and lower body strength using a hip-sled. When assessing 3RM, a warm-up set was given followed by gradually increased resistance until the participant could no longer complete three repetitions. A timed 2 min rest was given between attempts.

Following strength testing, cardiovascular endurance was examined using a 1-mile Rockport walking test. This walk test was used to estimate fitness level and maximal oxygen uptake (Kline, Porcari, Hintermeister, Freesdon, & Ward, 1987). Participants were asked to walk one mile as quickly as possible without running. Time to complete the mile was recorded in addition to final heart rate (BPM) using a Polar® heart rate monitor. This method was chosen over other tests due to the age and...
fitness level of the participants. Additionally, walking was the primary form of aerobic exercise in the program.

Treatment Groups

Concurrent training (CT). This group completed both RT and aerobic training. The resistance program was completed first and began with eight machine and free weight exercises for the main muscle groups. Volume began at 12 repetitions for each set for each exercise and progressed from two sets during the first and second weeks to three sets the third week. In the fourth week, load was increased maintaining a failure repetition range of 8-12 and continuing with three sets. Intensity and exercises were monitored and progressed based on individual development. As individuals progressed, additional weight and more advanced exercises were added to the program.

Immediately following completion of the RT, heart rate monitored cardiovascular exercise was performed by the CT group. Age predicted (220-age) heart rate max (HR max) was used to determine the individual’s exercise intensity. Aerobic exercise was monitored by Polar® heart rate monitors and began at 60-75% HR max. In the third week, intensity was assessed and increased to 75-90% HR max.

Control (RT). This group completed the same RT exercise program described for the CT group, but did not complete the cardiovascular training.

Results

Participant demographics are presented in Table 1. Participant’s groups were not significantly different pre to post. Several (2 x 2) repeated measures ANOVAs were used to compare dependent variable scores across time and between treatment groups and represented in Table 2. No statistically significant differences between treatments or time by treatment interactions were found for any of the measured variables. Improvements in upper body strength, body composition, FFM, HDL cholesterol, LDL cholesterol, blood pressure, and cardiovascular fitness were observed among the entire sample; however, only increases in HDL cholesterol, FFM, and bench press strength were significant ($p = .03$, $p = 0.045$, and $p < .001$, respectively).

Discussion

The addition of resistance exercise to aerobic activity has been shown to be increasingly beneficial in producing results of decreased body-fat mass, which has been proven to aid in weight maintenance and glycemic control. A number of exercise intervention studies have shown multiple health benefits seen with CT, including improved glucose metabolism, lipid profile, blood pressure, immune function, and decreased chronic
Table 1. Demographics

<table>
<thead>
<tr>
<th></th>
<th>RT Group (n=8)</th>
<th>CT Group (n=10)</th>
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<tbody>
<tr>
<td></td>
<td>Pre</td>
<td>Post</td>
</tr>
<tr>
<td></td>
<td>M</td>
<td>SD</td>
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<tr>
<td>Age</td>
<td>52.13</td>
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<td>Height (in)</td>
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<td>Weight (lbs)</td>
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<tr>
<td>Body Fat (%)</td>
<td>31.97</td>
<td>8.32</td>
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</table>

Table 2. Pre- and Post-Treatment Means and Standard Errors

<table>
<thead>
<tr>
<th></th>
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<th>RT Group (n=8)</th>
<th>Combined (n=18)</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Pre</td>
<td>Post</td>
<td>Pre</td>
</tr>
<tr>
<td></td>
<td>M</td>
<td>SE</td>
<td>M</td>
</tr>
<tr>
<td>Bench Press (lbs)</td>
<td>73.5</td>
<td>5.5</td>
<td>84.0</td>
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<tr>
<td>Leg Press (lbs)</td>
<td>231.0</td>
<td>21.6</td>
<td>255.0</td>
</tr>
<tr>
<td>HDL (mg/Dl)</td>
<td>59.9</td>
<td>3.4</td>
<td>64.1</td>
</tr>
<tr>
<td>LDL (mg/Dl)</td>
<td>87.5</td>
<td>11.0</td>
<td>88.5</td>
</tr>
<tr>
<td>Systolic BP (mm/ Hg)</td>
<td>112.6</td>
<td>3.3</td>
<td>112.2</td>
</tr>
<tr>
<td>Diastolic BP (mm/ Hg)</td>
<td>67.0</td>
<td>2.3</td>
<td>64.9</td>
</tr>
<tr>
<td>VO2 max (ml/kg/ min)</td>
<td>31.7</td>
<td>2.2</td>
<td>33.7</td>
</tr>
<tr>
<td>FFM (lbs)</td>
<td>110.6</td>
<td>4.1</td>
<td>113.7</td>
</tr>
</tbody>
</table>

*Significantly different than before training, p<0.05
inflammation (Braith, & Stewart, 2006; Carroll, 2004; Woods, Vieira, & Keylock, 2006). In addition to physical activity, moderate to high levels of cardiorespiratory fitness and muscular strength appear to be protective against diabetes, CVD, and metabolic syndrome. This evidence supports the American College of Sports Medicine’s Position Stand on Exercise and Physical Activity for Older Adults (Chodzko-Zajko et al., 2009). Randomized studies have shown strength training to improve muscular strength, cardiovascular function, overall metabolic rate, and general quality of life (Ferketich et al., 1998; Schjerve et al., 2008; Sillanpää et al., 2009; Wood et al., 2001).

This study, however, did not demonstrate significant change in cardiovascular disease risk factors after RT or CT programming other than an increase in HDL when groups were combined. A number of cohort studies, however, have demonstrated a consistent inverse association between physical fitness and incidence of type 2 diabetes, CVD and metabolic syndrome. Evidence exists that antagonistic effects may be seen with CT on increases in strength and FFM, but was not demonstrated in this study. No significant differences were seen between the CT and RT group in regards to strength gains and changes in FFM.

Ekelund et al. (2005) examined the association between PA and CVD over a five-year period and was the first study to use valid objective measures to record Physical Activity Energy Expenditure (PAEE) and aerobic fitness. The study demonstrated benefits of increased physical activity by showing an inverse relationship between PAEE and metabolic syndrome, independent of obesity and aerobic fitness. In the Aerobics Center Longitudinal Study (ACLS), individuals with low cardiorespiratory fitness had an average 3.7 times higher risk of developing diabetes independent of BMI. Additionally, overweight and obesity were associated with a higher incidence of CVD mortality, but not after adjusting for fitness (Stofan, DiPietro, Davis, Kohl, & Blair, 1998). The correlation between risk factors and the occurrence of coronary events was also established in the Nurses’ Health Study. A total of 84,129 women without previous CVD, cancer, or diabetes, were followed for 14 years. The lowest risk group included those who had a BMI < 25 did not smoke, and engaged in regular exercise. This group showed a relative risk of 0.17 (CI, 95% 0.07-0.41) for coronary events when compared to other women (Meka et al., 2008).

Available data concerning physiological changes after periodized RT in women are limited. Additionally, inconsistency is shown concerning whether or not RT causes significant body composition changes. Physical training programs that have been shown to elicit whole body changes in lean and fat mass include both strength and aerobic training. However, other studies show that strength and endurance training can be antagonistic when combined (McCarthy, Agre, Graf, Pozniak, & Vailas, 1995). One important distinction of this study is that no negative interaction was seen by the addition of endurance training to a resistance program. The RT group increased FFM by 3.1% and the CT group increased by 2.8% leading
us to accept the hypothesis that the RT group would increase more than the CT group, but there was no significant difference seen between the groups in regards to FFM. Additionally, the CT group was not significantly different from the RT group in any of the tested variables following the intervention.

A study by Nindl et al. (2000) showed that women who trained with CT exercise 5 da/wk effectively decreased total body adiposity and increased lean tissue mass by 5.4%. Subjects in our study significantly increased FFM, however, decreases in body fat were not significant. A study in the same year by LeMura et al. (2000) examined various modes of training and the effects on blood lipid profiles, cardiovascular fitness, and body composition after 16 weeks. The study compared aerobic and RT separately to CT. Results showed a decrease in body fat by 10% and an increase in FFM of 3% in the CT group. While the aerobic group showed beneficial changes in blood lipid profile with increases in HDL and decreases in LDL and triglycerides, these changes were not seen in the CT or RT group. Additionally, the aerobic group increased VO$_2$ max while the CT group had no increase in this area. These results were similar to that of our study in the RT group reduced body fat by 11% and increased FFM by 4%. The CT group also had similar strength gains as the RT, indicating only small amounts of interference by the addition of aerobic training. In contrast to the study by LeMura et al. (2000), significant positive changes were also seen in HDL, upper body strength, and FFM by our CT and RT groups.

Randomized controlled trials that have used aerobic and resistance exercise have produced limited beneficial results mainly in the elderly and middle-aged people (Pistavos et al., 2009). A study by Boardley et al. (2007) used aerobic walking and RT with elderly subjects for 16 wks and reported no change in lipid profile in comparison to the control group. Similar results were found by LeMura et al. (2007), who combined jogging and RT in young women for 16 wks. After 21 wks of CT, a study by Sillanpaa et al. (2009) in middle aged women showed significant increases in lean body mass, cardiovascular fitness, and strength. Similar to our study there were minor, however, not significant changes on resting blood pressure, cholesterol, and glucose concentration after training. Given a longer study length as in the following studies, perhaps change would have been more significant as this intervention lasted only 12 wks.

**Conclusion**

Significant increases were seen in HDL, FFM, and bench press strength across both groups. Decreases in body fat were also seen, however, not significant. No interference was seen with the addition of cardiovascular training to RT as there were no significant differences between groups. CT participants engaged in 90 min of cardiovascular and 90 min of resistance exercise/wk. While participants met the 2-3 da/wk ACSM guidelines for RT, current ACSM guidelines recommend $\geq$150 minutes of moderate
intensity cardiovascular exercise per week to improve and maintain cardiovascular fitness. While CT participants engaged in a total of 180 min of activity, lack of significant changes seen in cardiovascular fitness could be attributed to being less than the guidelines. Additionally, it is unclear if 12 wks is enough time to induce chronic physiologic change induced by RT. It appears additional minutes per week and a longer intervention time is needed to affect chronic disease risk parameters.

