February 29, 1980 the Missouri Association for Health, Physical Education, Recreation and Dance became incorporated as an association.

Editorial Policy

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All correspondence concerning the publication of the Journal should be addressed to Dr. Kathleen Haywood, Associate Dean, College of Education, University of Missouri-St. Louis, 1 University Blvd., St. Louis, MO 63121 or haywoodk@umsl.edu and Dr. Scott Strohmeyer, strohmeyer@ucmo.edu. Manuscripts must be submitted as Word documents.

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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Effect of Listening to 140 BPM Music on Stationary Cycling Time

Victoria Halfmann and Samantha Smith

Previous studies have suggested that music may act as a distraction for an exerciser to aid in maintaining exercise pace and intensity. Less attention has focused on the effect of fast music to produce a fast pace during activity. The purpose of this study was to determine the effect of listening to fast-paced music on the time required to cycle five-kilometers (km) on a stationary bicycle. University students (8 M, 9 F) performed two five-km rides at moderate intensity while listening to music at 140 beats/min or not listening to music. Treatment conditions were randomly assigned and self-selected resistance remained the same for both rides. Participants had significantly faster times ($p<0.02$) when cycling to music (8.89 ± 2.09 min) than without music (9.54 ± 1.90 min), regardless of gender or resistance. Participants reported no significant difference ($p=0.61$) in rate of perceived exertion level after riding with music (13.4 ± 1.5) compared to without music (13.7 ± 2.6). Fast music appears to improve stationary ergometer ride times by an average of 7% compared to no music, although the perception of effort was not significantly different between the two trials. Future studies might investigate the effect of fast music while performing other forms of exercise such as treadmill running, track running, or swimming.

Key Words: perceived exertion, ergogenic aid, motivation

Everyone who dreads exercise seeks motivation to lighten the load. Many different forms of motivation have been investigated, with music being a popular strategy. Various forms of music have been found to increase the rate at which one performs during an exercise session (Edworthy & Waring 2006; Atkinson, Wilson, & Eubank, 2004; Waterhouse, Hudson, & Edwards, 2009). In addition to increasing motivation, music may also act as a distraction during the performance of an exercise bout. Yamashita, Iwai, Akimoto, Sugawara, and Kono (2006) determined the influence of music on the rate of perceived exertion (RPE) and on the autonomic nervous system of participants before and after sub-maximal cycling exercise. They concluded that music provided a “distraction effect”
during low intensity exercise. Atkinson, Wilson, and Eubank (2004) found that participants rode faster when listening to music at 142 beats per minute (BPM) but felt more exhausted according to RPE scores. Thus, it is possible that music may distract the performer and permit a higher exercise intensity.

However, not all studies have produced positive effects of music during exercise. Hagan et al. (2012) tested well-trained, task-habituated cyclists while they rode stationary bicycles for 10-km and found that music had no effect on performance time to complete the task during high intensity cycling. Dyer and Mckune (2013) found that different tempos of music had no significant effect on physiological function or ride time on a 20-km cycling trainer ride. Thus, it is possible that the experience and/or training level of the participant may influence the effect of music on performance. However, Schie, Stewart, Becker and Rogers (2008) determined that submaximal cycling while listening to music produced no significant difference in physiological measures compared to a no-music condition in average men and women.

Since the majority of exercisers are not highly trained and thus may not exercise at high intensities, it would be beneficial to determine if music has an effect on simple performance outcomes of average participants. If music can act as a motivator or a distraction to allow an individual to perform more exercise in a given time span, it might serve as a viable, safe, and effective ergogenic aid. Therefore, the purpose of this study is to determine the effect of listening to music at 140 BPM on the time required to complete a five-km stationary bicycle ride in college students.

Methods

College men \((n = 8, \text{ age } = 18.3 \pm 0.5 \text{ yrs})\) and women \((n = 9, \text{ age } = 18.9 \pm 0.9 \text{ yrs})\) volunteered to complete a five-km stationary bicycle ride individually under two conditions. During one trial, participants listened to loud background music played at 140 BPM. During a second trial, participants performed the bicycle ride without music. The trials were randomly assigned, and three to seven days separated trials.

Preceding each trial, participants warmed up by performing a three-minute ride at a self-selected pace either with or without music, depending on their trial for that day. Following a one-minute rest, participants were individually timed as they rode five-km on a stationary cycle ergometer (Monark, model 816E). Resistances were set individually between 0.5 to 2.0 kg for men and 0.5 to 1.5 kg for women. Each participant rode the same ergometer for each trial, pedaled against the same resistance, and wore similar clothing. The time to complete the five-km was measured by individual stopwatches to the nearest full second. RPE was recorded for each participant immediately after completing the ride.

For the musical trial, participants listened to a pre-selected list of popular songs by Bieber, Gomez, and other artists, with a beat of 140 BPM.
played on loudspeakers throughout the exercise facility. An explanation of the music was offered to participants upon inquiry, but not mentioned otherwise.

Means and standard deviations were calculated for all variables. Due to the small sample size, the differences between genders were determined using a Mann-Whitney U-test. Comparison between trials was determined using a Wilcoxon sign-rank test. All statistics were compiled using SPSS, version 20.

Results

Analysis of the composite group indicated that participants completed the five-km ergometer ride significantly faster when listening to music than when cycling without music (“no music”) (Figure 1). Analysis by gender revealed that men rode significantly faster with music ($p = 0.04$) than women ($p = 0.21$). Neither men ($p = 0.74$) nor women ($p = 0.34$) indicated a significantly different RPE during the music trial verses the no-music trial (Figure 2).

![Figure 1. Men and Women’s Cycling Time With and Without Music.](image)
Discussion

The findings in the current study support previous work showing that music has the potential to facilitate exercise performed on a stationary cycle. Nakamura, Pereira, Papini, Nakamura, and Kokubun (2010) determined that participants worked at a higher intensity and cycled farther when listening to preferred music. Calculating the potential revolutions per minute (rpm) for the current participants, we can speculate that pedal rate for men averaged 13.8 rpm more during the music condition while women averaged 3.2 rpm more. The increased work rate might be due to a “distraction effect” whereby the music may decrease the participant’s perception of fatigue while exercising and increases the comfort level (Elliott, Carr, & Orme, 2005; Sachie, Stewart, Becker, & Rogers, 2008; Yamashita et al., 2006).

The current participants pedaled at a higher rate and thus produced more work during their ride with music, but did not have a significantly different feeling of intensity (i.e., RPE). Faster time against the same resistance meant a greater amount of work was performed which should have burned more calories. Nakamura et al. (2010) noted a higher RPE during non-preferred music than during preferred music or no music. Heart rate was not significantly different among their three conditions. The fact that RPE was not significantly different in the current study could suggest that the music was not a preferred type for the current participants. However, other studies have also shown that exercising to music does not alter the perception of effort (Elliott, Carr & Orme, 2005). Other studies
have suggested that the effect of music on the perception of exercise stress may be greater in untrained than trained participants (Hasan, Bakhtiyar & Azhdar, 2008). Furthermore, the positive effects of music might be greater in the early stages of exercise than in the later stages (Atkinson, Wilson, & Eubank, 2004).

Conclusion

Based on these findings, cycling five-km with background music at 140 BPM may help decrease the time it takes for an average college student to finish the distance. Music can act as a helpful factor, whether as a distraction or motivator, when trying to decrease time while riding a stationary bike for a short distance.

Further research in this area could build on many aspects of this study. Studying the effects of heart rate with and without music would produce more accurate results than an RPE study. A further study with music tempo could compare heart rates at various tempos (120, 140, 160, 180 BPM) to look for a correlation. Observing the effects of music on time with other exercise machines (e.g., running, ellipticals, rowing) would help show if music helps decrease one’s time in different calorie-burning activities. Conducting the study with college participants again but with a longer distance would better compare to previous studies of 10-km distances. Additionally, having one self-select a playlist of music at a certain tempo (e.g., 140 BPM) may result in a more motivating or distracting effect due to personal investment and interest in the music. Further research on the difference between males and females results when listening to music could found beneficial as well. In summary, many more studies can branch off the current one to find the effects of music on time during one’s performance.

References


MOAHPERD Needs YOU to be a S.C.H.O.L.A.R.

Matthew L. Symonds

The Missouri Association for Health, Physical Education, Recreation, and Dance (MOAHPERD) is an organization promoting healthy, active lifestyles in Missouri. Volunteer organizations like MOAHPERD can thrive only when the membership is actively participating in the governance, mission, and vision of the association. Over the past year, I have spent time reflecting about the Lynn Imergoot MOAHPERD Scholar Award. As my thoughts developed, I first turned to considering what it means to me to be considered a scholar.

There are several definitions of the word scholar. First, according to the Oxford Dictionary, a scholar is “a distinguished academic.” While MOAHPERD has a number of members that meet this definition, I would not necessarily put myself in this category! Other words used to describe scholars include “profound knowledge of a particular subject”, “student”, and “pupil” (dictionary.com). I have gained knowledge in a variety of subjects, much of which has come largely through interactions with many bright students over the years. But profound knowledge? I am not sure. I would, however, consider myself a student – a student of teaching, learning, and relationships – in addition to being a student in a content area. I have also become a student of our association over the years. I have studied the organization through a number of roles: a member, a presenter, a division chair, and as MOAHPERD president. It is from this perspective, as a student of MOAHPERD, that I have written some thoughts as to how our organization needs every member to commit to becoming a S.C.H.O.L.A.R. on behalf of the association. My message is short, but my hope is that you will find a way to continue to connect with and serve our organization. So, here we go:

**S is for Service.** Our organization depends on committed service from its membership in order to continue to be successful. Service is critical for the advancement of our profession. Each of us serves our students, schools, and communities on a daily basis and through these connections we can spread the word about MOAHPERD and the good work that is done by the association. Furthermore, we serve our schools and communities by encouraging physically active lifestyles for Missourians. And, you and I
know, that a healthy, active citizenry is good for our schools, communities, state, and country. I urge you, however, to consider other ways that you can contribute to the advancement of our organization through service as a presenter, district representative, committee volunteer, or division chair. The roles are vital and we need YOU!

**C is for Collaborate.** Working together with other individuals who share a common purpose allows us to accomplish amazing things. There are so many benefits that stem from collaboration: Benefits like accomplishing shared goals, holding one another accountable, the intrinsic rewards of teamwork, and synergy to name a few. Taking on a volunteer role within MOAHPERD will present you with countless opportunities for collaboration and the rewards for working together for a job well done are special.

**H is for Honorable.** Professional service is an honorable endeavor. With so many talented individuals as active members of our organization, we all need to encourage committed and talented professionals to become involved in leadership and service activities. The quality programs and services we provide are not accidental and do not happen accidentally. Rather, countless individuals serve because it is the right thing to do to help our profession and organization grow and continue to provide the programs and services that meet the needs of our membership. Many respectable, dedicated professionals are committed to continue to advance the association, but we need additional assistance from more of our talented, honorable members!

**O is for Ownership.** To continue to make a difference as an organization, we need ownership from our members. MOAHPERD is a group of like-minded individuals with similar goals. We need to be more than a group of members and work to sustain ourselves as a group for members. Professional organizations of all sizes, shapes, and type are competing for members. If any organization we join is going to work effectively, our input involvement and ownership is critical.

**L is for Learning.** We have so many opportunities for learning by being involved with MOAHPERD. Every year, we get to learn from talented professionals in our field at summer workshops, the convention, Quality Health and Physical Education sessions, and by reading the journal and newsletter. Also, we have a unique opportunity for learning *through* physical activity in our profession: we involve people in their learning. As Benjamin Franklin said, “Tell me and I forget. Teach me and I remember. Involve me and I learn.”

We also help shape individuals to become lifelong learners. As teachers, lifespan learning is a noble goal for us and our students. As professionals, we can exemplify continuous learning by being actively involved in all of the great programming and services that MOAHPERD has to offer.

**A is for Authentic.** Our fields depend on application in real-world settings, and we teach a very authentic or real content area. In other words, do we make good health choices in our daily lives; can we make a
jump shot in a game situation? There are few better examples of authentic learning than through physical activity. For example, we can teach about making healthy lifestyle decisions, like the benefits of physical activity, in the classroom. We can assess knowledge of physical activity principles on an assignment or quiz. But the real test comes when that student – or any of our students – makes the decision to BE physically active in his or her life. What other content area has this type of real, authentic assessment so readily available? As health and physical educators, we should continue to leverage the authentic nature of our field, and you can help by continuing to focus on authentic learning for our students and by sharing your successes with other members.

**R is for Relationships.** The opportunity to develop meaningful, lifelong relationships with colleagues from across the state is one of the most rewarding aspects of serving the association. As I have stated before, my time as a member of the MOAHPERD executive committee remains one of – if not the most – worthwhile experiences of my career. This time was worthwhile, satisfying, and rewarding not because of the work accomplished or because of traveling to Central District and AAHPERD conventions on behalf of MOAHPERD, but because of the relationships I developed with so many wonderful people involved in our professional organizations. I consider this to be the case with my teaching, as well. The most meaningful classroom experiences I have are due to the relationships with students. In the end, our work is really all about relationships and there are many opportunities for building lasting relationships through continued involvement and service with MOAHPERD.

I would ask each member of the organization to consider this question: Can I serve my professional organization as a district representative, division chair, cadre member, convention presenter, or in another volunteer role? If the answer is yes, you can serve students and fellow professionals, collaborate with outstanding colleagues, get involved in honorable effort, take ownership for the professional growth of you and your colleagues, learn so many things along the way, be active in an authentic profession, and develop new and lasting relationships. If you are already active in MOAHPERD, I hope you will continue to stay involved. If you would like to become more involved, we are always looking for the next S.C.H.O.L.A.R.!

*MATT SYMONDS, Ed.D., is an Associate Professor at Northwest Missouri State University. Symonds is a past Health Division Chair and served as the 2010 MOAHPERD President.*
Cross Curricular Connections in Elementary Physical Education

Leah Johnson

In 2010 Common Core State Standards swept into the United States school systems. At least forty-five states have adopted the nationwide standards that are intent on preparing students for college and the workforce through rigorous writing, critical thinking and real world problem solving (SPARK, 2013). Math and literacy have become the utmost focus in nearly all schools. Unfortunately, these changes have not had a positive impact on physical education. Schools have realized they are lagging behind in the race to meet these common core standards and physical education and recess time have been cut in favor of delegating more time to core subjects.

Excelling in education is currently determined on high stakes tests. These tests now hold the key to a teacher’s job, or lack thereof. Many administrators have concluded that more time spent in in the classroom working on literacy and math is the answer. As physical education teachers it is time to prove the importance of physical education, as well as stress the fact that literacy and math can be authentically implemented and create real life connections that will impact overall learning and memory of these skills.

Brain research in the area of learning has proven time and time again that quality daily physical education is crucially important for student’s learning. Yet, physical education programs have been eliminated or reduced to mere minutes per week, thus impacting both physical activity level and brain function. Dr. John J. Ratey is an associate professor of psychiatry at Harvard Medical School. Ratey is expert on the inner workings of the brain and has taken considerable interest in how exercise affects the brain. Based on evidence from hundreds of research papers and personal experience he asserts, “That exercise is the single most powerful tool you have to optimize your brain function” (Ratey & Hagerman, 2008, p. 245).

Ratey, among others, took quite an interest in the physical education program in Naperville District 203 in Illinois. This interest reaches beyond the fact that the district turned 19,000 students into the fittest in the nation. They have also proven that their students are some of the smartest. In 2005 Naperville Central High School’s composite ACT score for their graduating class was 24.8, 4.6 points above the state average. Even more impressively, Naperville’s eighth graders signed up to take the Trends in
International Mathematics and Science Study (TIMSS). Normally American students’ average eighteenth in science and nineteenth in math. Naperville finished first in science and second in math, in the whole world! What does this have to do with physical activity? Uniquely Naperville desired to get their kids’ brains functioning more efficiently through physical activity. The scores sparked the interest of many important people. In 2001 and again in 2002 the California Department of Education conducted a study that compared how fit kids scored compared to unfit kids on academic tests. Both years the fit kids scored better (Ratey & Hagerman, 2008).

...emerging research showing that physical activity sparks biological changes that encourage brain cells to bind to one another. For the brain to learn these connections must be made; they reflect the brain’s fundamental ability to adapt to challenges. The more neuroscientists discover about this process, the clearer it becomes that exercise provides an unparalleled stimulus, creating an environment in which the brain is ready, willing, and able to learn. (Ratey & Hagerman, 2008, p. 10).

Further studies have proven that physical education and physical activity do not take away from academic performance. Therefore, increasing physical activity during the school day may positively impact academic performance (CDC, 2010), as well as improved physical fitness, motor skill development, regular, healthful physical activity, self-discipline, improved judgment, stress reduction, strengthened peer relationships, improved self-confidence and self-esteem, and experience in goal setting (AAHPERD, 2013).