References


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Comparison of Pushing and Pulling Shoulder Strengths in College Wrestlers

Brittany A. Beeler, Colton D. Schmitz, and Jerry L. Mayhew

The purpose of this study was to compare the pushing and pulling strengths of college wrestlers prior to and in the middle of the competitive season. Division II college wrestlers ($n = 18$) performed maximum repetitions on a seated horizontal shoulder press and a seated horizontal pull machine. If the subject could perform more than one repetition with the maximum weight stack, a curvilinear prediction equation was used to estimate 1RM from repetition weight and maximum repetitions. Test order was randomized, and a minimum of five minutes recovery was given between tests. Pulling strength decreased significantly by mid-season, while pushing strength remained relatively constant. This caused the push:pull ratio to increase nonsignificantly ($p = 0.08$) from pre-season ($0.89 \pm 0.13$) to mid-season ($0.94 \pm 0.07$). Body mass was significantly correlated with both pushing ($r = 0.59$) and pulling ($r = 0.60$) strengths but not with the push:pull ratio ($r = -0.05$). These results illustrate the fluid nature of the upper-body strength imbalance ratio.

Muscular strength imbalance around a specific joint has been implicated as a possible contributory factor to the risk of injury (Croisier, Forthomme, Namurois, Vanderthemmen & Crielaard, 2002; Croisier, Ganteaume, Binet, Gentry & Ferret, 2008; Wang & Cochrane, 2001). The majority of the research on this topic has focused on comparison of agonist and antagonist strengths at various joints (Baumhauer, Alosa, Renstrom, Trevino & Beynnon, 1995; Cheung, Smith & Wong, 2012; McMaster, Long & Caiosso, 1991).

Most of the injury investigations have tended to center on the predominant joint involved in a particular sport. The knee joint has
received a great deal of attention because of the inordinate number of injuries to that joint (Arnedt & Dick, 1995; Ingram, Fields, Yard & Comstock, 2008; Majewski, Susanne & Klaus, 2006; Powell & Barber-Foss, 2000). Musculo-skeletal evaluations of the knee joint have suggested that a flexion:extension ratio of 0.60 appears to be the most satisfactory, with lower ratios associated with an increased risk of injury (Croisier et al., 2002; Croisier et al., 2008). Investigations conducted on baseball players have noted muscle imbalances at the shoulder joint, especially in the pitching arm (Cook, Gray, Savinar-Nogue & Medeiros, 1987; Trakis, McHugh, Caracciolo, Buscia, Mullaney & Nicholas, 2008; Wilks, Andrews & Arrigo, 1995). In baseball players, stronger adductor muscles compared to abductor muscles or shoulder flexion compared to shoulder extension has been connected to an increased injury rate (Baumhauer et al., 1995; Chandler, Kibler, Straccener, Zeigler & Pace, 1992; Cools, Witvouw, Mahieu & Danneels, 2005). The repetitive motion of swimmers also shows the effect of over-development of the pulling muscles of most strokes verses the antagonistic muscles (Bak, 1996; Bak & Magnusson, 1997; McMaster, Long & Caiosso, 1991). The same patterns have been shown for other athletes whose sport requires greater adduction and/or internal rotation at the shoulder (Alfredson, Pietila & Lorentzon, 1998; Chandler, Kibler, Stracener, Ziegler & Pace, 1992; Wang & Cochrane, 2001).

The findings of many studies have noted that over-development of the muscles involved in a specific movement at the expense of compensatory strength in the antagonist muscles can result in various types and degrees of injury (Niederbracht, Shim, Sloniger, Paternaostro-Bayles & Short, 2008; Rahnama, Lees & Bambaecichi, 2005; Wang & Cochrane, 2001). Most of the previous studies have used isokinetic procedures to evaluate the agonist and antagonist muscle strengths. However, recent research on rugby players used the isoinertial technique to evaluate maximal pushing and pulling strength of the upper body (Baker & Newton, 2004). Baker and Newton (2004) used a supine bench press with free weights for pushing strength and compared it to pulling strength measured from a weighted pull-up test. Their results suggested that the push:pull ratio for the upper body should be approximately 1.00. However, a major limitation to that study could have been that the pushing and pulling exercises were not performed by diametrically opposed muscle actions. Due to the involvement of the shoulder musculature in so many sports, it would be beneficial to strength and conditioning specialists, athletic trainers, and physical therapists to determine the push:pull ratio when exercises are performed in the same plane. Therefore, the purpose of this study was to evaluate the pushing and pulling strengths operating in the same plane for the upper body in college wrestlers.
Methods

NCAA Division II college wrestlers \((n = 18, \text{ age } = 20.1 \pm 1.4 \text{ y}, \text{ height } = 178.9 \pm 5.8 \text{ cm}, \text{ weight } = 81.1 \pm 13.5 \text{ kg})\) performed maximum strength assessments on a seated horizontal shoulder press and a seated horizontal pulling machine. The resistance on both machines was provided by weight stacks which were incremented by 4.5-kg stages. Intermediate loads were possible by adding 2.5-kg weights to the top of weight stack. A one-repetition maximum (1RM) was determined on each machine by assessing the maximum load a subject could lift one time through a full range of motion. If the subject could perform more than one repetition with the maximum weight stack, a curvilinear prediction equation was used to estimate 1RM from repetition weight and maximum repetitions (Mayhew, Ball, Arnold, & Bowen, 1992). Test order was randomized, and a minimum of five minutes recovery was given between trials and between tests. The aim was for subjects to reach their maximum on each device in a minimal number of trials. A push:pull ratio was calculated from maximum values on each device.

The seated bench press began from a flexed-arm position, and the levers of the machine pressed horizontally to full-arm extension. The back remained flat against the back support throughout the lift. The seated pull test began from a full-arm extension, and the independent handles of the machine pulled to a position within 2 cm of the shoulder joint (an elbow flexion of >90 deg). Although the device did not have a back support, each subject was admonished to maintain a straight posture and not to arch the back or lean backwards during the contraction. The experimenter also monitored the participant’s posture during each repetition. Test-retest reliabilities greater than 0.91 have been noted for similar exercises (Soe, Kim, Fahs, Rossow, Young, Ferguson, et al., 2012).

Means and standard deviations \((SD)\) were determined for all variables at pre-season and post-season. Paired t-tests were used to evaluate the changes from pre-season to mid-season. Independent t-tests were used to determine differences between groups that gained strength and those that lost strength. Pearson correlations were used to evaluate the relationships among variables.

Results

Pulling strength decreased significantly \((p = 0.04)\) from pre-season to mid-season, while pushing strength remained relatively constant from pre-season to mid-season (Table 1). This caused the push:pull ratio to decrease nonsignificantly \((p = 0.08)\) from pre-season to mid-season (Table 1). In subjects \((n = 5)\) who decreased their push:pull ratio \((1.02 \pm 0.15 \text{ to } 0.95 \pm 0.09, p=0.09)\) gained in pulling strength \((5.1 \pm 10.6 \text{ kg}, p = 0.34)\) while decreasing in pushing strength \((-2.6 \pm 6.7 \text{ kg}, p = 0.43)\). In subjects \((n = 13)\)
who increased their push:pull ratio (0.84 ± 0.08 to 0.94 ± 0.07, p = 0.001) significantly (p = 0.01) lost pulling strength (-13.7 ± 14.3 kg, p < 0.01) while maintaining pushing strength (1.9 ± 11.2 kg, p = 0.55).

Table 1. Subject Characteristics and Pre- and Mid-Season Strength Performances (n = 18)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Pre-Season</th>
<th>Mid-Season</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (y)</td>
<td>20.1 ± 1.4</td>
<td></td>
</tr>
<tr>
<td>Height (cm)</td>
<td>178.9 ± 5.8</td>
<td></td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>81.1 ± 13.5</td>
<td>80.0 ± 13.5*</td>
</tr>
<tr>
<td>Pushing Strength (kg)</td>
<td>122.4 ± 22.7</td>
<td>123.1 ± 22.2</td>
</tr>
<tr>
<td>Pulling Strength (kg)</td>
<td>138.7 ± 26.4</td>
<td>130.4 ± 18.5*</td>
</tr>
<tr>
<td>Push:Pull Ratio</td>
<td>0.89 ± 0.13</td>
<td>0.94 ± 0.07</td>
</tr>
</tbody>
</table>

*Significantly different at p<0.05.

Body mass decreased significantly by -1.3 ± 1.7% in most of the subjects (83%) from pre-season to post-season (Table 1). Body mass was significantly correlated with pushing (r = 0.77) and pulling strengths (r = 0.74) at the pre-season and remained unchanged at mid-season (r = 0.77 and 0.76, respectively). The relationship of body mass to both exercises was curvilinear due largely to including the heavyweight in the analysis (Figure 1). Neither the change in pushing strength (r = 0.18) nor the change in pulling strength (r = -0.25) was significantly related to the change in body mass. Push:pull ratio was independent of the influence of body mass at both the pre-season (r = -0.05) or mid-season (r = 0.13).