It is clear that physical activity provides positive benefits to the brain. This paper examines different strategies that can be used in the physical education classroom to include authentic literacy and math in everyday lessons. The overall benefits of physical activity on the body are well known. Research has also been successful in proving that physical activity has positive effects on the mental well-being. Even with the known benefits to the body and mind physical activity is seriously lacking in many schools across the United States. The main defense for cutting physical education and recess time is the need for more time in core subjects. Teacher effectiveness and high stakes testing has taking priority and students are spending more time sedentary in the classroom.

Evenson, Ballard, Lee, & Ammerman (2009) performed a study that examined the results of a survey performed in North Carolina in response to the NC Healthy Active Children Policy. This policy stated that students K-8th grade must receive at least thirty minutes of physical activity during every school day. This can be achieved through, recess, classroom energizers, recess, or other creative activities. One stipulation of the policy is that recess could not be withheld as a punishment. A 50 question survey was then placed online to determine how the staff felt about the change.
The authors of the study focused mainly on components regarding implementation of the policy. They found that in elementary schools the 30 min was primarily achieved through recess, physical education, and classroom energizers. In middle school the teachers relied more on physical education, but still included some recess and classroom energizers. Positive feedback included:

- increased time on task,
- alertness,
- student and staff enjoyment,
- fitness,
- improved behavior,
- decreased stress and many others

Challenges were also recorded. In middle school and elementary school the challenges were similar:

- too little time,
- teacher attitudes, and
- concern for academics

This study provided some proof that physical activity benefits classroom behavior, however teachers and administrators still struggle with giving up time in academics.

Teachers and administrators seek results that will show up in the form of tests scores. Thus, there is a need to incorporate core subjects, such as math and literacy into daily physical education lessons. This will encourage administrators to allow students the necessary physical activity time while still feeling as though students’ time is focused on academic growth.

Many teachers, students and parents are nervous that academic instruction is spilling over into the gym, where the primary focus is supposed to be getting students physically active. An overwhelming number of physical education teachers are hesitant, some even resistant to the idea of adding math and literacy to physical education. Most physical education programs are functioning on mere minutes per week. This makes it difficult to cover physical education and health standards, much less adding on literacy and math. However, as expectations in education soar to new heights, physical education programs must adapt and meet the growing needs of our society. The question then becomes, how is this to be accomplished without sacrificing physical activity?

As a physical education teacher one is not expected to introduce new literacy or math skills on a daily basis, but rather focus on reinforcing and developing real world connections from the lessons in the classroom. By using what the students are already learning in an authentic fun atmosphere, physical education teachers are developing connections that will help in memory retention. Ratey & Hagerman (2008) describe three levels of learning that are improved with exercise. Exercise enhances a person’s mindset and thus increases alertness, attention and motivation.
Serotonin, norepinephrine, and dopamine are neurotransmitters that have a powerful influence on mood, motivation, and attention. Exercise helps balance these neurotransmitters. It also, binds nerve cells to one another, which is the first step to logging new information.

**Incorporating Math**

Physical education and math have gone hand in hand from the beginning. Counting repetitions of an exercise, adding points in a game, subtracting for penalties, dividing up groups equally, and measuring distance jumped, the list goes on and on. Most physical education teachers have been including math without even thinking about it. Therefore, the goal now is how to link these lessons to the classroom and make the learning authentic to physical education. Students must learn to problem solve and develop critical thinking skills that will apply to real world situations. What better place to prove the relevancy of math than through physical education?

Talking to physical education teachers and general education teachers, one would quickly realize they are often clueless about what is occurring in one another’s classroom. The skills that are taught in physical education remain in physical education, and the same story for the classroom. This is where the first change must occur. Collaboration is the key to successfully incorporating different subject areas. Reinforcement of math and literacy is key in physical education and the skills that are included must be reviewed. Research has suggested that school administrators have the power to improve math test scores and reduce gaps in scores across groups of students by encouraging teaching environments where community and professional teamwork are valued and rewarded (American Sociological Association, 2013). Seeking out time to meet with different grade levels and subject area teachers will jump start ideas.

Many physical education teachers have already successfully included math in daily lessons. Below are ideas to help embed math into physical education, without taking away from the physical education standard that is being addressed.

- Counting, skip counting, counting backwards during warm up exercises.
- Allowing students to determine how to evenly divide themselves into teams.
- Scoring in games, this can be differentiated for grade levels or abilities.

Examples: “Line Attack” To invade other team’s half gaining points by touching lines and returning to your own half without being tagged.

• Even & Odd Game
  With dice or hands students roll or show two numbers. They must then add, subtract, or multiply the number and determine whether it is odd or even. The first person to shout out the correct answer (odd or even) gets to perform the winner’s movement, the other person must perform the other movement. Movements can be placed on cards or on an overhead projector (Smith & Handy, 2014).

• Stations with a Math Twist
  This can be done with any type of stations. Students will begin at one station. The group will perform a physical skill, then to determine their next station they must complete a math problem. The answer to the problem will be on the wall next to a corresponding activity.

• Jumping Junk Food Challenge
  On a similar theme, collect nutrition labels from a variety of different food items. Give students the following information:
  1 gram carbohydrate = 4 kcal
  1 gram protein = 4 kcal
  1 gram fat = 9 kcal
  Instructions:
  1. Choose a food label
  2. Work out how many calories come from fat/ protein/ carbohydrate (specify one for each label)
  3. Each lap of the basketball court will burn off 15 kcals (you can vary the activity here)
  4. Complete enough laps to burn off the calories from fat (T & L Nuts and Bolts, 2013).

• Collection and Counting Games
  Students can practice any skill (locomotor, dribbling, and throwing) while collecting numbers or fake money. They can work in teams or individually to determine who had retrieved the most, least, equal amounts.

• Accuracy with Shots or Passes
  This can be done as easy as tally marks for little ones to compare and contrast. Or actually figuring out the percentage of made or good vs. missed or dropped. This is a real life application that allows students to keep records on themselves and compare later to determine if they have improved.

These are just a few examples of incorporating math in to physical education in an authentic way. The goal is ensure that movement and skills are the main focus and math is occurring as an extra addition to the lesson.

**Incorporating Literacy**

The connection between literacy and physical education appear to be
a little more difficult to make. The word literacy brings about thoughts of reading and writing, both of which are not normally conducive to a gym class. However, literacy strategies are often the same as those used daily in physical education. Students activate prior knowledge to make connections to personal experiences and games they have played or seen, visualizing themselves performing a new skill or playing a new game and constantly questioning to clarify understanding of responsibilities, rules, and new techniques. Daily analysis of movements, strategies, results, motivations, actions and speech are notable in physical education classrooms (Adams & Martin, 2008). The United Nations Educational, Scientific and Cultural Organization (UNESCO) developed a definition of literacy that went far beyond reading and writing and thus is more appealing for inclusion in the physical education classroom.

**Literacy is the ability to identify, understand, interpret, create, communicate, compute, and use printed and written materials associated with varying contexts. Literacy involves a continuum of learning to enable an individual to achieve his or her goals, to develop his or her knowledge and potential, and to participate fully in the wider society. (UNESCO, 2003).**

Physical education teachers often boast about teaching the whole child. This statement swings both ways. Literacy is a defining part of a person’s life, thus incorporating in physical education cannot be the exception, it must be the rule. This does not mean taking time from physical activity to read books and write paragraphs, it means incorporating literacy through physical education skills. Embedding literacy may take a little more practice and planning than math, but can be done.

- **Alphabet Soup**
  Place a bucket in the middle of the room, polypots with letters (numbers for math) underneath will be scattered around. Provide students a whiteboard or piece of paper. The first partner finds a polypot and practices underhand throwing from that spot. If they make it in the bucket, they collect the letter underneath and bring it back to their group. This continues until all letters are gone. Once the letters are gone students can be asked to: come up with words that start with those letters, make words out of those letters, or put them in alphabetic order (Smith & Handy, 2014).

- **Exit slips**
  This does take 5 minutes at the end, and a little organization on the part of the teachers. Students are given a question regarding the game, the skills, their behavior, teamwork, or self-evaluation and they must write their response on a ½ sheet of paper or 3x5 index card. A fun way to display these so others can read them would be to have a light bulb posted, then students can stick their answers on the board. Or a clothes line with clothes pins.
• Teach me how to...
  Providing students opportunities to teach each other allows them to use their verbal communication skills to sequence, analyze and question. This is a great way to practice skills, determine strengths in weaknesses and have students fill a leadership role.

• Creating Routines
  Just like anything in the classroom when students are creating routines in gymnastics, jump rope, aerobics, it is helpful to create a plan and write it down to determine if the necessary components are there and are in a logical sequence.

• Warms up exercises can be used to sound out words. “Let’s jump to the sounds in CAT”.

• Basketball drills can be used to have students retrieve letters to allow them to spell weekly spelling or vocabulary words.

• New vocabulary can be introduced and demonstrated. In addition a word wall can be created to help students remember these words throughout the year.

Literacy allows our students to read directions, listen to the rules, and communicate with each other. As physical education teacher it is our duty to ensure they are just as proficient in these areas, as they are in their physical skills.

**Conclusion**

Education is not a field that is untouched by change. Every year the classroom changes, as do the needs, the hopes, the dreams, and the challenges. Physical education teachers have seen a decline in physical activity and a rise in obesity. Physical activity time was reduced in hopes of boosting academic scores and the nation’s youth suffers with their health. Many in the field of brain research, health and physical education are banding together to make a change. It is clear that the human body and brain perform better when physical activity is part of a daily routine. It is becoming clearer that physical education needs to make a change. A rising concern for core subjects such as math and literacy is on the rise with the introduction of the Common Core State Standards. Therefore, acknowledging that math and literacy is just as important in physical education as in any other classroom is the first step. Then, engaging the students in a physically active environment that allows them to practice their math and literacy skills while learning and engaging in a physically active lesson is the key to helping these students. It is not about giving up physical activity, it is about creating real life connections that will allow students to enjoy learning and be the best they can be at everything.
References


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Muscle strength imbalance at the shoulder in college wrestlers

Colton D. Schmitz, Brittany A. Eagan, Jana L. Arabas, and Jerry L. Mayhew

Muscle strength imbalance around a joint may increase the chances of injury. The purpose of this study was to compare the maximal pushing and pulling strengths of college wrestlers to assess the imbalance ratio at the shoulder. Division II college wrestlers (n = 23) performed one-repetition maximum for free-weight bench press (pushing) and seated horizontal pull machine (pulling), with the pulling test performed two days after the pressing test. Pulling strength was significantly lower (p < 0.01) than pushing strength by 10.3 ± 16.3%, producing a push:pull ratio of 114.8 ± 19.1%. Body mass had a higher correlation with pulling (r = 0.71) than with pushing (r = 0.67) strengths but was only moderately associated with the push:pull ratio (r = 0.43, p = 0.02). The push:pull ratio was more influenced by pushing strength (r = 0.88, p < 0.001) than by pulling strength (r = 0.28, p = 0.21) even when weight was held constant by partial correlation. Due to the nature of the sport of wrestling, perhaps more emphasis should be placed on development of pulling strength.

Previous research appears to be equivocal concerning the balance of strength for agonist and antagonist muscles around a particular joint. The majority of research has centered on the knee because of its high profile for injury in sport (Arendt & Dick, 1995; Ingram, Fields, Yard, & Comstock, 2008; Majewski, Susanne, & Klaus, 2006). Isokinetic evaluations of the knee joint have yielded flexion:extension ratios ranging from 0.60 for slower velocities to 1.00 for faster velocities (Aagaard, Simonsen, Magnusson, Larsson, & Dyhre-Poulsen, 1998; Nunn & Mayhew, 1988). Lower ratios at a given velocity appear to be associated with an increased risk of injury (Croisier, Ganteaume, Binet, Genty, & Ferret, 2008).

Research on injuries to the shoulder has focused primarily on baseball and predominantly on pitchers where considerable muscle strength imbalance has been noted in the pitching arm (Caracciolo, Busciacco, Mullaney, & Nicholas, 2008; Cook, Gray, Savinar-Nogue, & Medeiros, 1987; Trakis et al., 2008; Wilks, Andrews, & Arrigo, 1995; Yu & Lee,
However, a similar pattern of imbalance has been noted in other sports that require greater adduction and/or internal rotation force than abduction and/or external rotation force at the shoulder (Chandler, Kibler, Stracener, Ziegler, & Pace, 1992; Edouard, Damotte, Lance, Degache, & Camels, 2013; Kruger-Franke, Reininger, Trouillier, & Rosemeyer, 1996). The primary mechanism causing the injury is the overuse of shoulder flexion movements at high speed without a compensating emphasis on shoulder extension development (Page, 2011).

Previous studies on muscle imbalance 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 employing a supine bench press with free weights for pushing strength and comparing it to pulling strength measured from a weighted pull-up test (Baker & Newton, 2004). The results suggested that the push:pull ratio for the upper body should be approximately 100%. However, a major limitation to that study could have been that 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 using an isoinertial procedure. 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 = 23, age = 20.5 ± 1.2 y, height = 177.4 ± 7.0 cm, weight = 80.0 ± 15.6 kg, BMI = 25.3 ± 3.8 kg/m²) with a minimum of five years of resistance training experience performed maximum strength assessments on a free-weight supine bench press and a seated horizontal pulling machine during the early phase of a training cycle prior to any significant dehydration to achieve a desired wrestling weight (Schoffstall, Branch, Leutholtz, & Swain, 2001). A one-repetition maximum (1RM) was determined for each exercise by assessing the peak load a participant could lift one time through a full range of motion. Participants performed the 1RM bench press and the pull strength test two days later. The aim of each exercise was for participants to reach their maximum on each device in a minimal number of trials which typically did not exceed four attempts.

The free-weight bench press was performed according to the “touch-and-go” procedure (Stone & O’Bryant, 1987). A spotter assisted the participant in lifting the weight from the support rack of the bench. The weight was then lowered slowly to touch the chest without bouncing off it. The participant was required to extend the arms to complete lockout at the top of the motion. The participant’s posture was monitored during each
repetition to maintain proper contact with the bench. Test-retest reliability greater than 0.94 has been noted in similar individuals (Ritti-Dias, Avelar, Salvador, & Cyrino, 2011).

The resistance for the seated pulling machine (Pro Star, model PS646) was provided by a weight stack with 4.5-kg increments and intermediate loads possible by adding 2.5-kg weights to the top of weight stack. Since the weight stack could accommodate 123 kg, none of the participants exceeded the limit and thus were able to perform a 1RM. The seated pull was begun from an extended-arm position and required the participant to pull the handles of the machine horizontally until the hands were even with the chest. The participant’s chest remained in contact with a vertical support cushion throughout the lift, and no back arching was allowed. A push:pull ratio was calculated from the 1RM values for each lift and expressed as a percent.

Means and standard deviations (SD) were determined for all variables. The Wilcoxon signed-rank test was used to evaluate the difference between pushing and pulling strengths. Pearson correlations were used to evaluate the relationships among variables. Partial correlations were used to remove the effect of selected variables from the relationship between other variables.

Results

Pushing strength was significantly greater ($p<0.01$) than pulling strength by an average of $15.4 \pm 19.7$ kg. This produced a push:pull ratio for the entire group that was significantly greater ($p<0.01$) than 100% (Table 1). Four wrestlers (LPP) had lower push:pull ratios averaging $85.6 \pm 8.1\%$, while the remaining 19 wrestlers (HPP) had higher push:pull ratios averaging $120.9 \pm 14.4\%$. LPP had pushing strengths ($75.1 \pm 17.1$ kg) that were significantly less ($p<0.001$) than HPP ($117.9 \pm 16.8$ kg) by 63%, even when corrected for body weight differences. The pulling strength for LPP ($83.1 \pm 9.9$ kg) was also significantly lower ($p = 0.2$) than HPP ($97.6 \pm 9.7$ kg) by 15%.

The correlation of pulling strength with body weight ($r = 0.71$) was not significantly higher ($p = 0.75$) than the correlation of pushing strength with body weight ($r = 0.67$). The greater the body mass, the greater the disparity between pushing and pulling strengths (Figure 1). This produced a curvilinear relationship between body mass and the push:pull ratio (Figure 2). The correlation of pushing strength with body weight was higher but not significantly different ($p = 0.75$) in LPP ($r = 0.96$) than in HPP ($r = 0.70$). The correlations between pulling strength and body weight were more in agreement between LPP ($r = 0.66$) and HPP ($r = 0.73$). Furthermore, the correlation between pushing strength and pulling strength in LPP ($r = 0.84$) was similar to that for HPP ($r = 0.78$).
**Table 1**
Participant Anthropometrics and Strength Performance (n=23)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean ± SD</th>
<th>Range</th>
<th>Correlation with:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>1RM Pushing Strength (kg)</td>
</tr>
<tr>
<td>Age (y)</td>
<td>20.5 ± 1.2</td>
<td>18.4 – 23.4</td>
<td>-0.18</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>177.4 ± 7.0</td>
<td>160.0 – 188.0</td>
<td>0.34</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>80.0 ± 15.6</td>
<td>57.6 – 119.0</td>
<td><strong>0.67</strong></td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>25.3 ± 3.8</td>
<td>19.7 – 34.4</td>
<td><strong>0.68</strong></td>
</tr>
<tr>
<td>Arm Length† (cm)</td>
<td>36.9 ± 1.9</td>
<td>34.0 – 40.0</td>
<td>*0.48</td>
</tr>
<tr>
<td>Forearm Length† (cm)</td>
<td>28.1 ± 1.8</td>
<td>25.0 – 32.0</td>
<td>*0.50</td>
</tr>
<tr>
<td>Pushing Strength (kg)</td>
<td>110.5 ± 30.6</td>
<td>52.3 – 181.8</td>
<td>____</td>
</tr>
<tr>
<td>Pulling Strength (kg)</td>
<td>95.1 ± 15.3</td>
<td>63.6 – 118.2</td>
<td><strong>0.84</strong></td>
</tr>
<tr>
<td>Push:Pull Ratio</td>
<td>114.8 ± 19.1</td>
<td>78.6 – 153.8</td>
<td><strong>0.88</strong></td>
</tr>
</tbody>
</table>

*p < .05; **p < 0.01; †n = 19

**Discussion**

A major outcome of the current study is the degree of variability noted in the push:pull ratio for college wrestlers. Baker and Newton (2004) suggested that if the standard deviation of the push:pull ratio is large, it would mean there is greater disparity between the forces applied to the two motions and would suggest an imbalance in integrity of the joint during dynamic activity. While the standard deviation in the current study was nearly two times as large as that noted by Baker and Newton (2004) for rugby players, it was more in agreement with those found for tennis players, rowers, javelin throwers, and wrestlers (Beeler, Schmitz, & Mayhew, 2013; Edouard et al., 2013; Kennedy, Altchek, & Glick, 1993; Parkin, Nowicky, Rutherford, & McGregor, 2001). A recent study on college wrestlers (Beeler et al., 2013) noted that a season of training and competition reduced the variability in the push:pull ratio from 13% to 9%, a value similar to that noted by Baker and Newton (2004). Interestingly,
the change was a result of a decrease ($p = 0.08$) in pulling strength by 6% while pushing strength remained constant with a 0.5% increase. This might suggest that the specific nature of a sport, the competitive conditions, or training techniques could alter the imbalance ratio.

Figure 1. Relationship Between Body Mass and Pushing Strength (solid line) and pulling strength (dashed line) in college wrestler (n=23)

Figure 2. Relationship Between Body Mass and Push:Pull Ratio in College Wrestlers (n=23)
The extreme range of push:pull ratios noted throughout the literature may be influenced by numerous factors. Baker and Newton (2004) suggested that training background might have a great influence on the imbalance ratio, noting younger rugby players had a lower ratio (94.6 ± 5.6%) than older players (100.7 ± 10.7%). To the contrary, Parkin et al. (2001) found little difference in the isokinetic extension:flexion ratio of the legs between highly trained rowers and controls, with values of 157% to 195%. The 1RM bench press and bench pull values in sailors recorded by Pearson, Cronin, Hume, and Slyfield (2009) resulted in a push:pull ratio (120%) more in accord with the current subjects. This may suggest that major differences in imbalance ratios could be dependent on joint structure and function.

Early studies revealed that leg flexion:extension ratios were significantly different when recorded by different exercise techniques in male athletes (Moss & Wright, 1993; Nunn & Mayhew, 1988). The values ranged from 52% for an isotonic technique to 90% for a fast isokinetic technique. These figures would convert to push:pull ratios of 190% for the isotonic technique to 111% for the fast isokinetic technique. Thus, the mode of exercise used to assess strength may be as much a factor in determining the imbalance ratio as is the difference in the strength of the muscle groups performing the movement.

It may be difficult to establish a singular standard for various agonist:antagonist ratios because of so many factors confounding the test procedure. Not the least of these might be the inability to precisely quantify the volume of muscle performing the pushing and pulling movements. While studies have been able to approximate the amount of muscle performing limb flexion and extension movements, it would be more difficult to quantify muscle volume for pushing and pulling muscles of the torso. Previous studies have noted that flexed arm cross-sectional area can provide reasonably accurate estimates of bench press (Mayhew, Piper, & Ware, 1993). Such an approach may not accurately assess the total amount of muscle performing the movement, especially for estimating the volume of muscle performing the pulling movement.

Several studies have shown 1RM lat-pull strength to be moderately related to body mass in resistance trained men ($r = 0.47$) (Johnson, Lynch, Nash, Cygan, & Mayhew, 2009) and college athletes ($r = 0.62$) (Chandler, Ware, & Mayhew, 2001). The latter relationship is comparable to that shown in current study (Table 1) and may suggest that more highly-trained participants are better able to activate a given muscle mass. Baker and Newton (2004) further suggested that arm lengths might affect strength performances. In a subsample of the current participants ($n = 19$), arm and forearm lengths were significantly related ($p<0.05$) to pushing strength but not to pulling strength (Table 1). Confirmation of the varying effect of limb lengths and leverages on muscle strength performances is lacking and warrants further investigation.

Prior studies have suggested using an allometric scaling approach to
account for differences in body mass of participants by expressing strength measurements relative to body mass raised to the 0.67 power (Baker & Newton, 2004). In the current study, four individuals were identified with bench press relative strength values (BP/kg\(^{0.67}\)) more than one standard deviation below the group mean. In those participants, average pulling strength (78.4 ± 13.6 kg) was significantly below (p<0.01) the group average (98.6 ± 13.5 kg), resulting in a significantly lower (p<0.001) push:pull (85.6% vs 120.9%). Four different wrestlers with greater than one standard deviation above the mean pulling strength were not significantly different (p = 0.34) in average pushing strength (123.9 ± 17.3 kg) or push:pull ratio (116.2 ± 18.0%) compared to the other wrestlers (107.7 ± 32.3 kg and 114.5 ± 19.8%, respectively). If the eight outliers were removed, the correlations of body mass with pushing strength (r = 0.77) and body mass with pulling strength (r = 0.87) increased slightly. Interestingly, the correlations of body mass with pushing strength (r = 0.40) and pulling strength (r = 0.48) in the outliers were not significant (p>0.23), and there was no significant difference (p= 0.72) between pushing strength (95.5 ± 32.4 kg) and pulling strength (92.6 ± 17.8 kg). This resulted in a push:pull ratio closer to 100% (100.9 ± 20.9%).

According to the current study and previous investigations, there appears to be substantial range on the upper-body push:pull ratios in athletes. This could indicate that push:pull ratios are influenced by multiple factors which require further investigation to determine the degree of contribution of each to the imbalance ratio. Lacking is information on the influences that long-term specific sports training might have on muscle strength components that affect the push:pull ratio in college athletes.

References


Chandler, T., Ware, J. S., & Mayhew, J. L. (2001). Relationship of lat-pull


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Variation in Body Weight and Hydration Level of College Wrestlers During and After a Competitive Season

Hailey M. Benoist, David Schutter, Jana L. Arabas, and Jerry L. Mayhew

Weight cycling procedures currently being done by college wrestlers may lead to detrimental health consequences. The purpose of this study was to evaluate body weight and hydration changes during a college wrestling season. Eight NCAA Division II wrestlers (age = 19-22 yrs) who had to “cut weight” for the final match of the season were measured on four separate occasions. Body weight and hydration (i.e., urine specific gravity) were measured two hours before the match (T1), 20 hrs after the match (T2), one week after the completion of the season (T3), and three weeks after the season (T4). Body weight at T1 was significantly lower than at all other time points after the season and increased significantly (p<0.001) at each time point after competition. Wrestlers gained an average of 6.3% (± 3.0%) in body weight three weeks after the season. Urine specific gravity at T1 (1.035 ± 0.004 g/cc) was significantly higher than at all other time points, was significantly lower (p = 0.05) one day after the match (1.028 ± 0.008 g/cc), reached its lowest point one week after the season (1.019 ± 0.011 g/cc), and rose again three weeks after the season (1.024 ± 0.006 g/cc). Wrestlers who cut weight for competition may progressively regain weight following the season. Although hydration improved by one week after the season, it may regress towards dehydration several weeks after the season.

The most common method of weight loss among college wrestlers during the competitive season is dehydration (Lingor & Olson, 2010; Yankanich, Kenny, Fleck & Kraemer, 1998). Over the course of a season, many wrestlers frequently combine food and fluid restriction to achieve weight loss but typically employ dehydration in the final days before a match to reach their desired competitive weight (Lingor & Olson, 2010; Marttinen, Judelson, Wiersma & Coburn, 1984). Dehydration is perhaps the quickest method to achieve a significant weight loss but may result in
rapid fluctuations in body weight known as “weight cycling” (Jetton et al., 2013; Lingor & Olson, 2010).

Significant negative effects may result when athletes dehydrate too rapidly to lose weight prior to competition (Buford, Rosi, Smith, O’Brien & Pickering, 2006). Previous studies have shown that abrupt dehydration can decrease muscular strength, reduce blood plasma volume, alter cardiac function, diminish anaerobic capacity, and alter metabolism (Jones, Cleary, Lopez, Zuri & Lopez, 2008; Roshan, Hosseinzadeh & Saravi, 2012; Schoffstall, Branch, Leutholtz & Swain, 2001; Steen, Oppliger & Brownell, 1988; Yankanich et al., 1998).

The assumption surrounding the National Collegiate Athletic Association’s (NCAA) rule on adequate hydration appears to be that it would encourage wrestlers to avoid cyclic dehydration to reach a particular weight class (Utter, 2001). The rule requires a college wrestler to have a urine specific gravity (usg) of less than 1.020 g/cc in order to be assessed for %fat to establish a minimum wrestling weight at the beginning of the season. If the wrestler is dehydrated (usg > 1.020 g/cc) at the time of certification, body composition assessment cannot be done, and the wrestler must wait 48 hrs before being retested. If the wrestler is adequately hydrated, a minimum wrestling weight is established in an attempt to prevent drastic weight reductions in order to compete in a lower weight class. While this idea is theoretically sound, previous research on both high school and college wrestlers has shown that many of them are dehydrated during the season (Lacy, Milley, Arabas, Powell & Mayhew, 2011; Lingor & Olson, 2010; Utter, Stone, O’Bryant, Summinski & Ward, 1998).

Most of the previous studies indicating dehydration during the season have been “spot checks” done at a particular time (Lacy et al., 2011; Utter et al., 1998). Wenos and Amato (1998) determined changes in wrestlers’ total body water and muscle strength during pre-season and prior to and following the last match of the season, noting a lower total body water immediately prior to a match indicative of dehydration. Lingor and Olson (2010) reported weekly patterns of weight loss and regain throughout a competitive season. Limited information on the degree of weight loss and regain appears available across a longer time period to identify the extent of dehydration in college wrestlers. We hypothesize that body weight and dehydration changes will identify a cyclic pattern before and after a competition. Therefore, the purpose of this study was to evaluate weight and hydration changes during a specific phase of a college wrestling season.

Methods

Eight NCAA Division II wrestlers (age = 20.5 ± 1.3 yrs, height = 180.7 ± 6.0 cm) who were starters volunteered to be measured on four separate occasions. Body weight and hydration (urine specific gravity, usg) were
measured approximately two hours prior to the last match of the season (T1), 20 hrs after the match (T2), one week after the completion of the season (T3), and three weeks after the season (T4). Weight was measured on a certified digital scale to the nearest 0.2 kg with wrestlers wearing only gym shorts. All urine samples were measured by the same investigator using an optical refractometer (ICAL, model 2020). The same procedures were employed at each of the subsequent evaluation periods.

Due to the small sample size, Friedman’s nonparametric test for dependent samples was used to assess the difference across the four time periods for body weight and USG. If significance was noted across the time periods, a Wilcoxon signed-rank test was used to determine follow-up differences with a Bonferroni correction.

**Results**

Body weight measured immediately prior to a match (T1) was significantly lower ($p<0.05$) than at all other time periods (Figure 1). Within 20 hours after the match (T2), the wrestlers had gained $2.1 \pm 0.9$ kg ($3.0 \pm 1.5\%$) in body weight. One week following the match (T3), the wrestlers had gained $4.1 \pm 1.6$ kg ($5.9 \pm 2.9\%$) from the pre-match body weight. Three weeks after the season (T4), the wrestlers had gained a total of $4.5 \pm 1.8$ kg ($6.4 \pm 3.0\%$) compared to their pre-match body weight, which was not significantly different from the T3 post-match body weight.

![Figure 1. Changes in Body Weight of Wrestlers During and After the Competitive Season (a = significant difference from T1; b = significant difference from previous time period)](image-url)
Urine specific gravity was significantly higher \((p<0.05)\) at T1 than at all other time periods (Figure 2). All eight wrestlers were above the 1.020 g/cc limit at T1, and seven were still above the limit at T2. Three wrestlers remained dehydrated a week after the season was over (T3). Four wrestlers were dehydrated three weeks after the season was completed (T4); two of those were dehydrated throughout all four test periods.

![Figure 2. Changes in Urine Specific Gravity of Wrestlers During and After the Competitive Season (a = significant difference from T1; b = significant difference from previous time period)](image)

**Discussion**

The major finding of this study was that all starting wrestlers were dehydrated (i.e., above the NCAA limit of 1.020 g/cc) immediately prior to a home match. All but one of the wrestlers (88%) had \(\text{usg}>1.030\) g/cc, indicating severe dehydration. Furthermore, only one wrestler was able to rehydrate to an acceptable level by the day following the match, while three wrestlers (38%) remained severely dehydrated. Half of the wrestlers were still moderately dehydrated (usg>1.020 g/cc) three weeks after the season when restrictions on food and beverage consumption were less of a priority. These results support previous studies that noted extreme dehydration at the time of weigh-in for competition in college wrestlers and martial arts fighters (Jetton et al., 2013; Lingor & Olson, 2010). Lingor and Olson (2010) found the majority of college wrestlers will rehydrate by 48 hrs after a match, with individuals reporting an average fluid intake of 4.9 L during that period. Casa and colleagues (2000) recommend the consumption of 500 ml of fluid within 2 hrs before
competition and fluid replacement sufficient to match the sweat rate of the athlete, which apparently did not occur in our sample. Furthermore, sources have suggested that the fluid used for rehydration should be more than just water since the consumption of water alone may decrease the thirst sensation and increase urine output, thus limiting the potential for absorption (Casa et al., 2000). Fluids with adequate amounts of sodium and carbohydrates will be more beneficial for re-establishing a hydrated state (Casa et al., 2000; Osterberg, Pallardy, Johns & Horswill, 2010; Shirreffs, Taylor, Leiper & Maughan, 1996). Unfortunately, no record was kept in the current study of the type and volume of fluid replacement that occurred prior to the match and during the day following the competition.

A parallel finding to the dehydrated state in the current subjects was the lower body weight noted prior to competition in order to “make weight” (Figure 1). Lingor and Olson (2010) charted seven one-week cycles of weight lost leading up to competitions and found a consistent pattern of significant weight loss of approximately 4.7% of body weight each week. Much of this weight loss occurred in the final two days before a competitive match. Their participants appear to replace an equivalent percent within two days after completion. The current subjects regained only 2.4% of body weight by the day following competition, suggesting that perhaps they had lost less to reach a required body weight. Three weeks after the end of the competitive season, however, the current subjects had regained 5.4% of pre-match body weight, a value similar to the 6.9% reported previously for the same time period (Buford, Rossi, Smith, O’Brien & Pickering, 2006). Since Utter (2001) noted a decrease of only 1.9% in body fat with maintenance of fat-free mass during a wrestling season, it might suggest that a major part of the weight gain after the season was due to rehydration.

Buford et al. (2006) have intimated that wrestlers seem to be able to exhibit higher usg while actually being well hydrated, a phenomenon they attribute to the repeated dehydration cycling performed over their careers. Part of this speculation may stem from the moderate correlation between usg and plasma osmolarity, a measure to the relative fluid level of blood (Popowski, Oppliger, Lambert, Johnson, Johnson & Gisolfi, 2001). While plasma osmolarity has been suggested to be more sensitive to rapid fluid loss than is usg (Popowski et al., 2001), this remains controversial with other results showing usg is more sensitive in identifying a dehydrated state (Francesconi et al., 1987). With the possibility of measuring intracellular and extracellular body water compartments using multi-frequency bioelectric impedance (Utter & Lambeth, 2010), future investigations might focus on where water losses are occurring during dehydration in wrestlers and if repeated dehydration cycling can offer some protection to the ill-effects of extreme fluid loss in wrestlers. Since the same practices of dehydration as employed by college wrestlers are being used by high school wrestlers (Lacy et al., 2011; Stiene, 1993), it would be wise to perform both cross-sectional and longitudinal studies to
determine the impacts of cyclic dehydration on performance parameters such as strength, muscular endurance, and cardiovascular stamina.