Discussion

The current study is one of the first to document the fluidity of the push:pull ratio in athletes training for a competitive sport. The change in push:pull ratio for the entire group was due mainly to a 5% decrease in pulling strength by a majority of the subjects (n = 13) rather than a change in pushing strength (1% increase). This change seems surprising in a sport where the main objective is to continually use a pulling motion in an attempt to control the opponent. One possible explanation for the change in strength might be the common practice among wrestlers to dehydrate to “make weight” in order to wrestle in a lower weight classification. Previous studies have documented the negative effect of weight loss through dehydration (Roemmich & Sinning, 1997; Webster, Rutt & Weltman, 1990; Wenos & Amato, 1998) and diet restriction (Roemmich & Sinning, 1997) on strength in wrestlers. Webster, Rutt, and Weltman (1990) noted decreases in both pulling (-7.6%) and pushing (-6.6%) strengths.
in collegiate wrestlers, which are slightly greater than the losses noted in the current study due mainly to their greater relative weight loss in the former subjects (-4.9%). Among the 15 subjects in the current study who lost an average of 1.8% body mass, the decreases in pulling strength showed a wider range (-4% to -24%) than for pushing strength (-2% to -18%). However, decreases in body mass were not significantly correlated with decreases in either pulling ($r = -0.22$) or pushing strength ($r = -0.26$) in these subjects.
Baker and Newton (2004) found a push:pull ratio of 0.977 ± 0.090 in rugby players performing a standard eccentric/concentric free-weight bench press and a weighted pull-up. They noted that while a seated row test might provide a more antagonistic evaluation for comparison with a bench press, subjects have a great tendency to perform back arching to assist in achieving heavy loads. Care was exercised in the current study to eliminate any backward movement or extension during the performance of the seated row. The pre-season push:pull ratio for the wrestlers was significantly less than for the rugby players, but the increase by the wrestlers at mid-season was not significantly different compared to the rugby players (Baker & Newton, 2004).

Pearson, Cronin, Hume, and Slyfield (2009) used a concentric-only Smith machine bench press and a vertical bench pull to evaluate resistance-trained competitive sailor for both strength and power. The pushing strength for the current subjects was not significantly different from that of the sailors despite a significantly greater body weight for the latter. However, the wrestlers’ pulling strength was significantly greater (p<0.01) than vertical bench pulling test for the sailors. This might be due to the mechanical properties of the two tests. However, the push:pull ratio for the sailors (1.20) was significantly higher than that of the wrestlers for both pre- and mid-season. Power tests for each exercise produced push:pull ratios that decreased progressively as the %1RM loads increased due mainly to a faster bar velocity for the pulling motion. Interestingly, the force production for each exercise produced a consistent push:pull ratio (1.21 ± 0.01 N) throughout the range of %1RMs and similar to that produced from the 1RMs.

Numerous sources have suggested that strength balance between agonist and antagonist muscles surrounding a joint may aid in preventing injury. Typically, an athlete is instructed to strengthen weak muscles to achieve an acceptable agonist:antagonist ratio (Baumhauer, Alosa, Renstrom, Trevino & Beynnon, 1995; Croisier, Ganteaume, Binet, Genty & Ferret, 2008; Croisier, Forthomme, Namurois, Vanderthommen & Crielaard, 2002). To our knowledge this is the first study to document a loss of strength that enhanced the agonist:antagonist ratio. Although none of the subjects in this study experienced any upper-body injury, the question remains how strength decreases in one muscle group might affect the likelihood of susceptibility to injury despite improving the push:pull ratio.

A possible limitation of the current study could be the restriction placed on the assessment of the 1RM by the use of machine weights. Weight machines typically have a limit to the maximum load that can be placed on the weight stack. Eleven subjects exceeded the maximum load of the bench press machine, and 12 subjects exceeded the maximum load of the pull machine. Of those, 10 exceeded the maximum capacity on both machines. However, there was no significant difference in the push:pull ratio between those wrestlers performing repetitions to estimate 1RM.
and those actually measured for 1RM at either pre-season or mid-season. Previous studies assessing muscle imbalances at the knee have indicated that strength values using different measurement modes may not be interchangeable and could result in substantial difference in imbalance ratios (Moss & Wright, 1993; Nunn & Mayhew, 1988). Such a comparison has not been done for the shoulder girdle and may be of interest for athletes whose dominant work is performed by the upper body, such as swimmers, rowers, and baseball players.

In summary, the current study indicates that wrestlers may begin the competitive season with pulling strength significantly higher than pushing strength. However, over the course of training and the competitive season, some athletes may lose strength more in one movement than another that may alter the imbalance ratio in a positive or negative manner. Training programs should strive to reduce the difference between agonist and antagonist muscle groups in athletes while maintaining high levels of strength.

References


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Does The Middle School Physical Educator Make A Difference In Students’ Attitudes Toward Physical Education?

David Barney, Patrick McGaha, and Robert Christenson

Purpose: The purpose of this study was to investigate the middle school physical educators interaction and the effect it has on student’s attitudes towards physical education. Design/Methodology: For this study students from a middle school in the upper Midwest of the United States participated in this study. The students (N=227) came from intact classes comprised of 6th, 7th, & 8th graders. The University Institutional Review Board (IRB) granted approval to conduct this study, along with the school principal and the middle school physical educators gave their consent to conduct the study as well as parental consent. The instrument used for this study, the Physical Education Interest Questionnaire (PEIQ) was developed to measure interest in physical education and related factors (Van Wersch, Trew, & Turner, 1992). The survey’s 35 items were divided into six sub-areas. For this study, the sub-area that was analyzed was the effect physical education teacher has on the students. There were six questions that were analyzed for this study (questions 24, 25, 26, 27, 28, & 29). After the questionnaire was administered, 14 students were interviewed regarding their attitudes towards the teacher. Findings: A majority of the students felt: that the teacher does not treat students who are good at PE from other students; that the physical education teacher gives more help to those students who may need help; and that students appreciated their teacher taking the time to ask about how their sport team did over the week, or how their family was. Originality/Value: The value of this study is that middle school physical education teachers do make a difference in student attitudes towards physical education class and need to get to know their students and show that they care about them and what they do in class and outside of class.

Keywords: Physical Education, Attitudes, Middle School Students

The activities that take place in a physical education class are social in nature and are quite different from what may occur in a math class.
In a physical education class students have to work together which requires communication, patience, understanding of their classmates and many other social skills. These kinds of interactions take place on a daily basis. There are many types of social interactions within a physical education class between teacher and students, for example, the feedback that a teacher gives a student regarding a skill that the student is practicing, answering student’s questions, explaining strategy during an activity or game, or just a casual conversation between the teacher and student. Any of these interactions could have the potential to affect a student’s attitude toward their physical education experience.

When reviewing the literature regarding teacher/student interactions and the effect on students, the word that frequently is used in the literature to describe this relationship is caring. The literature from education has found many valuable insights regarding caring teachers. Hayes, Ryan, & Zselle (1994) studied middle school students perceptions of caring teachers, specifically teacher behaviors. The researchers found that middle school females felt caring teachers “didn’t yell,” “doesn’t get mad” or “stayed calm.” The middle school male students found caring teachers to be “organized” or “stopped fights.” African-American middle school students described a caring teacher as one that “helped with academic work,” “encouraged success and positive feelings,” and “responded to the individual student” as the most valued behaviors of a caring teacher. Two other studies in education regarding caring teachers revealed similar results. For example, Davis (2006) investigated the context that created a quality middle school. In her study one of the main factors that creates a quality middle school is positive and proper teacher/student relationships. Within those teacher/student relationships, students appreciated a teacher that had a good sense of humor and was able to use that sense of humor in class. Yet, the researcher cautioned that teachers need to be careful that the humor they may use in class does not turn into sarcastic comments. These types of comments could be “taken the wrong way” or “taken personally” and could do more damage then good to the student. The second study (Walsh, 2006) looked at middle school students that had an “I don’t care attitude” towards school topics. The researcher discovered many variables that could help change middle school students attitudes towards school topics. For example, first, get to know your students. This involves the teacher to observe, study, and listen to their students. Second, take time to talk to your students. Find out what their interests are, what they like to do in their spare time and be genuine with them (Davis, 2006). And third, build trust. Gaining a student’s trust may sound easy but many times it proves to be a difficult task. The researcher suggests when middle school teachers do the previously mentioned items the teacher will be able to build trust with their students. The researcher did mention that building trust with students takes time and effort and those middle school teachers need to keep this in mind.

The physical education literature regarding teacher’s interactions with students also has suggested the importance of positive teacher/student interactions in forming positive attitudes in their middle school students. Two older studies illustrated teacher/student relationships and their affects on student attitudes towards physical education.
Missouri AHPERD Journal (1985) looked at determinants that positively and negatively affect student attitudes towards physical education. In her study, five determinants (teacher, curriculum, atmosphere, student perceptions of self, and peer behavior) were found to affect student attitudes. Of the five determinants that had the greatest impact on student attitudes were the curriculum and teacher interactions. Some of the following words were used to describe interactions with the teacher: helpful, caring, positive, understanding, yelled, offensive, strict and stern. The findings indicated that 26% of positive determinants involved interaction with the teacher. As mentioned earlier teacher behaviors were also ranked second in affecting student attitudes negatively. The results revealed that 21% of the students were negatively affected by the teacher’s behavior. In this study students indicated that a teacher’s behavior and words do positively and negatively affect student attitudes towards physical education.

Luke & Sinclair (1991) looked at positive and negative determinants that affect male and female adolescent’s attitudes toward physical education. The teacher was identified, once again, as the second-ranked determinant of negative attitudes toward physical education for both male and female students. Approximately 25% of the negative statements referred to the teacher. This ranked second to the curriculum. Because the teacher was identified as the fourth-ranked determinant of positive attitudes. Both males and females indicated that they appreciated teachers who “held high expectations,” “focused on learning something”, “provided not just a play class with no challenges,” “valued sensitivity in a teacher,” “encourages me despite my low ability:” and “does not force me to run if I feel unwell.” The results of this study suggest that the teacher is a more powerful determinant of student’s negative attitudes than positive attitudes.