**Practical Application**

Reaching a competitive weight class (i.e., “making weight”) is a common practice among both high school and college wrestlers and typically follows a weekly pattern (“weight cycling”) across the competitive season (Lingor & Olson, 2010; Ransone & Hughes, 2004; Stiene, 1993). However, a large portion of college wrestlers may not maintain an acceptable level of hydration throughout the entire competitive season (Bledsoe et al., 2007), although this condition may also be evident in other sports (Smith, Mayhew, Koch & Roberts, 2006). The effect of mild-to-moderate dehydration on performance remains equivocal, with some studies showing no detrimental effects (Evetovich et al., 2002) and some indicated reductions in strength and endurance (Jones et al., 2008; Wenos & Amato, 1998). Attempts to rehydrate following competition weight-in have produced no significant improvement in performance, although the psychological benefits have received only limited attention (Marttinen et al., 2011; Utter & Kang, 1998). It appears that mild dehydration (<2% of body weight) may not be harmful to wrestlers and probably does not detract from their performance abilities. However, a potential long-term negative consequence of this practice might lead to greater weight gain following retirement from the sport (Saarni, Rissanen, Sarna, Koskenvuo & Kaprio, 2006), although this needs further investigation (Nitzke, Voichick & Olson, 1992). Therefore, continued efforts should be made to limit the amount of weight reduction and the number of weight cycling episodes performed by young wrestlers in addition to encouraging them to consume adequate amounts of hypertonic solutions throughout the day (Cutrufello & Dixon, 2013; Logan-Sprenger & Spriet, 2013).

**References**


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Refereed Paper

Role Strain in Dual Role Collegiate Athletic Trainers

Bryan Dorrel, Matthew L. Symonds, and Josh Lammert

Context: Role strain and its prevalence among dual role collegiate athletic trainers. Objective: To better understand the dual appointment athletic trainer working in the collegiate setting and to determine if they experience role strain. While role strain has been identified among health care educators, program directors, athletic training preceptors and dual appointment athletic trainers teaching as physical educators, research has not focused upon collegiate athletic trainers functioning in a variety of dual appointment positions. Design: Non-experimental survey. Participants: Dual role collegiate athletic trainers. Data Collection & Analysis: Data was collected via Survey Monkey. Data was entered into SPSS 20 and analyzed. Researchers calculated Cronbach’s Alpha for the survey instrument, compiled descriptive statistics, and calculated T-tests and ANOVA. Results: Cronbach’s Alpha was high (overall instrument = .949). Descriptive analysis revealed role overload as the most prominent factor contributing to role strain. ANOVA results uncovered that the number of hours worked per week was a significant predictor of role strain ($F_{(4,156)} = 3.96, p < .05$). Number of credit hours taught was also found to be a significant predictor of role strain ($F_{(4,156)} = 10.05, p < .05$). Another significant predictor was the average number of students an AT supervised as preceptor ($F_{(4,156)} = 8.02, p < .05$). Finally, increased job responsibilities were also a predictor of increased role strain ($F_{(9,151)} = 6.06, p < .05$). Conclusion: Due to the moderate to high level of role strain experienced by the majority of this sample, collegiate dual role athletic trainers may be at risk to develop symptoms of burnout, job dissatisfaction, and intention to leave. AT positions with two or more roles and high volumes of duties within each role set need to be re-evaluated and/or carefully considered by ATs.

Keywords: role strain, role overload, dual appointment athletic trainer

Athletic training is a unique profession placing Certified Athletic Trainers (ATs) in different job settings and diverse roles. One common position assumed by the collegiate AT is the dual appointment. A dual appointment position at the collegiate level typically involves traditional athletic training responsibilities coupled with educational responsibilities.
that may include instruction of courses and/or clinical supervision of students associated with a university’s athletic training program (ATP) or instruction of courses within other academic programs. Dual appointment arrangements that exist may include administrative responsibilities outside of the athletic training domain as well.

Dual appointment contractual responsibilities are arranged in a manner that split up the ATs time (e.g., 50% athletics and 50% academics). These dual appointment roles present unique opportunities for athletic trainers, especially those who wish to be directly involved with both the didactic and clinical education process. In many cases, dual appointment athletic trainers get the opportunity to pass on knowledge and provide essential mentorship to the Athletic Training Student (ATS). It is a unique situation where work and education are complimentary. Literature has shown the importance of the mentoring process for professional development and the consistent link of mentoring to the learning process (Pitney & Ehlers, 2004). The mentoring process, while time consuming, can have tremendous advantages to the students.

ATs with multiple job responsibilities may be at risk to experience role strain. Role strain is a term first coined by Goode in 1960, who described it as inability or difficulty to meet the demands of a role (Goode, 1960). Several authors have contributed to the theory of role strain to further define its characteristics, predictors and effects. Hardy defines role strain as a state of emotional arousal that occurs in response to outside conditions and social stressors. As well, Hardy identified several sources of role strain: role conflict, inter-sender and intra-sender conflict, role ambiguity, role overload, role incongruity and role incompetence (Hardy & Conway, 1988). Chang and Hancock (2003) identified potential predictors of role strain as age, experience, network of social support and workload.

In relationship to the field of athletic training, Henning and Weidner have concluded that collegiate ATs working as approved clinical instructors (now referred to as preceptors) experience significant role strain (Henning & Weidner, 2008). Since the implementation of Athletic Training degree programs, it is possible that more ATs find themselves in dual roles appointments, treating athletic related injuries in addition to teaching as educators or supervising ATSs as preceptors. According to the Commission on Accreditation of Athletic Training Education website, there were 346 undergraduate and 20 master’s level programs in 2010 (House, 2010). The academic responsibilities of educational programs have undoubtedly placed more responsibility upon some athletic trainers. This is not an isolated incident affecting the AT profession, as nursing programs have met similar difficulties associated with clinical responsibilities (Oermann, 1998).

Role strain is not isolated to the collegiate setting. Pitney has also identified role strain affecting high school ATs whom function as dual role physical educators. Forty percent of those surveyed reported high to moderate levels of role strain and common reoccurring themes emerged that demonstrate how role strain could affect ATs (Pitney, Stuart, & Parker, 2008). One cannot simply dismiss the added duties and responsibilities that go hand in hand with a dual role appointment. The added duties are significant and create additional responsibilities, time, and effort.
When attempting to treat patients with quality care and at the same time supervise AT students, job requirements can become mentally, emotionally, and physically exhausting (Oermann, 1998). Dual role appointments may be setting ATs up for burnout, family/life-balance issues, or the inability to obtain tenure for those in full time faculty lines at the university level (Dewald & Walsh, 2009; Mazerolle, Bruening, & Casa, 2008; Mazerolle, Bruening, Casa, & Burton, 2008). This is notably concerning for those athletic trainers functioning as program directors. Program director roles focus heavily on teaching and program administration, but may as well have clinical responsibilities. Many faculty ATs have been denied tenure and promotion because of unrealistic job responsibilities (Dewald & Walsh, 2009).

There is little doubt that athletic training students learn best in clinical environments that emulate real life situations (Mensch & Ennis, 2002). Furthermore, students desire to work with professionals who are approachable, accessible, and provide mentorship (Pitney & Ehlers, 2004). However role strain is a very real issue facing collegiate ATs that may affect the quality of education and/or clinical care (Henning & Weidner, 2008). Research has shown that 49% of ATs who serve as preceptors at collegiate institutions report a moderate to high level of role strain (Henning & Weidner, 2008). Nevertheless, little is known about other AT role combinations and their impact on role strain.

The purpose of this study was to examine the positive and negative aspects of dual appointment roles for Certified ATs at the collegiate level. We sought to determine if the number of role combinations could have an increased risk of role strain for collegiate ATs. It was important to the research team to focus on whether the number of role combinations might increase the risk of role strain and to heighten awareness for ATs when choosing future jobs. The following questions guided our study:

1. What is the extent of role strain among dual position ATs in the collegiate setting?
2. What are the biggest factors (i.e. role overload, role ambiguity, role conflict, etc.) that contribute to the presence of role strain for the above population?
3. What demographic characteristics (i.e. age, sex, amount of experience, etc.) can predict role strain?
4. What self-reported position combinations (i.e. Head AT, ACI, Head AT/ACI, Asst. AT/Instructor, etc.) are significant predictors of role strain?

Methods

Participants
Researchers worked with NATA member services to identify collegiate ATs in dual role positions. The NATA allowed 1,000 participants to be located for the study that matched our criteria representing all NATA districts, collegiate athletic levels, and demographic characteristics.

Instrumentation
Researchers obtained permission to adapt Mobily’s (Mobily, 1991) role strain scale and incorporated Pitney’s (Pitney et al., 2008) and Henning
and Weidner’s (2008) scales as guides to make our scale more relevant to athletic training (See Table 1). The survey collected demographic characteristics in an effort to explore predictors (e.g., salary, age, years of experience, etc.) of role strain within each role set. The 41-item role strain scale includes seven subscales used to measure the contributing factors as well as a total role strain score from the survey. The role strain questionnaire employed a five-point Likert-type scale (1= never, 2=rarely, 3=sometimes, 4=frequently, 5=nearly all the time) which measures the degree to which the participants’ dual roles contributed to role strain. The scale’s content validity and reliability have already been established. The internal consistency of Mobily’s (1991) scale, as measured by Cronbach’s alpha, was .96. In the current study, the alpha reliability coefficients based on the 41-item scale for the overall instrument (.949) and each of the seven subscales are shown in Table 2.

**Procedures**

The study was approved by the Institutional Review Board at the researchers’ home institution. The study group of 1,000 individuals received an e-mail invitation from the NATA to participate in the study including a link to an online version via Survey Monkey. The survey was initiated in December 2011 and ran through January 2012.

**Data Analysis**

After uploading the raw data set from the survey host, analyses were conducted using SPSS version 20 (IBM, 2011). Researchers calculated descriptive statistics for role strain factors, demographics, and dual role combinations. To replicate studies done by Mobily (1991) and Henning and Weidner (2008), researchers defined role strain by using the total mean score (X=2.37) of the 41-item scale. To categorize the degree of role strain, researchers used the overall mean score and its standard deviation (SD=.75). By using one standard deviation above and below the mean we were able to categorize role strain into four distinct groups: minimal (< 1.63), low (1.64-2.37), moderate (2.38-3.11), and high (>3.12). Total role strain and the seven subscales were compared using ANOVA with relevant demographics. A two-tailed t test was used to determine differences between the role strain score and the gender of the participants. To determine significance, we established the alpha level to be 0.05. We conducted Tukey post hoc tests when applicable.

**Results**

**Degree of Role Strain and Subscales**

Subjects from the study experienced varying degrees of role strain. Figure 1 represents the percentage of dual appointment ATs in the collegiate setting and the degree to which they experienced role strain. Also included in Figure 1, are the standard deviations from the mean that were used to categorize the participants’ scores. The results of descriptive statistics revealed that over 52% (n=84) of the participants were experiencing moderate to high levels of role strain. Table 4 depicts the mean rank, mean, and standard deviation for each of the seven subscales.
Table 1
Description of 7 Role Strain Subscales

<table>
<thead>
<tr>
<th>Role Strain Factors</th>
<th>Definition and Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-3: Role Conflict (3 subscales)</td>
<td>The existence of clear but competing or incompatible expectations.</td>
</tr>
</tbody>
</table>
| 1. Inter-Sender Conflict (5 items) | The demands of one member of a person’s role set conflict or are incompatible with demands of another person or persons in the role set.  
Example: Feeling unable to satisfy the conflicting demands of the athletic director and the athletic training education program director. |
| 2. Intra-Sender Conflict (8 items) | The demands from a single member of the role set are incompatible or mutually exclusive.  
Example: Having inadequate time to meet role expectations. |
| 3. Inter-Role Conflict (5 items) | When a person has membership in two different groups and the demands of one role conflict with the demands of another role.  
Example: Feeling that my teaching responsibilities take time needed from my athletic training clinical responsibilities. |
| 4. Role Ambiguity (6 items) | The degree to which clear information is lacking with respect to the expectations associated with a role, methods for fulfilling known role expectations, and/or the consequences of role performance.  
Example: Having a lack of clearly defined expectations of my role as an Approved Clinical Instructor. |
| 5. Role Overload (9 items) | The role expectations are too complex or make too many demands for the time and energy available or there is conflict between quality and quantity given the time constraint.  
Example: Feeling like I have too heavy a workload, one that cannot possibly be finished during the normal work week. |
6. Role Incongruity (5 items)

The expectations for role performance run counter to the individual’s self-perception, disposition, attitudes, and values\(^1\).

Example: Feeling that the goals and objectives established by the athletic training education program for athletic training students are incongruent with my own goals and objectives for these students\(^2\).

The role occupant lacks the requisite skills, knowledge, or ability to enact the role assumed\(^1\).

Example: Feeling I do not have the sufficient knowledge and skills to fulfill my role as an Approved Clinical Instructor\(^2\).

Key: \(^1\) - Mobily, 1991, pp. 74 ; \(^2\) - Henning & Weidner, 2008, p. 276

### Table 1 - Continued

<table>
<thead>
<tr>
<th>Subscale</th>
<th># of Items</th>
<th>Cronbach’s Alpha</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inter-Sender Role Conflict</td>
<td>5</td>
<td>.728</td>
</tr>
<tr>
<td>Intra-Sender Role Conflict</td>
<td>8</td>
<td>.753</td>
</tr>
<tr>
<td>Inter-Role Conflict</td>
<td>5</td>
<td>.726</td>
</tr>
<tr>
<td>Role Ambiguity</td>
<td>6</td>
<td>.814</td>
</tr>
<tr>
<td>Role Overload</td>
<td>9</td>
<td>.864</td>
</tr>
<tr>
<td>Role Incongruity</td>
<td>5</td>
<td>.721</td>
</tr>
<tr>
<td>Role Incompetence</td>
<td>4</td>
<td>.688</td>
</tr>
<tr>
<td>Overall Instrument</td>
<td></td>
<td>.949</td>
</tr>
</tbody>
</table>

### Table 2

Cronbach’s Alpha Scores for Subscales
that contributed to the presence of role strain. These data indicated role overload, two-types of role conflict, and role incongruity as the highest contributors to role strain in the study group. Role overload was the most prominent factor leading to role strain (X=3.09).

### Demographics and Role Strain

A total of 190 individuals participated in the study, resulting in a 19% response rate. Further analyses reflect the fact that not all participants completed each survey question and were thus eliminated from some hypothesis testing resulting in differing numbers of test subjects for some variables. Researchers note: although the NATA filtered only athletic trainers with dual positions, there were still clinicians who self-reported as employed in singular roles.

The study group included members of all NATA districts, all age groups, all competition levels, and other demographics. Over half (53%) of the sample reported working over 50 hrs/wk. Thirty five percent (n = 64) of individuals reported teaching greater than three credit hours per semester. Out of the ATs working at institutions with an ATP, over 19% (n=36) were assigned five or more clinical students per semester. Complete demographic data for the participants are included in Table 3. Analysis revealed that the following characteristics were not significant predictors of role strain: gender, years of experience, number of athletes under direct care, annual salary, athletic level, NATA district, and age.

*Number of hours worked per week* was a significant predictor of role strain ($F_{(1,190)} = 3.96, p < .05$). Tukey post hoc testing showed that ATs who work 40 hours or less reported lower role strain scores, compared to groups reporting 50 hrs or more. *Number of credit hours taught* was also found
Table 3  
Participant Demographic Data

<table>
<thead>
<tr>
<th>Variable</th>
<th>Category</th>
<th>Number</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td>Male</td>
<td>92</td>
<td>48.40%</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>98</td>
<td>51.60%</td>
</tr>
<tr>
<td>Age</td>
<td>20-30</td>
<td>72</td>
<td>37.90%</td>
</tr>
<tr>
<td></td>
<td>31-40</td>
<td>62</td>
<td>32.60%</td>
</tr>
<tr>
<td></td>
<td>41-50</td>
<td>30</td>
<td>15.80%</td>
</tr>
<tr>
<td></td>
<td>Over 50</td>
<td>26</td>
<td>13.70%</td>
</tr>
<tr>
<td>NATA District</td>
<td>1</td>
<td>18</td>
<td>9.50%</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>23</td>
<td>12.10%</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>19</td>
<td>10.00%</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>45</td>
<td>23.70%</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>27</td>
<td>14.20%</td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>8</td>
<td>4.20%</td>
</tr>
<tr>
<td></td>
<td>7</td>
<td>5</td>
<td>2.60%</td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>18</td>
<td>9.50%</td>
</tr>
<tr>
<td></td>
<td>9</td>
<td>21</td>
<td>11.10%</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>6</td>
<td>3.20%</td>
</tr>
<tr>
<td>Years of experience</td>
<td>0-5</td>
<td>57</td>
<td>30.00%</td>
</tr>
<tr>
<td></td>
<td>6-10</td>
<td>46</td>
<td>24.20%</td>
</tr>
<tr>
<td></td>
<td>11-20</td>
<td>49</td>
<td>25.80%</td>
</tr>
<tr>
<td></td>
<td>21-30</td>
<td>19</td>
<td>10.00%</td>
</tr>
<tr>
<td></td>
<td>Over 30</td>
<td>19</td>
<td>10.00%</td>
</tr>
<tr>
<td>Number of hours worked per week</td>
<td>0-30</td>
<td>6</td>
<td>3.20%</td>
</tr>
<tr>
<td></td>
<td>31-40</td>
<td>15</td>
<td>7.90%</td>
</tr>
<tr>
<td></td>
<td>41-50</td>
<td>67</td>
<td>35.30%</td>
</tr>
<tr>
<td></td>
<td>51-60</td>
<td>75</td>
<td>39.50%</td>
</tr>
<tr>
<td></td>
<td>Over 60</td>
<td>27</td>
<td>14.20%</td>
</tr>
</tbody>
</table>
to be a significant predictor of role strain \( (F_{(4,156)}=10.05, p < .05) \), and post hoc testing revealed that clinicians teaching four to nine credit hours per semester experienced greater role strain than clinicians teaching less than four credit hours (Table 6). Another significant predictor was the average number of students an AT supervised as acting preceptor \( (F_{(4,156)}=8.02, p < .05) \). In this category, post hoc testing demonstrated that ATs who serve
as preceptor for three or more students per semester are experiencing greater role strain (Table 7). Finally, greater job responsibilities were also a predictor of increased role strain ($F_{(9,151)} = 6.062, p < .05$). The results of post hoc testing for this survey item revealed that clinicians who reported fewer roles suffered less role strain (Table 8).

Discussion

The current study expands the investigation of role strain among collegiate ATs to include multiple role combinations. The results of this study support the presence of role strain among collegiate ATs working in a variety of dual positions. Over 52% of dual position ATs are experiencing moderate to high levels of role strain and results demonstrate that various role combinations of collegiate ATs can lead to role strain. Other studies on dual appointment ATs, specifically preceptors and physical educators, have shown the continued presence of role strain in those respective populations (Henning & Wiedner, 2008; Pitney et al., 2008). Logically, the more roles that a professional is asked to assume leads to a delicate balancing act for the AT professional and can contribute to role strain.

The current study also found certain subscales which were contributing to role strain more than others. In support of Henning and Wiedner (2008), the current study also demonstrates that role overload is the highest contributing factor to role strain among dual appointment collegiate ATs, but is not limited to those working as preceptors. With additional responsibilities and a finite amount of time, ATs are likely to experience role overload. While other factors contribute to role strain, role overload continues to be the most prominent factor for all dual appointment collegiate ATs.

Factors Contributing to Role Strain

It was discovered that hours worked per week for collegiate ATs was a significant contributing factor to role strain since this factor was previously identified in ATs working dual positions in the high school setting (Pitney et al., 2008). This is of concern as long work hours are shown to be a contributing factor to job dissatisfaction, intention to leave, and job burnout (S. M. Mazerolle, Bruening, Casa, et al., 2008).

Another significant factor that predicted the degree of role strain was the number of credit hours taught by ATs. Although information is limited in the AT field, nursing faculty members in dual role positions with academic and clinical responsibilities have been shown to experience role strain (Mobily, 1991). In retrospect, the categories utilized on the current survey instrument to report credit hours taught should have been further delineated. The category of 0-3 credit hours, which was utilized in the survey, allowed for individuals teaching no classes to be included with those teaching up to three credit hours. This limitation may fail to indicate the degree to which no teaching impacted the data analysis.

The current study found a higher presence of role strain in ATs working in ATP programs, but was dependent upon the number of students for which they were acting preceptor. Henning and Wiedner also found that dual roles ATs working as clinicians and preceptors were experiencing
### Table 4
Role Strain Contributing Factors

<table>
<thead>
<tr>
<th>Role Strain Subscales</th>
<th>Mean rank</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Role overload</td>
<td>1</td>
<td>3.090</td>
<td>0.761</td>
</tr>
<tr>
<td>Inter-role conflict</td>
<td>2</td>
<td>2.543</td>
<td>0.977</td>
</tr>
<tr>
<td>Intra-sender role conflict</td>
<td>3</td>
<td>2.486</td>
<td>0.704</td>
</tr>
<tr>
<td>Role incongruity</td>
<td>4</td>
<td>2.413</td>
<td>0.950</td>
</tr>
<tr>
<td>Inter-sender role conflict</td>
<td>5</td>
<td>2.304</td>
<td>0.977</td>
</tr>
<tr>
<td>Role ambiguity</td>
<td>6</td>
<td>2.113</td>
<td>0.931</td>
</tr>
<tr>
<td>Role incompetence</td>
<td>7</td>
<td>1.669</td>
<td>0.759</td>
</tr>
</tbody>
</table>

### Table 5
Summary of Post Hoc Analysis
More Hours Worked Equaled Higher Role Strain Scores

<table>
<thead>
<tr>
<th>Ave. hours worked/week</th>
<th>Ave. hours worked/week</th>
<th>Mean Difference in Role Strain Score</th>
<th>Std. Error</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>31-40</td>
<td>51-60</td>
<td>-0.6457</td>
<td>0.2146</td>
<td>0.025</td>
</tr>
<tr>
<td>31-40</td>
<td>Over 60</td>
<td>-0.7259</td>
<td>0.2468</td>
<td>0.031</td>
</tr>
</tbody>
</table>

### Table 6
Summary of Post Hoc Analysis Results
Teaching More Credit Hours Resulted In Higher Role Strain Scores

<table>
<thead>
<tr>
<th>Ave. credit hours taught/semester</th>
<th>Ave. credit hours taught/semester</th>
<th>Mean Difference in Role Strain Score</th>
<th>Std. Error</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-3 hours had less role strain than</td>
<td>4-6 hours</td>
<td>-0.6704</td>
<td>0.1389</td>
<td>0.000</td>
</tr>
<tr>
<td>0-3 hours had less role strain than</td>
<td>7-9 hours</td>
<td>-0.7940</td>
<td>0.1691</td>
<td>0.000</td>
</tr>
</tbody>
</table>
The current study found that years of experience, age, annual salary, athletic competition level and NATA district did not contribute to role strain. Of interest, the number of athletes under direct care of the AT did not contribute to role strain as well, and may warrant further study.

A majority of dual appointment AT’s in this sample are experiencing role strain. Our study reinforces the notion that multiple roles create the potential for role strain. Small role additions (i.e. traditional AT responsibilities along with one or two clinical students or a course to teach) may be manageable but should be monitored to ensure job satisfaction and to prevent role strain.

When ATs try to manage high volume dual or even triple roles, problems are likely to arise. Our results demonstrate that as dual roles reach higher volume, that the amount of role strain increases. As clinicians take on more roles (i.e. academic instructor, preceptor, etc.), responsibilities compete, which contribute to role overload, role strain and can negatively impact a clinicians quality of work. In these cases, clinicians have little choice but to prioritize roles due to role conflict, and are therefore unable to spend as much time and effort on other duties. We did not discuss role congruency in detail (i.e. participants’ ideal and actual role responsibilities), but this can become a factor as clinicians will prioritize their roles based on their ideal responsibilities (Brumels & Beach, 2008; Henning & Weidner, 2008).

Reducing Role Strain

Although the presence of role strain in dual position ATs may seem inevitable, that does not mean that the effects are unavoidable. ATs need to critically examine current and future positions to identify unreasonable expectations and high volume job responsibilities that contribute to role strain. Employers should be encouraged to post accurate and clear job descriptions, and create positions that do not contribute to role strain. Some suggestions noted in the literature to assist in decreasing role strain include:

1. increasing rewards for roles (Henning & Weidner, 2008)
2. increasing social support (McChesney & Peterson, 2005)
3. compliance to NATA guidelines on medical coverage (Mazerolle, Faghri, Marcinick, & Milazzo, 2010)
4. creating a priority-based coverage plan (Scriber & Alderman, 2005)
5. reassigning time-intensive duties (i.e. student worker completing appropriate administrative duties)

There are other ways presented in the literature to manage and reduce role strain. Many revolve around clinicians negotiating their roles and working with administrators and colleagues to improve their situation. It is crucial for administrators to realize the presence of role strain in this population and be willing to adapt to an ever-changing intercollegiate work atmosphere. It may be beneficial for administrators to provide peer support, guidance and prevent isolation.
Limitations and Recommendations

One limitation of any voluntary study is that subjects who do not have enough free time to participate would likely be the most at-risk for role strain. Although we found no significant difference between collegiate athletic levels, there is cause for concern for clinicians working with small staff sizes and large numbers of student-athletes. It would be beneficial to specifically study institutions with a low AT to athlete ratio. Future researchers should also investigate if clinicians who have two or more roles are negatively impacting the ATSs degree of learning or the health care provided to student-athletes. Since members of this population are experiencing higher levels of role strain, it would be beneficial to investigate to what extent these professionals are suffering from symptoms of burnout, job dissatisfaction, and intention to leave their setting or profession. Finally, our survey instrument design prohibited

Table 7
Summary of Post Hoc Analysis Results
ATs That Did Not Supervise Clinical Students Experienced Significantly Less Role Strain

<table>
<thead>
<tr>
<th>Ave. clinical students supervised per semester</th>
<th>Ave. clinical students supervised per semester</th>
<th>Mean Difference in Role Strain Score</th>
<th>Std. Error</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>3-4</td>
<td>-0.5215</td>
<td>0.1642</td>
<td>0.015</td>
</tr>
<tr>
<td>0</td>
<td>5-6</td>
<td>-0.8289</td>
<td>0.2144</td>
<td>0.002</td>
</tr>
<tr>
<td>0</td>
<td>Over 6</td>
<td>-0.8557</td>
<td>0.1789</td>
<td>0.000</td>
</tr>
</tbody>
</table>

Table 8
Summary of Post Hoc Analysis Results
ATs With Single Roles Experienced Less Role Strain Than ATs With Multiple Roles

<table>
<thead>
<tr>
<th>Single-role job responsibilities</th>
<th>Multiple-role job responsibilities</th>
<th>Mean Difference in Role Strain Score</th>
<th>Std. Error</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Head</td>
<td>Other (3 or more)</td>
<td>-0.6680</td>
<td>0.1663</td>
<td>0.004</td>
</tr>
<tr>
<td>Assistant AT</td>
<td>Other (3 or more)</td>
<td>-0.9306</td>
<td>0.1578</td>
<td>0.000</td>
</tr>
<tr>
<td>Assistant AT</td>
<td>Asst. /Preceptor</td>
<td>-0.6447</td>
<td>0.1832</td>
<td>0.020</td>
</tr>
<tr>
<td>Instructor</td>
<td>Other (3 or more)</td>
<td>-1.0966</td>
<td>0.3151</td>
<td>0.022</td>
</tr>
</tbody>
</table>
researchers from drilling down to identify which specific role(s) within a dual role position are most likely to contribute to role strain.

Since 48% \((n = 77)\) of ATs in our study experienced minimal to low levels of role strain, researchers should examine strategies that this group employs to manage their dual roles. Moreover, it may be beneficial to present ways institutions can redesign current and future positions that will limit the role overload and role conflict of ATs.

The purpose of this study was to examine role strain among collegiate athletic trainers who are fulfilling dual positions. Many athletic trainers serving two or more positions in the collegiate setting are experiencing role strain because of multiple duties they are required to perform. Role overload and role conflict are the highest contributors to the strain in this sample. Several demographic factors were found to predict role strain including: hours worked per week, credit hours taught per semester, students supervised per semester, and job responsibility combinations. Due to the moderate to high level of role strain experienced by the majority of this sample, these professionals may be at risk to develop symptoms of burnout, job dissatisfaction, and intention to leave. Therefore, these positions with two or more roles that includes high volumes of duties within each role set need to be re-evaluated and/or carefully considered by ATs.

References


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Work-Related Health Problems in Dance Teachers – A Pilot Study

Eileen Wanke, Katrin Clausen, Moira McCormack, and David A. Groneberg

The main tasks of dance teachers are to teach the vocabulary and techniques of the dancers’ and dance students’ chosen genre. The areas of activity and employment of dance teachers expand constantly. They are increasingly requested to teach in schools from nursery upwards. In class and rehearsals (e.g. for school performances) the teachers’ bodies undergo major exercise demands (e.g. demonstrating ‘wrong dance techniques’, ‘one leg’ – demonstrations). At that they often lack of sufficient warm up and constantly focus on their students). Therefore, dance teachers need health and fitness to function efficiently, especially in relation to cardio-pulmonary loads of up to sub-maximal intensity (Dahlstöm, 1997). In addition, they are to cope with non-dance activities (office work, preparing class, organization, etc.). Although much has been published about health topics of dancers (Ojofeitimi & Bronner, 2011; Gottschlich & Young, 2011; Deleget, 2010) little research has been done with dance teachers (Dahlstöm, 1997), who instruct students and professional dancers in professional and amateur theatrical dance. Therefore, it seems reasonable to analyze work-related health problems among dance teachers.

The aim of this investigation is to represent an overview of work-related problems among dance teachers with emphasis on physical health.

Material and Methods

A cross-sectional retrospective study was carried out as a primary questionnaire survey. The questionnaires were developed by dance teachers, choreographers, and medical doctors in compliance with the recommendations of Liederbach, Hagins, Gamboa and Welsh (2006) and the questionnaire of Wanke, Schmitter and Groneberg (2011). The questionnaire consisted of four parts:

• Part 1: General background as to person and education, professional satisfaction, duration of professional career
• Part 2: Professional activities (e.g. amount, type and contents, leisure time activities and health-related behaviour)
• Part 3: Acute injuries (work-related injuries) and chronic diseases
• Part 4: Causes for health-related problems and work-related lost-time injuries
The questionnaire comprised open and multiple choice questions allowing one or more answers. A pre-test was carried out with sports instructors whose tasks and loads can be compared with those of dance teachers. Prerequisites for the participation were that the dance teachers’ income was the basis of livelihood, that teaching was conducted in the theatrical dance field and that technique training was the teaching focus. This applied to all participating dance teachers. Due to the aim of the study, a further subdivision of the dancer teachers’ activity such as ‘being employed’ or ‘working freelance’ was waived.

**Definition Of Acute Injury And Chronic Disease**

According to Arendt and Kerschbaumer (2003), an acute injury is ‘a physical lesion resulting from a sudden exposure to physical forces’ and chronic complaints are ‘a result of recurrent micro traumata’. These include orthopedic and internal primary diseases.

The minimum age for participation was 21 yrs. The participation was on voluntary and anonymous basis with recruiting of population done via websites and dance teacher associations. The samples included 104 (78 female, 26 male) participants aged 21 - 66 yrs, averaging 40.3 ± 11.6 yrs (i.e. a response rate of 34.5%). Of all respondents, 77% were between 26 and 55 yrs old at the time of the questionnaire survey with 11.5% allotted to the two marginal groups aged between 21 to 25 yrs and 56 to 66 yrs.

The calculation of the Body Mass Index (BMI) based on body height and weight is presented in Figure 1. There were distinct differences noticeable in 53.9% of the females and 57.7% of the males in the norm level. The proportion of overweight persons was higher with the male dance teachers.

The data were evaluated anonymously and calculated using the PASW Statistics software package, Version 18.0 and Excel 2007. Predominantly, the evaluation was done as a form of frequency analyses. Chi-Square Tests were used to evaluate the differences between the subject groups. The significance level was set at $\alpha=0.05$.

**Results**

**Part 1**

**Professional Satisfaction.** All respondents indicated to ‘enjoy teaching very much’. Of all respondents, 95% called their occupation a ‘dream job’ with 5% contradicting. 50.3% of the teaching activities focused on work with adults, 30% with adolescents and 19.7% with children. 85% of the respondents had danced professionally (performing in a dance company) before their dance teacher career. Of all former professional dancers, 90% of the respondents had actively danced for at least eleven years.

**Health Screening.** Of all respondents, 77% stated to have ‘never participated in a health screening test before starting to teach’ with 23% reporting to have been physically examined.

**Duration of Professional Career.** The question up to what age dance teachers intended to remain in their occupation was commented with ‘as long as possible’, ‘forever’ and ‘until death’. Only 21.3% intended to teach by the age of 64 (Figure 2).
Part 2

Working Hours. The daily working hours were approximately 6 hrs ± 2.4 hrs on average. Of all subjects, 15% worked 8 hrs/day. 39.9% taught more than 5 hrs/day with 13.7% teaching 6 hours, 12.7% 7 hrs, 14.7% 8 hrs and 12.6% more than 8 hrs.