More recent studies regarding physical education teacher’s interactions with students have found much of what Figley and Luke & Sinclair found in their studies. Cothran & Ennis (2000) compared teachers’ and students’ perspectives on educational engagement. One of the findings from this study was that a student’s perspective regarding engagement was that the teacher listened to what the students had to say. Specifically the students mentioned that even though they are teenagers, what they have to say is important. Many of the students appreciated the teacher that would listen to a wide range of topics from students. Regarding the topic of teacher’s listening Ennis, Cothran, Davidson, et al. (1997) investigated what aspects of the classroom environment were particularly disengaging for students and teachers. One of the biggest aspects that negatively affected student disengagement in physical education class was when the teacher would not listen or pay heed to students suggestions when it came to changing or modifying the activities (curriculum) the students participated in during class. When this would occur, students became bored, which led to students being verbally abusive and using profanity towards other students. Many times these outbursts would result in students being sent to in-school suspension. Teaching middle school physical education students the skills or the rules of a games or activity is extremely important but perhaps just as important is creating positive teacher/student social interactions. If the middle school physical educator can positively
capitalize on these interactions, there is a greater possibility that student’s will have a positive experience in physical education. This will hopefully lead to healthy adults and a healthier society. Thus the purpose of this study was to investigate the middle school physical educators interactions and the effects it has on student’s attitudes towards physical education.

**Methods**

**Participants**

The participants for this study consisted of students from a middle school in the upper Midwest. The students (N=227) came from intact classes comprised of 6th, 7th, and 8th graders. The physical education program used in this study could be considered an excellent program. There are two main reasons why this program could be considered an excellent program. First, there was a low absentee rate among the students from their physical education classes. And second, this program has the students participate in a variety of curricular units. The curricular units that were taught at this middle school were flag football, soccer, basketball, volleyball, lacrosse, floor hockey, badminton, speedball, cooperative games/activities and other team activities. The two teachers (1 male and 1 female) that participated in this study had an average of 23 years of teaching physical education at the middle school level. The University Institutional Review Board granted approval to conduct this study, the school principal and the middle school physical educators gave their consent to conduct the study, and parents gave consent. All of the middle school students were verbally informed of the purpose of the study and were made familiar with the survey. Students were assured that nonparticipation or withdrawal from this study would not affect their grade in their physical education class.

**Instrumentation**

The instrument used for this study, the Physical Education Interest Questionnaire (PEIQ), was developed to measure interest in physical education and related factors (Van Wersch, Trew, & Turner, 1992). The survey was used in a pilot study and it was found to be .70 reliable. During the pilot study the authors established content validity of the survey. The total number of items in the survey was 35. Within the survey, six sub-areas were created. They were: 1) interest in physical education; 2) the degree to which students construe physical education as a subject with masculine or feminine connotation; 3) how students construed physical education compared with other school subjects; 4) satisfaction or dissatisfaction with class curriculum; 5) effect the physical education teacher has on the students; and 6) physical changes middle school students are experiencing and the effects they have on their attitudes. For the purpose of the study, six questions (24, 25, 26, 27, 28, & 29) on the survey dealing with how the middle school physical educator affects student’s attitudes towards physical education were used.
### Table 1. The Physical Education Teachers’ Affect on Student Attitude Toward Physical Education

<table>
<thead>
<tr>
<th>Question</th>
<th>Agree</th>
<th>Neutral</th>
<th>Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>24) My PE teacher does not treat students who are good at PE differently from the others.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total Population</strong></td>
<td>66%</td>
<td>17%</td>
<td>17%</td>
</tr>
<tr>
<td>6th</td>
<td>73%</td>
<td>16%</td>
<td>11%</td>
</tr>
<tr>
<td>M</td>
<td>81%</td>
<td>5%</td>
<td>14%</td>
</tr>
<tr>
<td>F</td>
<td>69%</td>
<td>23%</td>
<td>8%</td>
</tr>
<tr>
<td>7th</td>
<td>65%</td>
<td>18%</td>
<td>17%</td>
</tr>
<tr>
<td>M</td>
<td>60%</td>
<td>18%</td>
<td>22%</td>
</tr>
<tr>
<td>F</td>
<td>69%</td>
<td>19%</td>
<td>12%</td>
</tr>
<tr>
<td>8th</td>
<td>62%</td>
<td>16%</td>
<td>22%</td>
</tr>
<tr>
<td>M</td>
<td>61%</td>
<td>14%</td>
<td>25%</td>
</tr>
<tr>
<td>F</td>
<td>62%</td>
<td>25%</td>
<td>13%</td>
</tr>
<tr>
<td>25) When we learn new skills in PE my PE teacher only helps the good students.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total Population</strong></td>
<td>6%</td>
<td>8%</td>
<td>86%</td>
</tr>
<tr>
<td>6th</td>
<td>7%</td>
<td>5%</td>
<td>88%</td>
</tr>
<tr>
<td>M</td>
<td>14%</td>
<td>0%</td>
<td>86%</td>
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<tr>
<td>F</td>
<td>3%</td>
<td>9%</td>
<td>88%</td>
</tr>
<tr>
<td>7th</td>
<td>6%</td>
<td>9%</td>
<td>87%</td>
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<tr>
<td>M</td>
<td>13%</td>
<td>16%</td>
<td>71%</td>
</tr>
<tr>
<td>F</td>
<td>0%</td>
<td>3%</td>
<td>97%</td>
</tr>
<tr>
<td>8th</td>
<td>5%</td>
<td>10%</td>
<td>85%</td>
</tr>
<tr>
<td>M</td>
<td>4%</td>
<td>10%</td>
<td>86%</td>
</tr>
<tr>
<td>F</td>
<td>6%</td>
<td>13%</td>
<td>81%</td>
</tr>
<tr>
<td>26) My PE teacher does not pay much attention to the students who are not very good at games and activities.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total Population</strong></td>
<td>4%</td>
<td>13%</td>
<td>83%</td>
</tr>
<tr>
<td>6th</td>
<td>5%</td>
<td>7%</td>
<td>88%</td>
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<tr>
<td>M</td>
<td>0%</td>
<td>5%</td>
<td>95%</td>
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<td>8%</td>
<td>9%</td>
<td>83%</td>
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<tr>
<td>7th</td>
<td>4%</td>
<td>13%</td>
<td>83%</td>
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<tr>
<td>M</td>
<td>7%</td>
<td>20%</td>
<td>73%</td>
</tr>
<tr>
<td>F</td>
<td>2%</td>
<td>7%</td>
<td>91%</td>
</tr>
<tr>
<td>8th</td>
<td>4%</td>
<td>18%</td>
<td>78%</td>
</tr>
<tr>
<td>M</td>
<td>6%</td>
<td>13%</td>
<td>81%</td>
</tr>
<tr>
<td>F</td>
<td>0%</td>
<td>31%</td>
<td>69%</td>
</tr>
</tbody>
</table>
27) The PE teacher usually gives more help to the students who are good at PE than to the ones who are not good at it.

<table>
<thead>
<tr>
<th>Question</th>
<th>Agree</th>
<th>Neutral</th>
<th>Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>27) The PE teacher usually gives more help to the students who are good</td>
<td>5%</td>
<td>13%</td>
<td>82%</td>
</tr>
<tr>
<td>6th PE students who are good at PE than to the ones who are not good at</td>
<td>6th</td>
<td></td>
<td></td>
</tr>
<tr>
<td>it.</td>
<td>M 4%</td>
<td>9%</td>
<td>86%</td>
</tr>
<tr>
<td></td>
<td>F 5%</td>
<td>9%</td>
<td>86%</td>
</tr>
<tr>
<td>7th PE students who are good at PE than to the ones who are not good at</td>
<td>7th</td>
<td></td>
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</tr>
<tr>
<td>it.</td>
<td>M 7%</td>
<td>12%</td>
<td>81%</td>
</tr>
<tr>
<td></td>
<td>F 13%</td>
<td>18%</td>
<td>69%</td>
</tr>
<tr>
<td>8th PE students who are good at PE than to the ones who are not good at</td>
<td>8th</td>
<td></td>
<td></td>
</tr>
<tr>
<td>it.</td>
<td>M 3%</td>
<td>19%</td>
<td>78%</td>
</tr>
<tr>
<td></td>
<td>F 2%</td>
<td>19%</td>
<td>79%</td>
</tr>
</tbody>
</table>

28) My PE teacher does not pay more attention to the students who are good at PE than to the ones who are less good.

<table>
<thead>
<tr>
<th>Question</th>
<th>Agree</th>
<th>Neutral</th>
<th>Disagree</th>
</tr>
</thead>
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<td>28) My PE teacher does not pay more attention to the students who are</td>
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<td>25%</td>
<td>30%</td>
</tr>
<tr>
<td>good at PE than to the ones who are less good.</td>
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<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>M 52%</td>
<td>18%</td>
<td>30%</td>
</tr>
<tr>
<td></td>
<td>F 54%</td>
<td>23%</td>
<td>23%</td>
</tr>
<tr>
<td>7th PE students who are good at PE than to the ones who are less good.</td>
<td>7th</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>M 50%</td>
<td>22%</td>
<td>28%</td>
</tr>
<tr>
<td></td>
<td>F 44%</td>
<td>27%</td>
<td>29%</td>
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<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>M 33%</td>
<td>36%</td>
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</tr>
<tr>
<td></td>
<td>F 29%</td>
<td>35%</td>
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</table>

29) PE would be much more fun if the PE teacher did not praise only the good students.

<table>
<thead>
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<th>Neutral</th>
<th>Disagree</th>
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<tbody>
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<td>29) PE would be much more fun if the PE teacher did not praise only the</td>
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<td>25%</td>
<td>57%</td>
</tr>
<tr>
<td>good students.</td>
<td>6th</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>M 12%</td>
<td>20%</td>
<td>68%</td>
</tr>
<tr>
<td></td>
<td>F 6%</td>
<td>9%</td>
<td>67%</td>
</tr>
<tr>
<td>7th PE students who did not praise only the good students.</td>
<td>7th</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>M 24%</td>
<td>9%</td>
<td>67%</td>
</tr>
<tr>
<td></td>
<td>F 6%</td>
<td>26%</td>
<td>68%</td>
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<tr>
<td>8th PE students who did not praise only the good students.</td>
<td>8th</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>M 22%</td>
<td>24%</td>
<td>54%</td>
</tr>
<tr>
<td></td>
<td>F 19%</td>
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Interviews
After the questionnaire was completed and analyzed, the researchers conducted interviews with the middle school students. For this study, 28 students were interviewed. After the surveys were analyzed 14 students who responded positively and 14 students who responded negatively to the survey were interviewed. The researchers reasoned that 28 students would give a good picture of student attitudes towards their physical education class. The number of questions asked each student was determined by their responses from the survey. Every student was not asked the same number of questions. The researchers analyzed all of the interview data regarding how the middle school physical educator affects student attitudes towards physical education.

Data Analysis
The data were analyzed using descriptive statistics in the Statistical Package for the Social Science (SPSS) program. Percentages were used to reflect the students’ responses for each item being analyzed. A 3-point Likert scale was used. The following numerical values were given for student responses: 1=Agree, 2=Neutral and 3=Disagree. When analyzing the data the following variables were investigated: a) total population of the participants’ attitudes (N=227), b) grade levels: 6th, 7th, and 8th, and c) male (n=118) and female (n=109) for each grade level.

Interviews were conducted in a conference room on a one-on-one basis. All interviews were videotaped with audio. After the interviews were completed each interview was transcribed. Responses from each survey question were complied and analyzed.

Results
Table 1 provides information regarding how the middle school physical educator affects student attitudes towards physical education. Survey questions 24, 25, 26, 27, 28, and 29 were examined. For question 24, 66% of the participants felt that the teacher did not treat students who are good at PE differently from other students. The data for each grade level indicated that students felt that the teacher did not treat students who are good at PE differently from other students. For example, 73% for the sixth grade, 65% for the seventh grade, and 62% for the eighth grade agreed with question 24. For question 25, 86% of the students disagreed that the physical education teacher only helped the good students when learning new skills. The data for each grade was as high as 88%, and interestingly 97% of 7th grade females disagreed with question 25.

For question 26, 83% of the students felt that the physical education teacher does not pay much attention to the students who are not very good at games and activities. For each grade level the results were similar (6th, 88%; 7th, 83%; & 8th, 78%). Interestingly, only 69% of 8th grade girls disagreed with this question. Question 27 asked the students if the physical education teacher usually gives more help to the students who are good at PE than to the ones who are not good at it. Once again 82% of the students disagreed with this survey question. The eighth grade students had the lowest percentage (78%) regarding this question. For question
28 student percentages were more evenly distributed when asked if their physical education teacher does not pay more attention to the students who are not good at PE than to the ones who are less good. The data for each grade level and for the male and female students for each grade level showed that there was not an overwhelming percentage that either agreed or disagreed with this survey question. The highest percentage was 55% (agreed), which came from the 7th grade females. And finally, question 29 asked students if physical education class would be much more fun if the physical education teacher did not praise only the good students. For this survey question 57% of the students disagreed. When looking at grade level and male and females in each grade level, similar percentages were common.

The additional data results from this study involved the student interviews. The following are responses from the students from the six survey questions. When students were asked if the physical education teacher does not treat students who are good at PE differently then from the other students, students responded by saying that, “no, when we were playing football, she (the physical education teacher) would help us with our throwing it (the ball) right. She helped me a lot”. Also, students were asked when learning new skills in physical education class, does the teacher only help the good students. Student responses were, “no, she helps everyone equally. She is equal to everyone.” Another student stated, “No, he always helps out everybody. He listens to all of the students.”

The next question students were asked was, does the physical education teacher give more help to the students who are good at PE than to the ones who are not good at it? One student stated, “She makes everyone do the same stuff. She will tell you to do your best. She won’t say, ‘oh look at these students they can’t do it.’” Another student stated “that’s not true, because he helps those people that don’t really know the game. He pays attention to a lot of people. He is a fair person.” And finally, students were asked if physical education class would be much more fun if the physical education teacher did not praise only the good students. One student responded by saying, “He gives praise to everybody. If he didn’t those kids that didn’t get praised would be mad.” One student said, “She is very good about being fair and equal. I don’t think that is an issue.” One last student said, “no, he tells everybody ‘good job’.”

**Discussion**

The purpose of this study was to investigate the middle school physical educators’ interactions with students and the effects it has on students’ attitudes towards physical education. It appears that the physical education teachers in this study did not treat students who were more skilled in physical education class differently from the other students (Question 24). This question had a similar tone as questions 26, 27 and 28, which stated, “My PE teacher does not pay much attention to the students who are not very good at games and activities” (Question 26). Question 27 states “The PE teacher usually gives more help to the students who are good at PE than to the ones who are not good at it.” And question 28 states; “My PE teacher does not pay more attention to the students who
are good at PE then to the ones who are less good.” Many students felt that the physical education teachers did not give special or additional help in class to students because they were more skilled or better than other students. Student responses to these types of interactions were similar to what Larson (2006) found in her study. She found that middle school students with varying skill levels were being persuaded, motivated and encouraged to do their best, to give their best effort and were being recognized for what they had done in class. This act of treating all students with different skill levels equally can positively affect a student’s attitude toward physical education. Rink (2002) has stated, when teachers interact with students, it sends a message to the student that the teacher knows who they are and that they care for their learning. As one student stated in the interview, “I am real bad at basketball, but Mrs. Jones (pseudonym) kept on me and encouraged me to stay with it (basketball).”

Over 86% of the students disagreed with question 25 which asked, “when students learn new skills in PE the teacher only helps the good students.” Once again, it is positive to see that the middle school physical educators were interacting with all students. As one student put it, “She makes everyone do the same stuff. She will tell you to do your best.” Another student stated, “Mr. Brown (pseudonym) helps us all, and will demonstrate over and over again what he wants us to do.” These student responses imply that they appreciate a teacher that is patient with them when they are learning a new skill or continuing to practice a skill that needs to be improved upon. Additionally Larson (2006) found in her study students responded positively when the teacher “showed me how to do a skill” or “allowed me to re-do a test.” Larson concluded that these types of interactions fostered a climate in the class that encouraged learning and personal achievement among the students.

When analyzing question 26, 83% of the students disagreed with the statement that “the teacher does not pay attention to them during games and activities.” This shows that teacher attentiveness is another important component of affecting student attitudes positively. The students are learning and improving their skills, and getting an opportunity to implement what they have learned in class and are applying what they have learned in a practical game like situation. These types of situations are another opportunity for middle school physical educators to positively interact with their students.

Questions 27, 28 and 29 looked at teachers that give attention to students that are more skilled and those that are not as skilled. Over 81% of the total population of students felt that the physical education teacher did not pay more attention to the students who are very good at games and activities. Middle school students are not easily fooled. If the physical educator tends to play ‘favorites’ to those students that are more skilled, the other students will pick up on it and as a result of the teacher’s behaviors it could negatively affect student attitudes towards physical education. Those types of teacher behaviors could severely affect class morale, thus affecting student learning and attitudes. Ennis et. al. (1997) found that when physical educators interacted equally with all students, the students responded by being more cooperative and respectful toward the teacher.
Conclusions

The findings from this study add to the literature and provide recommendations to middle school physical educators. When talking to students, the physical educators were fair and equitable with all of the students. During the study, the researchers observed many instances of teacher/student interactions. Many times researchers observed that the teachers would ask students how they were doing, how their after school sport team had fared, what their plans were for the upcoming weekend and in many cases joked with students. Responses during interviews indicated that the students liked the interactions they had with their teachers and because of these positive interactions; student’s attitudes were positively affected towards physical education. It may be inferred from this study that for a teacher to positively influence student attitudes they should talk to students about subjects beside school or classroom events.

Another interesting aspect revealed by the data was that as the students got older their attitudes toward the teacher became less positive. Generally speaking, student attitudes towards the teacher were positive, yet, eighth grade student attitudes weren’t as positive as sixth and seventh grade students’ attitudes. This could be the beginning of the decline of student interest in physical activity we witness as children move into their high school years.

According to the data from this study, the middle school physical educator has a great opportunity to positively influence student attitudes towards physical education. If the middle school physical educator can positively affect student attitudes towards physical education, then there is a hope that as the student becomes an adult they will be more willing or likely to be physically active throughout their lives. With a physically active population there will be a greater chance for a healthier society.

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Osgood-Schlatter Disease: A Debilitating Condition in Adolescent Athletes

Mozaffar Rahmatpanah

It is typically recommended by physical educators or coaches that individuals engaging in physical activity should follow the exercise prescription regimen FITT -- Frequency, Intensity, Time and Type so that appropriate physiological and biological adaptations happen to the body. However, it is uncommon for adolescents and young athletes to follow this concept due to their urgent desire and ample energy to engage in physical activities and competitive sports. As a consequence of too much and too often physical activity and sport participation, some children's bodies might suffer overuse injuries (McLeod et al., 2011, p. 206). In fact, those young athletes who specialize in one sport too early (early specialization) are prone to more injuries because they use the same muscles or joints repeatedly and frequently. According to Kaleth & Mikesky (2010, p. 31) “The majority of injuries seen in young athletes are related to specific, repetitive movement patterns that result in damage to a tissue structure (e.g., bone, muscle, tendon). Overuse injuries (e.g., tendinitis, apophysitis, stress fractures), as they say are typically called, generally occur when the athlete does not allow sufficient time for the tissue to heal and adapted to the imposed physiological stress”.