The average working week was approximately 31 hrs ± 14.5 hrs. Forty seven per cent worked more than 30 hrs/wk. From the respondents working more than 30 hrs/wk, 16% worked more than 40 hrs and 6% more than 50 hrs/wk.
Nature of Predominant Work. Of all work, 44% consisted of teaching dance technique, followed by choreography (24%), administrative and office work (20%), advisory and talks with parents (5%) and other activities such as performances, teaching in theoretical subjects or child care. 75% of the teachers stated that they ‘cannot afford to take sick leave in case of an injury or chronic complaint’. Another 14% stated ‘not to have thought about being unable to work due to sick leave. Eleven per cent stated they could theoretically afford longer periods of sick leave (at least a couple of weeks). Eighty-six per cent of the respondents ‘disagreed’ or ‘somewhat disagreed’ with the statement ‘I am often injured’ with 14% ‘agreeing’ or ‘rather agreeing’. Seventy-five per cent stated they would continue working despite pain. Only 23% stated not to continue working despite pain. All respondents stated to ‘know their bodies very well’. Thirty-eight per cent agreed to the statement that their work ‘is threatened by injuries’ with 24.4% ‘somewhat agreeing’. The remaining approximately 37.7% stated they ‘somewhat disagree’ or ‘disagree’ to the statement that ‘their work implies the risk to be ‘threatened by injuries’.  

Leisure Time Activities And Health-Related Behaviour

Smoking. Eighty-nine per cent were non-smokers. Only 10.6% described themselves as smokers; of the smokers, 45% smoked less than 4 cigarettes daily and 54% smoked 4 and more cigarettes a day.

Recreational Activity. Alongside their main occupational activities, almost 75% of the respondents did recreational sport. Of these, more than 50% did sport more than three times weekly (Table 1).

The research respondents tried to minimize work-related negative stress by participation in recreational sports (65.7%), Yoga (53.6%) and meditation (52.6%). More than half of the dance teachers ‘more often’ or ‘always’ made use of these three methods to relieve stress. This was followed by progressive muscle relaxation practiced by 34% of the dance teachers. Autogenic training, smoking, drugs and the Feldenkrais method as well as the Alexander technique were “seldom” used methods to cope with stress. Both, smoking and drugs were ‘more often’ or ‘always’ used by 4% and 9% respectively, with 12% stating to ‘seldom’ smoke or take drugs to compensate for stress.

Consulting a Medical Doctor. The most common motive for consulting a medical doctor was ‘being in severe pain’ (37%). More than thirty per cent (30.2%) consulted a medical doctor, when the self-treatment had failed (p<0.001). If the illness or injury had still bothered them a few days after occurring, 20.2% consulted medical doctor. Almost eight percent (7.6%) intended to exclude possible risks or consequences when calling in a medical doctor with 5% consulting a medical doctor at the first signs of a disease or injury (p<0.001) (Figure 3).

Sixty per cent (p<0.001) of the respondents consulted a medical doctor for occupational injuries or diseases less than once a year. Thirty-three percent sought medical help 1-3 times annually. Some 3% visited a medical doctor up to ten times during the year. The remaining 4% used medical advice in connection with occupational injuries and illnesses more than ten times per year.
### Table 1
**Extent of Weekly Recreation Sports (n=104)**

<table>
<thead>
<tr>
<th>weekly extent</th>
<th>in %</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 1 hour</td>
<td>15.1</td>
</tr>
<tr>
<td>1-2 hours</td>
<td>32.9</td>
</tr>
<tr>
<td>3-4 hours</td>
<td>21.9</td>
</tr>
<tr>
<td>&gt; 4 hours</td>
<td>30.1</td>
</tr>
</tbody>
</table>

### Table 2
**Reasons for Work-Related Health Problems (n=104)**

<table>
<thead>
<tr>
<th>Reason</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tight schedule</td>
<td>26.3</td>
</tr>
<tr>
<td>High work load</td>
<td>25.9</td>
</tr>
<tr>
<td>High expectations</td>
<td>14.3</td>
</tr>
<tr>
<td>Poor working conditions</td>
<td>12</td>
</tr>
<tr>
<td>Poor working atmosphere</td>
<td>5</td>
</tr>
<tr>
<td>Lacking concentration</td>
<td>5</td>
</tr>
<tr>
<td>Poor training condition</td>
<td>3.8</td>
</tr>
<tr>
<td>Deficient nutritional status</td>
<td>3.1</td>
</tr>
</tbody>
</table>

### Part 3

**Acute Work-Related Injuries.** A total of 89 acute injuries were reported. This represents 0.9% acute injuries per participant. Just 2 dance teachers sustained more than one traumatic injury. Of all body regions, the most affected was the lower limb (acute: 67.9%, chronic: 60.8%, \(p=0.000\)), vertebral column (21.8%), and injuries to the upper limb (10.3%).

Within the acute injuries of the lower limb the ankle joint was most affected in 30.8% of the respondents, followed by knee (17.9%), and foot (14.1%) \(p=0.059\). In the spine region, the lumbar spine was the most likely acute injury sustained (Figure 4). Ligamentous lesions, muscular strains and ruptures (29.9%) were most commonly injured, followed by bone injuries (fractures) and pulled muscles (each 17.4%) with injured tendons (13.4%) the most commonly injured structures.

**Chronic Health Problems (Diseases and Injuries).** A total of 130 chronic problems were reported which represents 1.3 chronic problems per participant. Of all respondents, 50.1% reported primary diseases, with 44.9% internal disorders and 55.1% orthopedic complaints. The most common problems were migraine with 26.4%, followed by arthrosis (17.0%), hypertension (11.3%), scoliosis (9.4%) and thyroid dysfunction
Figure 3
Reasons to Consult a Medical Doctor (n=104)

Figure 4
Body Regions Affected by Chronic Diseases and Acute Injuries in Dance Teacher
The lower extremity was the most affected body region, followed by spine (26.9%), and upper limb (12.3%) (p<0.001).

**Comparison Of Acute Injuries And Chronic Complaints.** In comparison with acute injuries, there were significant differences reported for chronic musculoskeletal injury localization (p=0.001): chronic musculoskeletal complaints were almost three times higher in the lumbar spine (14.6%), and twice as high in the hip and shoulder region. Chronic problems in the ankle joint were significantly less than the other body area (Figure 5). One in three chronic problems resulted in an interruption of the occupational activities with back problems as the main cause. Tendinopathy was the most commonly reported problem (30.3%), followed by chronic joint instability (13.8%), and osteoarthrosis (13.8%). More than half (59.8%) of all respondents had suffered from the aforementioned chronic complaints up to nine years, with 23% stating a period of 10 to 19 years meaning that 83% of all statements covered a disease period of up to 19 years.

**Part 4 Reasons for Work-Related Health Problems.** Of all participants, 64% stated that physical strain was the most common reason for health problems with 36% claiming the mental stress (p=0.003). High expectations of oneself or of students and parents (14.3%) lay third, followed by subjectively perceived poor working conditions (e.g. poor acoustics, large groups, inadequate flooring). All causes are shown in Table 2.

**Acute injuries and chronic diseases.** Only 2% of the respondents thought that the causes of diseases resulted from their profession. Eighty-five percent were of the opinion that their occupation was only rarely the cause for their health problems and almost 14% indicated that the activity as dance teacher never was the reason for their own illness. Twenty-six percent of the dance teachers claimed that the most common cause for their illness was a subjectively perceived tight schedule (e.g. no breaks between the classes, no lunch break) with 25.9% stating a heavy workload (Borg Scale 8-9).

**Interruption of teaching activity.** Fifty-eight percent of the respondents reported to have already interrupted their career because of a work-related injury or chronic disease with 35% of them having paused once and 23% more than once. The remaining 42% had no interruption of their professional activities. The question as to the longest interruption undertaken so far, 25% of all dance teachers named a period of several days. The majority (56%) named a few weeks, 9% a few months, with 12% stating to have interrupted the career for more than half a year because of work-related injuries or diseases. An acute injury was significantly more often a reason for an interruption than a chronic disease (p<0.001). 56 percent cited that acute injuries were the reasons for their interruption, 30% named a chronic disease, 30% a subjectively perceived overload situation and 14% name a combination of the latter two.

Only every third acute injury interrupted their occupational activities. The most common were ankle joint injuries (20%), foot and back injuries (each 14.3%) as well as knee joint injuries (11.4%).
Figure 5
Localization of Acute Injuries and Chronic Diseases in Dance Teachers (n=104)

Discussion

A good state of health is very important for dance teachers for even minor deficits can significantly disrupt a physical activity (e.g. during demonstrating movement patterns). The aim of this investigation is to represent an overview of work related problems among dance teachers with emphasis on physical health.

Work Related Health Problems

Most of the respondents stated that they had never undergone a medical examination to have their physical suitability for the profession tested. They are aware that they are exposed to substantial physical strain and that a good state of health is vital to cope with work-related demands, though (Dahlström, 1997). The small number of annual medical consultations and the number of dance teachers that never had to interrupt their occupational activity due to work-related injuries or diseases could be a sign of the good physical health of this profession. The personal view of participants that their profession only rarely caused diseases or injuries, supports this assumption. Taking the high physical work load resulting from the activities of dance teachers during teaching dance technique lessons into consideration that according to Dahlström (1997) effect persons in this profession this is amazing. On the other hand, other reasons (e.g. difficult financial situation) could be the motive for neglecting own health problems.

With this survey, health restrictions were observed. On the one hand, there were the primary chronic diseases and on the other hand work-related chronic complaints that were mainly orthopaedic. After all, barely one third of the dance teachers suffered from inflammatory and
degenerative joint diseases that may have resulted from an overuse injury (Rietveld, 2000).

Females tended to be underweight, with males seemingly overweight. However, the BMI can only be seen as orientating parameter, particularly with a high lean body mass which restricts the validity. Whether or not the underweight for females is constitutional or a work-related nutritional disorder should be investigated in further studies. As all of the respondents could look back on an own active professional dance career and as eating disorders are common in professional dance, this conclusion could at least not be ruled out (Ringham et al., 2006; Friesen, Rozenek, Clippinger, Gunter, Russo & Sklar, 2011; Nordin-Bates, Walker & Redding, 2011; Hincapié & Cassidy, 2010; Toro, Guerrero, Sentis, Castro & Puertolas, 2009).

Acute occupational injuries affected only approximately half of the subjects. Based on their entire professional life and physical workload situations this appears rather low. However, acute injuries resulted more frequently in a medical leave than chronic problems.

More than half the dance teachers suffered from chronic diseases that were the most common work related occupational health problems. As with the acute injuries – compared to professional dancers - mainly the lower extremities and the back and especially the knee respectively the ankle joint and the foot as well as the lumbar spine region were affected here (Echegoyen, Acuña, and Rodríguez, 2010). This concurrs with the results of Rietveld (2000).

Despite the numerous chronic complaints, only about one third of them resulted in a temporary absence from work. The total number of occupational health problems was probably much higher than the questionnaire survey covered. This assumption is based on results, after which a large number of dance teachers continued working even with pain and, thus, many health problems were probably played down and self treated similar to dancers (Ojofeitimi & Bronner, 2011; Nordin-Bates, Walker & Redding, 2011). Since all the respondents experienced a perennial active dance career, it is likely that this method is as familiar to them as to dancers and still applies.

A considerable number of dance teachers sought medical advice only after self-treatment had failed. Such a do-it-yourself method was already mentioned by Drees (2000) as a typical procedure for dancers. The financial situation plays an important role in this regard, for a health problem could not only mean a loss of income but also the risk of possible termination. From the dance teachers’ point of view, the causes for sick leave were mainly acute injuries and less chronic diseases.

According to the dance teachers’ responses, the most common causes of occupational health problems were a tight schedule, high physical strain and high expectations (intrinsic and extrinsic). Improving the knowledge of health hazards through education could be an important approach. In addition, it is recommended to develop one’s own performance within the anatomical-physiological limits and adjust it to the requirements (Garrick & Lewis, 2001; Wyon, 2005; Wyon, 2010; Rafferty, 2010). This would include knowledge on nutrition, body mechanics and exercise physiology.

According to Dahlström (1997), the physical strain on dance teachers
depends on the target group and, thus, with advancing age, teaching advanced adolescents or adults beginners should be preferred to teaching beginners.

Although it has not yet been made clear whether the dance teachers’ activity itself has a preventive character, generally a well balanced relation between physical workload and relief with corresponding regeneration phases should be respected. In addition, a nationwide access to quality medical care and assistance is necessary to ensure effective rehabilitation and prevent occupational health problems.

Without exception, all participants liked teaching and almost all thought that to be their dream job. This passionate attitude was reflected in the need for an above-average career. On the other side, approximately half of the respondents feared their activities to be threatened by injuries and diseases. Also noticeable were the indicators for high psychological stress amongst these professionals. Migraine and high blood pressure, for instance, could draw the attention to psychological stress.

A dubious 25% coped with stress by consuming alcohol. These factors show that the psychological impact has probably been underestimated up to now and suggests the assumption, that mental well-being of a large proportion of the investigated dance teachers was impaired. Here is a contradiction between the self perception of the respondents and the findings that clearly show that the psychological demand in this profession should not be underestimated. Therefore, further research on the state of mental health of dance teachers is recommended.

Limitations of the Study

A questionnaire-based survey requires a reliable completion of questionnaires by the subject group. The assurance that the data would be evaluated anonymously may have encouraged candor in this survey. In addition, most of the dance teachers had never participated in a questionnaire survey which may have favoured the study. The tendency to minimize physical problems cannot be completely excluded and, therefore might have influenced the results. Neither the response rate that was within the normal range nor the clarity of the survey questions were limitations due to the pre-test that had been done.

Conclusion

The aim of this pilot study was to represent an overview of work related problems among dance teachers with emphasis on physical health. The results show a variety of health problems resulting from mental stress and physical strain dance teachers are exposed to and should not be underestimated. Furthermore, the results indicate an existing demand for research in this diverse profession that is characterized by a variable field of activities and target groups. The correlation between exposure and disease as well as the potential of this profession to protect from injury should be clarified with a differentiation of the dance pedagogic activities should be taken into account.

Author Note: Due to the research design, neither permit from the Ethics Committee nor from the Institutional Review Board was required.
References


Lehrkräften am Beispiel der Tanzpädagogik. Sportverl Sportschad, 26(1), 49-56.


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Music as a Cognitive Stimulant to Increase Athletic Performance

Michael R. McGann

Numerous studies have looked into the correlation between the brain and the stimulus of music. Many of those studies have concluded that music not only activates the auditory area of the brain, but also the areas of the mind that control emotions, motor activity and creative thought. One could then pose the question, does the stimulus of music during athletic participation have a positive influence on increased athletic performance? This question is important because an increase in athletic performance could lead to more successful outcomes through competition. An increase in athletic performance can be directly related to an arousal in the brain in the areas involved with emotion, motor control and creative thought process. Let’s examine these possibilities more closely.

Literature Review

The best way to open this position that music plays the role of a positive cognitive stimulant that increases athletic performance would be to look at the data that has been collected about how the brain reacts to the stimulant of music. In a study conducted by Vinoo Alluri (2011) of the University of Jyväskylä in Finland, it was found that when participants of the study were introduced to real music stimuli, not only were the auditory areas of the brain activated but there were also large scale neural networks active during the stimulation. In these neural networks the researchers were able to discover that the process of the musical pulse activates the motor units in the brain that supports the idea that music and movement are closely related in the way they are processed in the brain. The method by which the researchers were able to assemble this data was through the use of a magnetic resonance imaging machine and using specific algorithms design for this study to measure the activation in the brain when presented with the stimuli of music.

Further, Alluri (2011) found that the limbic areas of the brain that are associated with emotions became active during the presence of the rhythm and tonality processing. It can be assumed that different rhythm rates and tones can trigger different emotions to be felt and or processed when different types of music stimuli are presented. The study also determined that the way the brain processes the timbre activated the same areas of
the brain that are associated with mind wandering, or day dreams if you will, and creativity. What was interesting from this study in comparison to other studies on this subject matter was that, according to Alluri (2011), this was the first study of its kind to actually pinpoint which musical features where processed in the brain and also the areas in the brain in which the musical stimulus were processed.

From Alluri’s work (2011) we can see that the brain processes the stimulus of music in several different types of responses. It has become common knowledge that music plays an integral part in generating specific responses that are intended to be achieved by the listener of the stimuli. Due to the specific responses that an individual gets from being stimulated by music and inference can be made that music plays an integral part in an individual’s everyday life. According to research done concerning the effects of music on an individual’s everyday life it has been noted that music is related to arousal regulation (Czech, Gonzalez, Klein, Lachowetz, & Sorenson, 2008). Arousal regulation has a direct relationship to intrinsic motivation and also mood regulation. This relationship is very important when looking at the relationship between music and athletic performance because there is a very distinct relationship between both motivation and mood as it relates to one's level of athletic performance.

It is difficult to make the generalization that all different types and genres of music affects everyone the same. Individuals have different preferences when it comes to music therefore a positive response to music stimuli is directly related to that individual’s preference. A person’s psychological response to music stimuli is described by Tomas Chamorro-Premuzic (2011) concerning preference in musical taste:

...music fulfils three important psychological functions. Indeed, scientific research shows that people listen to music in order to: (a) improve their performance on certain tasks (music helps us combat boredom and achieve our optimal levels of attention while driving, studying or working); (b) stimulate their intellectual curiosity (by concentrating and analyzing the music we hear); and, most importantly (c) manipulate or influence their own emotional states with the goal of achieving a desired mood state, e.g., happiness, excitement, and sadness.

All three of these factors play a major role in the processing of music stimuli as it pertains to increased athletic performance. The first point, psychological function dealing with performance on certain tasks, is relevant because individuals choose a specific genre of music that they know will trigger the state of arousal needed to perform the task successfully. The second psychological function that deals with stimulation of a person’s intellectual curiosity is important because a person, who is interested in performing a specific task well, will choose a type of music that stimulates the area of the mind needed for concentration and focus.
on that specific task. Concentration and focus are key aspects that pertain to the level of performance achieved at its highest level. And the third and final psychological function dealing with the manipulation of emotional states is probably the most important of all three because it triggers the level of arousal. An individual who wishes to perform well athletically must reach a certain state of arousal and be able to maintain that level to continue to perform well.

The inference can be made that music can employ the arousal response, therefore it is important to look at the arousal response and how it relates to athletic performance. According to the Yerkes-Dodson Law (2014), athletic performance can be increased with physiological and or mental arousal. This relationship holds true up to a certain point when according to the law the response of arousal becomes too high and an individual will see a decrease in their performance. This law is graphed out on an inverted-U diagram showing the direct relationship between levels of arousal and how it affects athletic performance.

![Figure 1. Hebbian Version of the Yerkes-Dodson Curve (2014).](image-url)

Figure 1 illustrates the inverted-U theory of the Yerkes-Dodson law. The information that this graph presents is the direct relationship that arousal both somatic and cognitive has on performance.

If the arousal response has not yet been initiated, performance outcome will remain low. For example, a person who is sitting in a relaxed position not doing much of anything, has a low arousal response. His performance will not change because there is no desire to get do anything that requires performance.

At the peak of the inverted-U, when both arousal and performance meet at their highest point, an individual will notice their athletic ability being used to its fullest potential. Many athletes who have commented on their play have referred to this point as being “in the zone”, and this is described as the point where they were maximizing their physical abilities.
while not using much cognitive strength to support it, meaning that their play was a result of reaction not thinking. This is the point that all athletes strive for when they are involved in competition because this is the point where they can achieve the highest point of personal performance.

An athlete has a fine line of arousal and performance because too much arousal will in turn impair performance. This is shown in Figure 1 when the arousal rate starts to increase and performance starts to drop. If the arousal response level rises too quickly, the cognitive state slowly turns into anxiety. And, with the introduction of anxiety, the athlete experiences the symptoms associated with anxiety and impaired performance because of those symptoms.

After taking a look at the Yerkes-Dodson law inverted-U model and how it relates the rate of arousal with the increase at athletic performance, it may be important to then take a look at the two types of arousal. The two types of arousal that occur in the human body include somatic and cognitive. Somatic arousal deals with how the body reacts to the anxiety brought on by certain tasks, and cognitive arousal deals with how the mind reacts to the same anxiety from the same task. Brian Mac of BrianMac.co suggests that “Competition can cause athletes to react both physically (somatic) and mentally (cognitive) in a manner which can negatively affect their performance abilities. Stress, arousal and anxiety are terms used to describe this condition” (Mac, 2013). Therefore athletic performance is based on the performance of the individual when put into situations where competition is the foundation of the tasks presented to that individual. Competition will bring about the specific reactions associated with stress, arousal and anxiety. Athletic performance is determined by whether or not the individual responds to these intrinsic and extrinsic factors and reaches a plateau between their own individual potential and these factors.

An athlete will face more external and internal factors associated with stress, arousal and anxiety during competitive games more than they will during practice like competitions. This is just the nature of competition. According to Elizabeth Quinn from About.com/Sports Medicine “Performance anxiety in sports, sometimes referred to as ‘choking’, is described as a decrease in athletic performance due to too much perceived stress. Perceived stress often increases in athletes on game day because (1) they have an audience and (2) they have extremely high expectations of their success” (2013). The problem in athletics is that with practice, a team or individual is supposed to practice the situations that are part of the perceived stress of a game. This is supposed to better prepare the athletes for the unexpected factors that could influence their athletic performance due to the irrational fear and anxiety that might come upon them during game competition. The problem is that it is almost impossible to prepare for every last detail that could possibly affect the outcome of a game and therefore the perceived stress will always be present because of those unknown situations that may occur.
An August 2012 article in Sports Illustrated was centered on the upcoming 2012 college football season and the conference realignment that included the Texas A&M University football program competing in its inaugural season in the Southeastern Conference. The title of this article was “Listen Up, SEC: A Music Loving Coach Wants To Move To A Tempo That Won’t Permit You To Catch Your Breath.” Elizabeth McGarr wrote in the article “Not only have the Aggies moved over from the Big 12, but they also have a new coach, Kevin Sumlin, who brings to College Station a go-go attack, a revamped defensive scheme and a musical approach (tunes over the loudspeakers during practice!” (McGarr, 2012). Coach Sumlin is bringing a new technique to his program in order to achieve unprecedented success as a new member of one of the best college football conferences. And, the new technique has to do with the providing musical stimuli to stimulate his players cognitively and, hopefully in turn, create an increase in athletic performance.

The new technique that Coach Sumlin employed by introducing music into his football practice is almost unprecedented, especially in playing the music throughout practice. The research on the use of music as a cognitive stimulant to increase athletic performance suggests why Coach Sumlin employs this technique.

Although this technique may seem to be unorthodox at best there is obviously data that supports the reasoning behind this decision. First, there is the study conducted in connection with observing how the brain responds to music stimuli. The study, discussed earlier, concluded that the reaction of music in the brain closely mimics the responses of motor movements, meaning that music stimuli and movement are closely related to how they are measured in the brain. This is probably the reason that dancing is a common reaction to music. This same study was also key in determining that different rhythm rates and tones were responsible for activating the areas in the brain that control emotions, meaning that different types of music with specific rhythms and tones could potentially trigger emotions that are associated with them. This could tell us the reason behind why we choose as individuals to listen to a specific genre of music associated with the emotions being felt at that particular time.

This then leads to the next topic concerning the reason why certain genres of music are chosen at specific moments. A person who intends to reach their maximum potential in regards to athletic performance will follow the three basic psychology functions to choose the specific genre of music, as suggested in the article by Chamorro-Premuzic. These functions include better performance on certain tasks, stimulation of intellectual curiosity, and manipulation and/or induction of a certain emotional response. Therefore it can be suggested that individuals who are competing in athletics and want to compete at a high level will choose a genre of music that will help satisfy all three functions.
These three functions then fall under the Yerkes-Dodson law and the inverted-U theory as it relates to the relationship between stress, arousal and anxiety. As an athlete begins the process of preparing to compete, they usually display behavior associated with getting “psyched up,” which basically means that they are beginning at the bottom of their arousal level. The whole process of getting “psyched up” mentally is designed to reach the peak of arousal shortly before or shortly after the competition starts. For an athlete it is important to reach this peak at the time of competition in order to be able to compete at the highest level and in turn be successful. Music is used in this task of reaching the peak of the inverted-U because it is used to perform better at the task at hand such as the upcoming competition. Athletes want to stimulate their brains in order to prepare for the upcoming task. This can vary from athlete to athlete, for example some athletes use music as a way to block out distractions to maintain focus on the task and some athletes use the music to visualize the perceived stress associated with the task. And finally athletes use music as a way to manipulate their emotional response to the upcoming task. This also varies from athlete to athlete, because as individuals we all respond to perceived stress differently meaning individuals will find music that helps them reach that emotional equilibrium before the task starts.

Conclusion and Future Study

This review suggests it would have been only a matter of time before the technique of using music as a cognitive stimulant throughout a competitive practice became common. It just so happened that Coach Sumlin and the Texas A&M University football program caught on before everyone else and set the precedent. It is hard to determine how and why Coach Sumlin introduced this technique in his first year as head coach of the Aggie football program, but the success of the football program during the 2012 college football season was unprecedented. After making the transition to the Southeastern conference, the Texas A&M football team had a record of 11 wins and two losses, their best record in 10 years, and they finished with a final Associated Press ranking of five.

Obviously many factors determine the success of an athletic team and or individual, but to look at how things are done differently from an outside perspective can shed some light on the process of finding success. This is how we can look at the implementation of music during practice. Before the Sports Illustrated documented the technique being used by Texas A&M, it would be hard to find a program that followed suit. There had to have been a thought process for implementation. To draw the conclusion that the music was used to stimulate the players throughout the duration of practice in order to keep them mentally stimulated and focused might be a stretch, but this unprecedented technique was accompanied by unprecedented results on the field. Of course this is a single case of one team and more studies should be conducted in order to determine the overall
effect of music during practice, but the precedent has been set and college football is a game of copycats. Likely it is only a matter of time before this technique catches on.

References


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The topic of concussions and the management of sport-related concussions is something that is surprisingly underappreciated. It is astounding the number of athletes who suffer from concussions and even more impressive is the number of those concussions that go unnoticed until they become serious medical emergencies. With the increasing awareness of the dangers of concussions, it is vital that the mindset on this traumatic brain injury be swayed. We are learning more everyday about the dangerous effects of concussions, especially those that went untreated or ignored. By implementing stricter concussion legislation we can help limit the number of serious brain injuries from sports. In order for us to do this we must first teach everyone, from coaches to parents to children, the seriousness of concussions and the dangers of continuing to play with concussions.

I will first provide some general knowledge about concussions, specifically concussions and concussion management in sports. Next I will outline the different positions on the subject and explain why I think it is best to educate anyone who may come into contact with concussions and enforce stricter legislation. I will then introduce some ideas and suggestions for taking action and directing further research and action. It is difficult to recognize something that you don’t know about so I believe education is the key in protecting athletes. I also believe providing nationwide legislation about concussions will increase the benefits and decrease the number of players suffering from game, season, or even life ending brain and cervical spinal cord injuries. Stricter legislation and education requirements can greatly reduce and someday eliminate severe traumatic brain injuries caused by numerous concussions.

It’s surprising to see how slowly the term concussion has entered the sporting world. Almost everyone you pass on the street can tell you of a professional football player or even an average high school kid, who had their life all but destroyed by suffering too many concussions. The National Athletic Trainers’ Association released their position statement on the Management of Sport-Related Concussions in September of 2004, which included recommendations for defining and recognizing concussion (2004). This article stressed that as participation increases, so does the responsibility to minimize the risks of injuries. Going from 1968, when there were 36 brain and cervical spine fatalities in high school and collegiate football reported, to an average of 5 a year since 1990, shows us that steps are being taken to protect player. But, we still have room for improvement (NATA Position Statement, 2004).

How are concussions defined and when do they become “dangerous”? According to the American Medical Society for Sports Medicine position statement on concussion in sport, a concussion can be defined as, “a
traumatically induced transient disturbance of brain function and involves a complex pathophysiological process. Concussion is a subset of mild traumatic brain injury (MTBI) which is generally self-limited and at the less-severe end of the brain injury spectrum” (Harmon KG, et al. 2012). The main issues arise when: a player doesn’t report concussion symptoms, a player returns to play too soon, or a player receives numerous concussions in a short period of time. It is important that anyone who supervises players with a concussion is properly trained to handle it. We are seeing more and more young children suffering from second-impact syndrome because they did not tell anyone about their concussion symptoms and continued playing.

According to Ziegler (2012), second impact syndrome occurs when the athlete suffers a second brain injury before the brain has fully recovered from the first. This often happens when athletes return to play after suffering a concussion because they did not tell anyone about the concussion. There are countless stories across the nation that tell of the dangers of second impact syndrome. Kort Breckenridge’s story is one of them. Kort recalled hiding his concussion symptoms from coaches and parents and telling his teammates to keep his secret as well so he would be allowed to play on his senior night. That same senior night he collapsed on the sideline and began seizing. Doctors had to perform a crainectomy, which left him with slurred speech, a limp, difficulty staying on task and limited short-term memory (knowconcussions.org). A large majority of these devastating stories lead to paralysis and a response is often a change in legislation. As Ziegler’s acknowledge, such stories have pushed to make sports safer for athletes.

Concussions are not only seen in football and contact sports. The research behind concussions, while evolving quickly, is still behind the times. According to an article in Health News by Linda Carroll, while parents and coaches are just becoming more educated on concussions in collisions sports, there are an increasing number of concussions occurring in a variety of other sports. This article brought to light the story of MLB player Ryan Freel, who was found to have concussion-related brain changes. The concussions were not necessarily suffered in baseball but all of his concussions combined were thought to lead to his depression and eventual suicide. Concussions happen more readily in football but that does not limit them to football. Carroll’s article also touches on the importance of parents understanding that concussions must be properly managed to prevent long-term damage.

It is also important to realize that concussions are more serious when suffered by younger athletes. In a story featured on the CNN television news program, 17-year-old Max Conradt suffered numerous concussions over a period of weeks, and now has to live with the mental capacity of a 9-year-old (Smith, 2010). The Centers for Disease Control and Prevention (CDC) reports that United States emergency rooms treat an estimated 173,285 sports and recreation related traumatic brain injuries in children aged birth to 19 years per year. This statistic has increased by 60% in the last decade (CDC, 2011). Simply knowing what to look for and how to deal with concussions can help tremendously. To assist CDC has developed the Heads Up: Concussion in Youth Sports initiative. This program provides
information to coaches, parents, and athletes in youth sports regarding concussions. This training and information is provided for free by the CDC.

With all of the initiatives and horror stories about concussions, it seems as though we should be experiencing less and less instances. While the CDC and other organizations have provided things such as the Head’s Up initiative, there is little legislation enforcing the proper treatment of concussions. While a majority of the states have legislation enforcement lags behind. There are still a few states that do not have any sort of legislation concerning concussions. Even when there is legislation, there are still too many examples of improperly treated concussions that lead to extreme and permanent brain damage. Often, it is only after an adolescent or young child is severely injured that legislation is changed. Texas has Natasha’s Law. Athletic trainers are required by this law to be trained. Coaches are also required to go through concussion training, yet many coaches don’t have the health of a child in mind as much as winning the game.

Roger Goodell, National Football League (NFL) Commissioner, has also urged state governors to initiate concussion legislation (knowconcussions.org). Information on this website was to provide knowledge on the symptoms and facts of concussions. The three main aspects of ideal concussion legislation, as found on this site, were to: mandate educational outreach to coaches, parents, and athletes, mandate immediate removal from play of any athlete who sustains a concussion or exhibits signs, symptoms, or behaviors consistent with the injury and to only allow those athletes to return to physical activity after receiving written clearance from an appropriate health care provider trained in concussion assessment, and require parents to sign an acknowledgement form prior to allowing their child to play contact sports (knowconcussions.org)

Concussion legislation is becoming a more common and its importance is being clarified. In 2013, 49 states and the District of Columbia had legislation on concussions (Children’s Safety Network, 2013). According to the CDC, Washington was the first to pass a concussion in sports law, modeled after the story presented by Zeigler about Zackery Lystedt. Oregon followed, passing Max’s law that was modeled after Max Conradt’s incident.

However, not everyone realizes the seriousness of concussions. In a study by Chrismas, Quitiquit, and Rivara about barriers to concussive symptom reporting in high school athletics, it was found that although athletes demonstrated knowledge of concussions, their symptoms, and long-term dangers, they would continue playing. Some of the barriers found in reporting the concussions symptoms included coach approachability, communication, and absence of significant pain or disability. The athletes did not report their symptoms, not because they were unaware or not knowledgeable about the topic, but rather because of communication issues. In this study it was suggested that communication coaching might increase symptom reporting.

Another situation where concussion symptoms may go unreported is in professional or higher level sports, where missing a game means missing a paycheck. In an article by John Branch about the death of
hockey star Dereck Boogaard, researchers determined that the 28-year-old had chronic traumatic encephalopathy (C.T.E.), believed to be caused by repeated blows to the head. Researchers were astonished to find such extensive damage in such a young brain. The NHL doesn’t believe there is enough data to draw conclusions about blows to the head but researchers at Boston University say there is little debate that C.T.E. is caused by repeated blows to the head. While the NHL has enforced stricter policies such as examining suspected concussions in a “quiet” room and banning blindside hits to the head, they have no intention of ending fighting on professional hockey. Situations such as this one don’t mean that we must stop any and all activities that may lead to a blow in the head, but rather that we need to educate on the dangers of these blows and the proper way to handle them to limit the destruction that is occurring to the brain.