Injuries can be classified into two types, acute or chronic. An acute injury is an immediate brief damage to the body such as a sprained ankle, bruises or a ligament tear, or a broken bone. Chronic injuries happen as a result of overuse or repeated stress to the body parts over extended periods of time such as shin splints, tennis elbow, jumper’s knee, or Osgood-Schlatter Disease (OSD)/condition. OSD is one of the most common conditions that occurs in physically active children (Williams & Marston, 2001). The name of OSD derives from two physicians’ names that identified the condition in 1903, Dr. Robert Osgood and Dr. Carl Schlatter (Kujala, Kvist & Heinonen, 1985). Prentice (2006, p. 644) noted that “OSD usually resolves when the athlete reaches the age of eighteen or twenty. The only remnant is an enlarged tibial tubercle”. On the other hand, there is another overuse injury similar to OSD called Sinding-Larsen-Johansson (SLJ) disease which happens at inferior pole section of the patellar tendon (Wall, 1998). SLJ symptoms involve swelling, pain, and tenderness of the inferior patellar pole at the origin of the patellar tendon (Wall, 1998). Teachers and coaches should be aware of these similar overuse knee injuries, but the focus of this paper is OSD.
What is OSD?

Prentice (2006, pg. 644) defined OSD as “an apophysitis characterized by pain at the patellar tendon to the tibial tubercle” and Wall (1998, p.29) defined OSD as “a disturbance of the patellar tendon attachment to the tibial tubercle apophysis”. Since in children and adolescents the apophysis is going through ossification and is normally weaker than the surrounding tissues, excessive force, overuse, and repeated traction and pull by the patellar tendon on the tibial tubercle apophysis causes the separation of the tibial tubercle and results in pain, tenderness, and swelling. OSD commonly occurs in active boys and girls when their bones are growing most rapidly (ages 8 to 15 yrs; Auxter, Pyfer, Zittel, & Roth, 2010, p.487). This is the growth period for most teenagers, and the bones, muscles and tendons are growing fast. This growth spurt increases the risk of movement injuries in youngsters. Adolescent athletes who are involved in sports such as soccer, volleyball, gymnastics, basketball, and track and field are more prone to this condition. Activities that are so-called “non-weight bearing activities,” such as swimming and bicycling, might not cause serious damage to the knee in respect to Osgood-Schalleter disease. I contracted OSD when I was young and at a time when I was active. I still have a large bump at the end of the tibia just below the kneecap on both legs, indicating that I had OSD. Parents and coaches please know: the bone bump is not a tumor and it is benign. It is recommended that an x-ray or MRI be taken to make sure about the rare possibility of a tumor. The enlarged tubercle is the result of a fracture to the tibial tubercle because of the pulling of the patellar tendon. When the fracture heals, the tubercle becomes larger. Coaches and teachers, if students in your physical education classes or your athletes complain about symptoms similar to OSD or any knee problems, please do not overlook the condition. Refer the athlete to the school athletic trainer, school nurse, or notify parents about the problem. Most often, we tell our athletes “no pain no gain” or you have to “tough it out” or “it is O.K. to play with some pain.”

If a student or an athlete experiences the onset of OSD like symptoms, usually he/she will complain about discomfort around the knee joint (roughly 2 to 3 in. below kneecap) when participating in physical activities, especially in squatting, rope jumping, running, or kneeling as in wrestling. It is advisable to recommend that the student see a family physician or sport physician. For example, this past summer when I was helping coach my son’s youth soccer team, one of the players was always complaining about his knee. He had to sit out in middle of several matches. When I asked him the source of his pain, he pointed to below the kneecap. I advised his parents to take him to a sport specialist, who told him he was experiencing OSD.

Treatment

The treatment of OSD depends on the severity of the injury. According to many experts, it takes twelve to twenty-four months to run its course (Wall, 1998; Williams & Marston, 2001). This means the condition heals and resolves on its own natural course. The commonly recommended RICE
(Rest, Ice, compression and elevation) concepts are a very conservative method when treating an OSD injury. OSD can be classified into three categories: mild, intermediate, and severe (Wall, 1998). In a mild case, pain after activities goes away within 24 hours; in an intermediate level there is pain during and after physical activity. However, the pain is not significant enough to limit activity and goes away within 24 hours. In severe cases there is constant pain that limits sports participation and daily activity. All experts recommend rest from six to twenty-four months until the fracture of the tibial tubercle is healed. In a severe case, the affected knee may have to be immobilized in a cast or brace for an extended period of time, depending on the philosophy and personal professional opinion of the orthopedic physician. It is critical to initiate rehabilitation, strengthening and stretching programs for the quadriceps and hamstring muscles after the rest and immobilization period. The following exercises are very helpful after permission from an orthopedic doctor:

- **Swimming** is an excellent non-weight bearing activity to improve muscle strength, endurance, and flexibility of the knee and hip joints. For example, stand on the edge of the pool and perform leg raises in different directions: straight leg raise, abduction and adduction of leg, writing alphabetic letter with affected leg as well as locomotor motion using various types.
- **Stationary Bicycle:** A non-weight bearing activity that helps to build leg strength and improve cardio-respiratory functions.
- **Straight-leg Raise:** lie on the floor while supporting your back few inches off the floor using your elbows, bend unaffected knee and lift the affected leg 10 times. Next, tighten the thigh muscles (isometric contraction) and then lift the leg about 16 in. hold for ten sec. Slowly lower the leg and relax your leg. As you build strength, you can use an ankle weight starting with 1/2 pound and gradually increasing the weight. Progression is key.
- **The Hamstring Stretch: Sit and Reach** (sit with the knees fully extended and the feet shoulder-width apart. Reach forward with both hands and touch your toes. Hold for 10 sec.)
- **Modified Hurdler stretch** (sit with left leg straight and your right leg bent close to your body. Lean forward and touch your extended leg’s toe and alternate legs).
- **Alternate Leg Stretcher** (lie flat on your back extending both legs. Bend the right leg and now grasp your right leg behind the thigh and pull it gently toward your chest. Alternate legs.)

**Prevention**

Adolescent athletes should not be exposed to a large volume workouts in terms of frequency, intensity, and duration due to the growth spurt period. It is recommended that adolescent athletes participate in multi-sports versus specializing in one sport. Contact sports and weight lifting should be carefully supervised and monitored so that trauma and movement injuries can be prevented. Teachers and coaches should understand that children are not little adults and select age-appropriate activity, making sure that they get enough rest and recovery time between
games, practices, and seasons. Many principles of conditioning such as overload, progression, warm-up and cool down, individual differences, mode or type of exercise and training must be carefully considered in order for the young and motivated athlete to enjoy the beauty of sport participation and experience successful future. As one of my doctors told me “the body never forgets about injury” so let’s make the participation in athletic competition injury-free as much as possible.

References


MOZAFFAR RAHMATPANAH, Ph.D. is a professor of physical education at Central Methodist University in Fayette, MO.
Validation Of ACSM Metabolic Equation As An Accurate Predictor Of VO2 In Division II Cross-Country Athletes

Nicole Arnold, University of Central Missouri

Introduction: The American College of Sports and Medicine (ACSM) Metabolic Equation is used to predict steady state VO2 levels of runners and is said to be accurate up to 13 mph. Purpose: The purpose of this study was to determine if the ACSM running equation is an accurate predictor of steady state exercise at high running speeds of cross country runners. Methods: Sixteen (8 male, 8 female) Division II cross country runners (19.5 ± 1.1 yrs, 15.08 ± 6.19% body fat, VO2max 61.3 ± 8.27 ml/kg/min) performed two separate treadmill exercise tests. First their height and body weight was measured using an Inbody 120 (BioSpace Technologies). The first test was a maximal VO2 measurement in which subjects ran on the treadmill while expired gases were collected and analyzed (ParvoMedics Inc). The initial speed was 8 mph and grade was 0.0%. Speed increased every two minutes and the grade began to increase once the subject reached 12 mph until the subject reached volitional exhaustion. VO2max was determined by subjects reaching two of four thresholds; RER ≥1.0, RPE ≥ 17, HR within 11 BPM of age predicted HR, or VO2 plateau. From the VO2max assessment ventilatory thresholds for each subject were determined along with their heart rate at that threshold. The goal of the second treadmill test was to achieve a steady state heart rate within 10 bpm below the ventilatory threshold. Participants then ran at that speed while VO2 was measured for the actual VO2 consumption. The speed and grade were then entered into the ACSM running equation to determine if the value predicted by this equation was equal to the actual VO2 measured. Results: Based on the data collected VO2 measured was 49.9 ± 6.9 ml/kg/min at an average speed of 244 m/min. VO2 estimated at the same speed using the ACSM running equation was 52.4 ± 6.6 ml/kg/min. Statistical analysis was conducted on the data to determine if the values were significantly different. A paired t-test revealed t (1,14) = -1.44 p = 0.16. Conclusion: These results indicate the ACSM Metabolic Equation is able to predict steady state VO2 at a speed of 244 meters per minute in division 2 cross country runners thus confirming the validity of the prediction equations at high speeds in highly trained runners.
Comparison of Perceived and Actual Percent Body Fat

J. E. Bossard, S.S. Krispin, and J.L. Humphrey. Truman State University, Kirksville, MO

Studies have shown that college men and women view their bodies differently. Percent body fat is an indicator of these differences. Purpose: The purpose of this study was to determine if there was a correlation between a participant’s body image and their actual percent body fat. In addition, we sought to determine if there was evidence of a difference between male and female body image views. Methods: Health 195 class (n=) volunteered to participate after having the conditions of the study fully explained. The participants completed information regarding their gender, estimated height, weight, and percent body fat. They were sequentially measured for actual height, weight, and percent body fat. Participants estimated weight in pounds and height in feet and inches. Actual values were measured in kilograms and centimeters to prevent altering estimations. A skilled technician performed skinfold measurements to estimate percent fat. Results: the rank-order correlation between BMI and participants’ perceived body classification was .55 for women and .57 for men (p<0.05). The Pearson correlation between perceived percent fat and actual percent fat was r=0.42 for and 0.50 for men (p<0.05). Men underestimated percent fat by 1.9% (p=0.18) while women overestimated percent fat by 2.6% (p<0.05). Conclusion: Males tend to underestimate their percent body fat while females overestimate their percent body fat. There was a significant difference in the way men and women view their body; males more often view themselves as ‘smaller’ or perhaps more muscular, while females view themselves as larger than their BMI proved.

Influence of Color on VO2 Consumption, Heart Rate, Ventilation Rate and Rate of Perceived Exertion While Running

Toby Chambers, University of Central Missouri

Introduction: Psychological factors play a role in exercise. If psychology plays a role in exercise performance then it may affect the physiological responses to exercise. Purpose: The purpose of this study is to examine the physiological effects different colors have on active college aged participants running on a treadmill at 6.0 mph for 15 consecutive minutes by measuring VO2 consumption, ventilation rate, heart rate, and rate of perceived exertion during exercise. Methods: The study consisted of 10 participants (5M, 5F) that were 21.3 ± 1.9 years, 80 ± 9.4 kg, and 174.2 ± 10 cm. Participants ran 15 minutes on a treadmill. Expired gases were collected by a True One Parvomedics Metabolic Cart in the Human Performance Lab at the University of Central Missouri. The participants warmed up for five minutes at 6mph while looking at a white color environment (control). Once the warm-up was completed, the subject was exposed to one of three colors (yellow, blue, or red) each in a random order. Results: The difference in VO2 consumption, ventilation rate, heart rate, and RPE between blue, red, white, and yellow minimal. The data
showed no significant difference between the different colors that were presented to the participants. **Conclusion:** According to the current data, while running on a treadmill, color does not influence VO$_2$ consumption, ventilation rate, heart rate, or rate of perceived exertion. **Key Words:** VO$_2$ consumption, ventilation rate, heart rate, RPE

**Effect Of Music On Time To Completion Of One Mile Treadmill Run**
Nicole J. Clark, Megan M. Distler, and Allysa C. Rimkus  
Faculty Mentor: Jerry Mayhew

Music has been suggested as a diversionary measure when exercising. The purpose of this study was to assess the effect of music on time to completion for a one-mile treadmill run in college students. College students (12 M, 17 F; age = 18-23 yrs) with varying activity backgrounds performed two one-mile self-selected pace treadmill runs. During one trial, a preselected six-song play list, at 180 beats per minute administered through earphones. During another trial, no music was presented. Trial order was randomized. During each trial, the subjects were permitted to control the speed of the treadmill based on their perceived comfort. There was no significant difference ($p \geq 0.75$) between run times with music (9.93 ± 6.24 mins) versus those without music (9.82 ± 6.06 mins). Activity level and gender did not have a significant effect on the time to complete a one-mile treadmill run. Listening to music with a rapid beat pattern does not appear to have a significant ergogenic effect on the time to complete a one-mile treadmill run.

**The Effect of Fatigue on Reaction and Movement Times in College Baseball Players**
Pete Esau, Katie Dames, Allysa Surenger  
Faculty Mentors: Jerry Mayhew and Dan Davis

The purpose of this study was to determine the effect of post-exercise fatigue on reaction (RT) and movement times (MT) of college baseball players. Male baseball players ($n=19$) volunteered to be measured for RT and MT were measured twice before and after an off-season workout. RT was measured using a touch pad on which subjects stood with only one foot in a position similar to base running. On an auditory beep, subjects lifted the drive foot, stopping a digital timing unit, and sprinted one meter through a photoelectric sensor to stop a second digital clock (MT). Following pre-test, subjects participated in an hour-and-a-half off-season weight training workout. Immediately following, subjects were tested again. Pre-test RT was not significantly different from post-test RT. Pre-test MT was significantly faster than post-test MT. Fatigue generated during an average exercise training session does not affect RT among baseball players but may significantly decreases MT.
Effect of Static and Dynamic Stretching on Vertical Jump Performance
Taylor Denkinger and Joe Emery
Faculty Mentor: Jerry Mayhew

Introduction: Prior to physical activity, stretching and a light warm-up are widely recommended before athletic performance. Two of the most common methods of stretching are static and dynamic. It has been hypothesized that dynamic stretching is the more beneficial of these two techniques in preparing the body for physical activity. Purpose: This study was designed to test the effects of static stretching (SS) and dynamic stretching (DS) on vertical jump (VJ) performance in athletes. Methods: NCAA Division II baseball, softball, and soccer athletes (29 F and 22 M) were tested on two separate days for maximal countermovement vertical jump using a Vertec. Participants were randomly selected to perform standard static stretches on the first day and dynamic stretching on the second day. Following each stretching routines, participants were allowed a practice jump and then performed three maximal jumps. Results: A paired t-test on the first jump revealed that DS produced a significantly greater VJ (19.9 ± 6.6 ins) than SS (19.1 ± 6.9 ins). By the third jump, the difference between DS (20.2 ± 6.5 ins) and SS (19.9 ± 6.7 ins) had decreased to a nonsignificant level (p=0.14). Conclusion: The results of this study suggest that dynamic stretching might offer a slightly greater benefit for the initial VJ, but the effect may be dissipated by the third jump.

Key Words: dynamic stretching, static stretching, vertical jump

What’s A Serving? Colleges’students Knowledge Of Common Serving Sizes
Amanda Dunn and Emily Mesecher
Faculty Mentors: Liz Jorn and Dr. Jerry Mayhew, Truman State University Health and Exercise Sciences

Purpose: The purpose of this study was to investigate the serving size knowledge of college students. Methods: Fifty students (M=21, F=29) completed a demographic survey and were then asked to estimate the serving size of seven common food items. The serving size of each item was then measured with a balance and compared to the standard USDA serving size. Results: This study showed that there were significant differences between estimates and actual USDA servings. There was a trend towards significance between actual and perceived values for cereal (t=1.95, p=0.056) and peanut butter (t=1.86, p=0.068). Males tended to overestimate cereal servings and females underestimated, both genders overestimated peanut butter serving size. An independent t-test (t=3.9, p<0.05) showed that those students who classified themselves as knowledgeable estimated the cereal serving significantly different and more accurately than the other students. Using a one sample t-test the group significantly deviated (p<0.001) from the USDA serving size for spaghetti noodles, water, salad, mashed potatoes and peanut butter. Conclusion: The group significantly deviated from some of the chosen USDA serving sizes. Students who indicated on the survey they felt “knowledgeable about nutrition” were more accurate in estimating serving sizes.
size. Future research could increase the types of food, visual appeal of food and also focus on knowledge of younger children/adolescents where trends show increasing obesity levels. Results of this study may be of interest to on-campus health departments and instructors of college health classes.

**Key Words:** nutrition, serving size, portion size

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**Examination of Physical Activity Enjoyment between Female Athletes and Non-Athletes**  
*Kelsey Echterling & Alex Noble*  
*Missouri Western State University*  
*Faculty Advisor: Dr. William Russell*

**Introduction:** Previous research has been mixed on whether athletes differ from non-athletes on their motivators for exercise. Because female athletes are mandated to physically train for their sport involvement, they may develop different motivations for and enjoyment of physical activity in general. **Purpose:** The purpose of the study was to determine if female athletes enjoy physical activity more than female non-athletes due to a lack of forced motivators. **Methods:** Participants were 48 female college students which included 25 student-athletes \(n=10\); women’s basketball, \(n=15\); women’s soccer, \(n=10\) and 23 non-athletes. The age range of participants was between 18 and 24 (M age =20.0). All participants completed a survey packet asking questions regarding motivations for engaging in exercise and included the Physical Activity Enjoyment Scale (PACES, Kendzierski & DeCarlo, 1991). All athletes completed the survey packet at scheduled team practices. Non-athletes were contacted by the first author and completed surveys at an organizational meeting. All participants completed the survey packet in 10-15 minutes. **Results:** An independent t-test was conducted to determine if female athletes differed from non-athletes on their physical activity enjoyment (PACES). No significant difference was found on physical activity enjoyment \((t=.990, p=.52; M \text{ PACES score for athletes }=102.88, M \text{ PACES score for non-athletes }=110.09)\). **Conclusion:** These results suggest that college female student-athletes do not differ in their enjoyment of physical activity compared to college female non-athletes. The most commonly reported motivator for all participants was to obtain/maintain a healthy body. **Key Words:** Motivation, Females, Physical Activity, College Athletes

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**An Examination of Female University Students’ Personal Body Weight Perceptions, Body Mass Index, and Dieting Practices**  
*Erin O. Foster*  
*Truman State University*

**Introduction:** Many women incorrectly perceive their weight and select their dieting practices based on their inaccurate perceptions rather than medical standards for weight. **Purpose:** The purpose of this research was to compare female university students’ personal body weight perceptions
to their BMI and determine the relationship of these variables with their selected dieting practices. **Methods:** A convenience sample of 68 female students had their heights and weights measured, and from these measurements the participants’ BMIs were calculated. Subsequently, the participants completed a survey assessing their personal body weight perceptions and dieting practices. **Results:** Linear regressions were run to determine the presence and strength of relationships between the following variables: personal body weight perception and dieting practices; and BMI and dieting practices. Additionally, descriptive statistics determined if the participants had accurate personal body weight perceptions when compared to their BMI. The results of this study indicated 31.8% of participants were inaccurate in their body weight perception. Furthermore, there was a significant relationship between BMI and past dieting practices ($r = .488$) and between personal body weight perception and both past and current dieting practices ($r = -.621$ and $r = -.398$, respectively) **Conclusion:** The results of this study suggest female university students chose their dieting practices based on their personal body weight perceptions rather than their BMI. Moreover, their perceptions of weight were potentially inaccurate. These results emphasize the need for campus health educators to implement programs focused on achieving a healthy weight by using appropriate dieting practices and understanding BMI. **Key Words:** personal body weight perception, body mass index (BMI)

**Effect of Hula Hoop Exercise on Heart Rate**  
*Samantha Hoefener, Emily Done, Kelly Wiemelt, and Stephanie Crecelius*  
*Faculty Mentors: Jerry Mayhew and Melody Jennings*

The purpose of this study was to evaluate the effect of hula hoop exercise on heart rate (HR). Subjects (7 M, 15 F) wore a HR monitor during a 10-min seated rest followed by 20 mins of hula hoop exercise. While exercising, subjects were required to keep the hoop moving by whatever means possible. Resting HR averaged $86.4 \pm 14.5$ bpm and post-exercise HR averaged $143.4 \pm 31.9$ bpm. Eighteen students (81.8%) reached 60% of their age-predicted maximum HR after exercise, leaving only 4 students (18.2%) that did not. Those 4 students reached 50% of their age-predicted maximum HR after exercise. A paired t-test between final HR and 60% of age-predicted maximum HR indicated that the average exercise HR was significantly higher than the required minimum threshold for aerobic development. Hula hoop exercise may provide sufficient exercise intensity to achieve American College of Sports Medicine guidelines for cardiovascular training and provide an interesting motivation for participation.

**College Athletes’ Perceptions on Strength Training**  
*Amber Long & Dalton Krysa*  
*Missouri Western State University*  
*Faculty Advisor: Dr. William Russell*

**Introduction:** In addition to potential differences across gender, there
may be differences in the perceived importance of strength training between collegiate athletes across different sports. For example, it has been suggested that male athletes are more competitive and win-oriented than females (Poiss, Sullivan, Paup, & Westerman, 2004) and this may influence attitudes toward the importance of strength training. **Purpose:** The purpose of this study was to examine whether gender and sport differences were evident in perceptions toward strength training a sample of college athletes. **Methods:** Participants were 54 college athletes (25 males, 29 females) from football (n=25), women’s basketball (n=7), women’s soccer (n=12), and women’s volleyball (n=10) at Missouri Western State University and all surveys were administered prior to scheduled team practices. Questions were developed to assess attitudes on strength training and included a modified version of the Physical Activity Enjoyment Scale (PACES, Kendzierski & DeCarlo, 1991). **Results:** An independent t-test was performed on gender differences on perception of strength training. No significant difference was found between males and females (t=1.42; p>.05). An ANOVA was performed on sport differences on enjoyment of strength training. No significant differences were found between the sports (p>.05). Finally, a t-test was performed on gender differences on enjoyment of strength training, again having no significant differences (t=.995; p>.05). **Conclusion:** Results indicated no statistical significance between gender and their perceptions toward strength training. However, development of strength and speed were viewed as prominent reasons athletes participated in strength training activities. **Key Words:** Perceptions, Strength Training, College Athletes

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**Effects Of Exercise Attitudes, Social Norms, And Perceived Behavioral Control On Intent To Exercise In College Students**

*Kirsten Maakestad, Jayme Reynolds, and Jenny Hill*

*Faculty Mentors: Chris Lantz, Jerry Mayhew*

The purpose of this study was to determine the power of attitudes, social norms, and perceived behavioral control as predictors of intent to exercise in college students. A survey was administered to students (n = 88) at a small, public, liberal arts university in the Midwest. Exclusion criteria included: pursuing a major in the department of Health and Exercise Sciences; participation in a varsity sport at the University; participation in the ROTC program; or current enrollment in a health class with a physical activity requirement. The survey contained demographic information aimed at determining “perceived behavioral control” (number of credit hours, hours per week spent in co-curricular activities, residence on or off campus) as well as questions targeting “social norms” (media influence on body) and “exercise attitudes” (degree to which the student looks forward to exercise). Linear regression revealed strong correlations between exercise attitudes and intent to exercise (p = 0.000) and social norms and intent (p = 0.011). No significant correlation was found between perceived behavioral control and intent (p > 0.05). Stepwise multiple regression selected attitude and social norm as significant predictor variables (R = 0.66, %CV = 22%). These results suggest that looking forward to exercise is the
most accurate predictor of intent to exercise in college students, while perceived behavioral control is not a significant contributor.

**Association Of Pain With Overhead Throwing And Upper Extremity Range Of Motion And Strength In Collegiate Baseball Players**

*Devon Myers, Joe Emery, Vanessa Kvam and Mary Manley*

*Faculty Mentor: Kevin Marberry, M.D., Department of Surgery, A.T. Still University, Kirksville, MO*

Upper extremity range of motion has been shown to be related to injury risk and performance, especially in overhead throwing athletes. To identify athletes at risk for shoulder and elbow injury, it is necessary to understand the roles of upper extremity range of motion, muscle strength, and throwing velocity. The purpose of this investigation was to explore the relationship between upper extremity pain, current throwing velocity, shoulder and elbow range of motion (ROM), and upper extremity strength in college baseball players. Twenty-seven NCAA Division II college baseball players (age=19.96±1.4 yrs, height=181.73±6.15 cm, weight=87.34±12.7 kg) completed an injury surveillance survey detailing past and present upper extremity injuries and/or pain. Bilateral shoulder and elbow ROMs and strength were measured. Throwing velocity in the dominant arm was measured after adequate warm-up. Wilcoxon signed rank tests were used to determine differences between dominant and non-dominant arm measurements. Dominant to non-dominant arm ROMs were significantly different in forward elevation (\(p=0.02\)), abduction (\(p=0.0007\)), internal rotation in adduction (\(p<0.0001\)), internal rotation in abduction (\(p=0.009\)), and total ROM in abduction (\(p=0.03\)). Dominant to non-dominant strength for shoulder external and internal rotation were significantly different (\(p=0.001\)). Pain with overhead throwing on the date of testing was noted in 11 of 27 athletes. There were no significant differences (\(p>0.05\)) in strength or throwing velocity between athletes with pain and those without pain. Wilcoxon-Mann-Whitney univariate analysis revealed elbow ROM as a factor associated with pain (\(p=0.007\)). Logistic regression analysis showed the odds of experiencing pain with overhead throwing are 17% higher for every one degree decrease in total elbow ROM. In this cohort, decreases in shoulder ROM and strength were not related to pain in the shoulder of the dominant arm. Total elbow ROM appeared to be closely related to upper extremity pain in the overhead throwing athlete.

**Correlation between Body Composition and Swim Performance in College-Aged Swimmers**

*Sarah Dieckgraefe, Cassandra Rodden, and Elizabeth Ryan*

*Faculty mentors: Jerry Mayhew and Jeff Arabas*

The purpose of this study was to evaluate the relation between body composition and swim performance in college-age swimmers at three different ability levels. Non-Swimmers (NS, \(n=9\)), intermediate swim
class students (IS, \( n = 12 \)), and varsity swimmers (VS, \( n = 9 \)) were timed in a 75-yard swim (stroke not specified). Body composition was assessed using Dual Energy X-ray Absorptiometry (DXA) providing values for %fat, muscle mass, and bone density. Also, arm area was estimated for the forearm and hand via calculation of the surface area from a model outline of the dominant arm. There were no significant differences among the different ability groups in any body composition measure. When groups were collapsed into a composite sample (\( N = 30 \)), there were no significant correlations between swim time and any body composition component. Factors other than body composition appear to affect swim time in swimmers of diverse ability. Further study might include the effect of swim stroke power and anaerobic ability on swim performance among participants of different ability levels.

### Body Composition Comparison between Offensive and Defensive Skilled Position Players in NCAA Division II College Football

**Kaitlin Stump, Dustin Howard, Bianca Szafarowicz, Paul Taylor, and Emily Briseno**  
Faculty Mentor: Jerry Mayhew

A common assumption in football is that certain body build/types may be pre-disposed to play certain positions. The purpose of this study was to assess the difference in body composition among offensive and defensive skilled position players in college football. Offensive (\( n = 8 \)) and defensive (\( n = 8 \)) players from an NCAA Division II team volunteered to be assessed for body composition using dual energy x-ray absorptiometry (DXA). The offensive positions were wide receivers, running backs, and tight ends; defensive positions were cornerbacks, safeties, and linebackers. Analysis revealed no significant difference (\( p > 0.05 \)) between offensive and defensive players in age, height, weight, %fat, or fat-free mass. However, the slight greater height and lesser weight of the offensive players yielded a significantly lower BMI (26.4 ± 0.9 kg/m\(^2\)) than noted in the defensive players (29.0 ± 1.5 kg/m\(^2\)). The correlation between BMI and fat-free mass (\( r = 0.63, p < 0.01 \)) was significantly higher than the correlation between BMI and %fat (\( r = 0.36, p > 0.05 \)). Thus, there is no connection between BMI and %fat in heavily muscled football players. Furthermore, fundamental body composition parameters of specific offensive and defensive skilled position football players may be similar and cannot be used to differentiate among these playing positions.

### Relationship of Regional Body Composition to Jump Performance in College Volleyball Players

**Katelyn Thomason and Jessica Tomash**  
Faculty Mentors: Jerry Mayhew and Ben Briney

The sport of volleyball is dominated by jumping ability of the players. Player selection and training might benefit from assessment of the relationship on various aspects of body composition and jump
performance. The purpose of this study was to assess the contribution of regional and total body composition to vertical jump performances in college varsity volleyball players. Eight varsity volleyball players performed 3 trials each of a countermovement vertical jump (CMJ), a 4-jump repetition test (4VJ), and a 3-step approach jump (3AVJ). Reactive strength (RS) was calculated at the ratio of average 4-VJ/CMVJ. Total and regional body composition was determined from dual-energy X-ray absorptiometry scans (DXA). Reliabilities of the all jump performances were high (ICC>0.90). Most jump performances were negative related to %fat (r = -0.50 to -0.81), except RS (r = 0.26). 3AVJ was positively correlated (0.92) and to a lesser degree (0.27). Leg lean mass was positively related to 3AVJ (r = 0.83) but negatively related to 4VJ (r = -0.25) and CMJ (r = -0.14). Total lean mass followed a similar pattern. 3AVJ was poorly related to CMJ (0.27) and 4VJ (r = 0.16). Jump performances among volleyball players were only moderately related to regional lean mass and lacked high interrelationships.
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*Editors, 2013*

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