The NFL has, on the other hand, gotten on board with new concussion education. There has been a growing amount of research done on professional football players and the impact of concussions suffered while playing later in life. Didehbani, Cullum, Mansinghani, Conover and Hart (2013) studied the relationship between a history of concussions and current symptoms of depression in retired professional athletes. Comparing the depressive symptoms of professional athletes with a history of concussions to controls of similar age and IQ without a history of concussions showed a significant correlation. Using the Beck Depression Inventory, it was determined that NFL players who had the history of concussions suffered from more symptoms of depression compared to matching controls.

There have been a number of other NFL players who have suffered similar consequences from repeated blows. Junior Seau played for twenty years in the NFL and was never diagnosed with a concussion. This is where concussion education and recognition comes into play. Upon examining Seau’s brain postmortem, the National Institute of Health found evidence of C.T.E., exactly as was found in Boogaard’s (Cummings, 2013). So how does a professional football player who never missed a game due concussion symptoms get diagnosed with the same degenerative brain disease as a NHL enforcer who suffered from hundreds of blows to the head? It could be because team physicians did not know the signs and symptoms of concussions, but that’s highly unlikely. A more probable answer is that the people in charge of making playing decisions were uneducated on the seriousness of concussions. A large number of former professional football players are allowing their brains to be autopsied upon death, and are being found to have suffered from C.T.E.

Shortly before the start of the 2013 NFL season, a court decision awarded $765 million to retired players who demonstrated concussion-related brain injuries (Irell & Manella LLP, 2013). The awarded money in this “historic agreement” goes to provide medical benefits, injury compensation, medical and safety research, and to cover litigation expenses. Roger Goodell, commissioner of the NFL said that, “this is an important step that builds on significant changes we’ve made in recent years to make the game safer, and we will continue our work to better the long-term health and well being of NFL players.” This court case awarded $10 million to a research and education fund. I believe this is a major step,
having one of the most popular and most commonly affected sports in our nation, backing the fight to educate about and research concussions. According to the press release, the $10 m is to go to medical, safety, and injury-prevention research, including initiatives in youth football.

If professional sports teams were to implement stricter concussion policies there is concern about payment and monetary issues. Because of new research and initiatives to increase safety in athletics, I believe professional athletes who suffer concussions should still get paid during their time away from the sport. This would not only be the right thing to do but I think it would also increase the instances where players actually report their symptoms. In the sports world today, concussion is a swear word. It’s not to be mentioned unless absolutely necessary. But doctors shouldn’t be holding back their true diagnosis because of a fear of an athlete missing a game. Athletes need to realize that it is better to miss one game than the entire season, or even their life. With all of the research that has been done involving concussions, there is increasing awareness of the dangers. The difficult thing about this is that while concussions are a very real thing, they are difficult to formally diagnose.

With the growing number of concussions and awareness that concussions can be deadly, it is important that our education and response matches that growth. Educating everyone from coaches, to athletes, to parents, and even teachers, about the seriousness of concussions could help save a life. As mentioned previously in my findings about concussions, often concussions go unreported. People in positions of power such as professional athletes need to back concussion research and initiatives. This is important because those are the men and women that children look up to. Concussion symptom education must start at a young age and there is no excuse for any athlete to have a life ruined or even a life lost because a concussion went unnoticed or untreated. By educating the nation on these dangerous brain injuries we can ensure a safer level of play. Educating parents of athletes can ensure that they know the risks and that they know what to look for. A large majority of high schools in our nation do not even have medical personnel readily available for contact sports. If we educate our coaches and parents, they can be the first line of defense.

Ensuring nationwide legislation for concussions is the best way to get everyone on the same page. By implementing laws that dictate what a concussion is considered to be, when it is unsafe for a player to return to activity, and when it is safe for a player to return to normal activities, we can avoid a large number of these injuries. By enforcing legislation we can ensure that we are doing our best to limit the number of minor brain injuries that turn into major brain injuries. With this legislation comes education. In order to develop and support this strict legislation we first need to educate everyone on the dangers of concussions and the importance of minimizing them. Legislation on concussions can also make decisions easier than in previous years because, instead of leaving the call to judgment, there are set ground rules for dealing with concussions. I challenge all of you reading this paper to go educate yourselves on concussions. Learn what a concussion is and what the concussion legislation is in your state. In this way, maybe you can prevent a child from suffering serious brain damage
and we have changed one person’s life.

References


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Are Steroids Harmful to Health?

Cary Lanzoni

Steroid usage is becoming increasingly more prevalent in today’s society. Steroids are being used not only in professional sports, but also among Americans in general society. Steroids are being used for many different purposes. Athletes use steroids for performance enhancing properties. It is believed that anabolic steroid use is widespread in competitive body-building. Anabolic steroids are also used, especially by men, to change their body shape towards more muscular physique. Though anabolic steroids are banned under the Anabolic Steroid Control Act there are medical uses under the direct care of a physician. Some of the medical uses of anabolic steroids are: treating delayed puberty, some types of impotence, wasting of the body due to such conditions as HIV, some types of anemia, osteoporosis (brittle bones in menopausal women), and for itching caused by a liver condition called primary biliary obstruction (Kennard, 2006). After looking at some of the uses of steroids the question remains: Are steroids harmful to health and well-being? The position taken here is that steroids are harmful to overall health, but could have health benefits in the later years of life.

History of Steroids

The history of steroids can be traced back to the original Olympic Games. Early Olympic athletes, those we call the fathers of modern athletics were known to ingest animal testicles before a competition, sometimes for extended periods before their meet was to take place. In doing this they were actually increasing their testosterone levels through a natural source. In most cases they probably did not understand the mechanisms of this diet.

To trace the history of steroids in more recent times we start in 1931 with a German chemist, Adolf Butenandt. Butenandt first found a way to pin-point and purify the hormone androstenone. Fellow German chemist Leopold Ruzicka developed a means to synthesize the hormone, making it safer for human use. Shortly after this breakthrough, in 1935, Ruzicka along with Butenandt compounded the first batch of synthetic testosterone. This discovery was so profound that both Butenandt and Ruzicka were awarded the 1939 Nobel Prize for their work in chemistry. As research continued in the late 1930’s the first injections of testosterone-propionate were administered to humans. By the 1940’s anabolic steroid
use in the Soviet Union was becoming common place. During the 1940’s the Soviet Union was the dominating force in athletics thanks to anabolic steroid use but this dominance was short lived as Dr. John Ziegler, the U.S. Olympic team physician, found a way to develop methandrostenolone, also known as Dianabol or Dbol (STEROID.COM, 2014).

Following this discovery and evolution of the drug, steroids continued to evolve and pervade sports everywhere. Olympic athletes were using steroids despite the International Olympic Council having banned the use of anabolic steroids. In 1972 the International Olympic Council began implementing a full-scale drug test program for all athletes (STEROID.COM, 2014). In 1990 US Congress passed the Steroid Control Act, prohibiting non-medical use of anabolic steroids. Those opposed to this decision were: The Food and Drug Administration, The American Medical Association, and The Drug Enforcement Administration. All three of these organizations testified that steroids were not addictive and did not meet criteria for becoming a controlled substance. Despite this opposition Congress passed the Steroid Control Act (Lofft, 2011). Since the Steroid Control Act of 1990 steroids continued to evolve and spread into every major sport. They have even overflowed into the youth of today.

**Benefits of Steroids**

There are two different types of steroids: anabolic steroids and corticosteroids. Anabolic steroids are synthetic versions of hormones that the body produces naturally. Doctors use corticosteroids to reduce inflammation but use anabolic steroids to build muscle. When an athlete trains intensely, natural levels of testosterone in the body drop drastically, and in some cases to levels of a castrated man. The body also releases another hormone called glucocortico to reduce inflammation. Glucocorticoids also have a catabolic effect, meaning they break down muscle tissue. This is a double negative against the body in that there is a drop in testosterone levels and an increase in muscle wasting hormone. It is speculated that steroids affect the hormone imbalance in two ways. First, they may replenish testosterone levels after a workout, accelerating muscle repair. They may also block the muscle wasting effects of glucocorticoids. The result is a muscle that quickly gets bigger and stronger (Lofft, 2011).

The benefits for athletes are tremendous. Charles E. Yesalis stated “These drugs will take you places that you can lift for fifty years and you will never get to naturally……they are that potent” (Lofft, 2011). So what happens when an athlete takes anabolic steroids? When an athlete engages in a stressful workout the muscle fibers are torn. The body naturally repairs these muscles with a process known as protein synthesis. The result is a bigger, stronger, faster muscle. When steroids are added into the body muscle repair can come faster. A normal person takes up to 48 hours to repair torn muscle tissue. With steroids, instead of taking 48 hours, it may only take 24 hours, thus giving the athlete the ability to work out
more frequently, longer, more intensely, and then recover faster so they
can work out again in a shorter time frame (Lofft, 2011). In 1988, Ben
Johnson won the gold in the 100 meter dash shattering the world record.
Ben Johnson’s urine test tested positive for anabolic steroids (Lofft, 2011).
This is one of the first events that really showed the world that athletes can
gain a performance benefit from anabolic steroids.

Harmful Effects of Steroids

Although there are some benefits to taking these drugs there are also
very harmful side effects. Most side effects are dose dependent meaning
high dosages could produce greater side effects. Some of the side effects
are cardiovascular effects, hepatic effects, endocrine effects, urologic
effects, hematologic effects, and dermatologic effects (Kishner, 2013).

The most common deleterious effects of anabolic steroid use are on the
cardiocirculatory system. They include increased heart rate, increased blood
pressure, and changes in lipid metabolism, including lowered high-density
lipoprotein (HDL) and increased low-density lipoprotein (LDL). The
increase in heart rate is thought to be more profound with the androgens,
especially those resistant to aromatase, and is believed to be due to the
inhibition of monoamine oxidase (MAO). This effect, when combined with
the increased renal recovery of ions, such as sodium, causing subsequent
fluid retention, can lead to dramatic increases in blood pressure. Combine
this with a tendency to lower HDL and raise LDL, and the stage is set for
untoward atherogenic and cardiac effects. Anabolic steroid users can have
a lower left ventricle ejection fraction. Anabolic steroid abuse has been
associated with ventricular arrhythmias (Kishner, 2013).

Some of the hepatic side effects of anabolic steroids are suppression of
clotting factors II, V, VII, and X, as well as an increase in prothrombin time.
Another life-threatening, albeit rare, adverse effect that is seen in the liver
and sometimes in the spleen is peliosis hepatitis, which is characterized
by the appearance of blood-filled, cystic structures. These cysts, which
may rupture and bleed profusely, have been found in patients with near-
normal liver function test (LFT) values, as well as in individuals who are
in liver failure (Kishner, 2013).

The endocrine effects of anabolic steroids have also been shown to alter
fasting blood sugar levels and decrease glucose tolerance, presumably
due to either a hepatic effect or changes in the insulin receptor. Thyroxine-
binding globulin (TBG) may also be lowered by anabolic steroids and
result in lowered total T4 levels, with free T4 levels remaining normal.
An up-regulation of sex-hormone binding globulin, with a concomitant
decrease in TBG, is thought to cause the changes in total T4 levels. The
aromatization of testosterone to estradiol and related compounds can
render many adverse estrogenic effects. The most apparent and common
adverse effect is the growth of tender, estrogen-sensitive tissue under the
male nipple. This unsightly growth is termed gynecomastia (Kishner,
Urologic effects of anabolic steroids are that the male prostate is very sensitive to androgens, especially those that are reduced in prostatic tissue to dihydrotestosterone (DHT) or DHT analogs. In response to this stimulation, the prostate grows in size, potentially causing or exacerbating benign prostatic hyperplasia (BPH). Worsening BPH may indeed cause severe bladder and secondary renal damage (Kishner, 2013).

Hematologic effects of anabolic steroids cause increases in hemoglobin and hematocrit and are used in many cases of anemia, although the clinician must be aware of the potential for polycythemia (Kishner, 2013).

Finally, the last side effect mentioned is dermatologic effects. Skin, especially the face and scalp, has a high degree of androgen receptors and 5AR. DHT is known to cause increases in sebum production, leading to clinical acne. Also, male pattern baldness is related to scalp DHT production and binding, along with genetic factors influencing hair growth. Male pattern baldness is greatly exacerbated by most anabolic steroids in susceptible individuals (Kishner, 2013). This can occur in both male and females. On conclusion, anabolic steroids have many harmful and potentially life threatening side effects.

**Discussion**

After reviewing the history, benefits, and harmful side effects of anabolic steroids the question becomes, is the risk worth the benefit? I believe that anabolic steroids have their place in this world under the correct circumstance. The research above definitely shows that the potential life threatening risk does still exist. For overall health and wellness purposes I believe that anabolic steroids are more harmful than useful to the body due to the side effects. However, this also depends on dosage. Studies do show positive effects in the middle age male. This can be important in that as males start to age we could see less aging effects with the use of testosterone replacement therapy. The problem with this research is that there is a lack of research. It is unethical to conduct a study giving research participants anabolic steroids. Charles E. Yesalis related that he is more concerned with alcohol, tobacco, methamphetamines, and cocaine than he is with anabolic steroids. Also there are no studies that concluded anabolic steroids are the main cause of death in people who used them. There is much speculation that they are the cause, but there is no scientific proof at this time.

For a healthy individual anabolic steroids have no room in a healthy lifestyle. In fact, I would argue that they are unhealthy because of the side effects that they cause. Taking anabolic steroids is considered to be self-medicating and potentially dangerous in extremely high dosages. The key to living a healthy lifestyle is to exercise and maintain a healthy diet. Natural bodybuilding has emerged in tremendous numbers in recent years but is still tainted by those who use steroids. In conclusion, the
health effects of anabolic steroids on the body are not of natural body function. The health risk outweighs the benefits of steroids, but could have positive effects in the aging male in later years in life. More research still needs to be conducted on this subject matter in order for it to become clearer and understood.

References


STEROID.COM. (2014, February 23rd). Retrieved from The Most Visited Anabolic Website: www.steroid.com

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Abstracts of the Student Research
Poster Presentations

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Stretching is a popular warm-up technique when preparing for physical activity. The current debate is between static stretching (SS) and dynamic stretching (DS) when used for movements involving explosive power. **PURPOSE:** To investigate the acute effects of (SS), (DS), and no stretching (NS) on vertical jump height in moderately active Caucasian college male students (weight 72.6 ± 9.4 kg; height 178.3 ± 4.4 cm; age 19± 0.6 yrs). **METHODS:** 6 subjects were randomly divided into 3 groups and performed each stretching technique in a different order on 3 successive days to reduce a learning curve. Subjects completed 3 stretch treatments SS, DS, and NS each on different days. SS & DS included a 5-minute stretch period with 5 stretches for the respective stretching technique. Subjects then performed three stationary jumps on a Vertec vertical jump machine; SS (55.6 ± 5.6 cm), DS (57.4 ± 6.9 cm), and NS (53.3 ± 7.4 cm). All 3 jump heights were recorded and averaged to reduce variance due to a learning curve; however, no learning curve was observed between the 3 jumps. **RESULTS:** Using a repeated measure analysis variance test, none of the 3 stretching techniques significantly affected vertical jump height \((p = .187)\). **CONCLUSION:** The findings suggest there is no difference between SS, DS, and NS on vertical jump height \((p > 0.05)\). Results maybe skewed because of the subjects used, ex. individual participation in club sports, previous sport performance, and activities done during testing period.

**Key Words:** Static, dynamic, stretching, moderately active, vertical jump height.

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**Introduction:** Motivation is a key factor in initiating and adhering to physical activity. Understanding the motives for exercise across the lifespan may help exercise science professionals develop more effective interventions and programs to better help individuals adopt and adhere to regular exercise programs. **Purpose:** The primary purpose of this study was to determine if motivational factors to engage in physical
activity vary across different age groups. **Methods:** Twenty participants were obtained from a campus fitness center of a mid-size university and twenty-two from a 24-hour commercial fitness center for a total of forty-two participants among varying age groups. The participants were administered a survey packet asking about their motivation and barriers for physical activity and included The Reasons for Exercise Inventory (REI; Silberstein, 1988) which is a 24-item, 7 sub-scale Likert-scored scale that evaluates motives for exercising. The participants were also asked to rate the importance of each motive and a variety of questions in regards to motivations and barriers to exercise created by the researchers. **Results:** An independent t-test showed that there was a significant difference between age groups in intrinsic motivation. Non-college age proved to be more intrinsically motivated, whereas the college-age individuals were more extrinsically motivated. The non-college age individuals scored higher in weight, fitness, mood, health, enjoyment, and muscle tone as reasons for exercise. College-age participants scored higher in the attractiveness reason. **Conclusions:** These results reinforce previous research indicating motivation toward physical activity appears to be associated with different stages of the adult lifespan.

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**The Effects of a 5-Minute Nonspecific Warm-up on Sit-and-Reach Flexibility**

*Brandy Clough*

*Truman State University*

Flexibility provides an increased range of motion and is purported to potentially reduce the risk of injury. Limited information exists, however, on the effect of pre-flexibility activity on the range of motion during a flexibility movement. **Purpose:** To determine the effect of a 5-minute nonspecific warm-up on sit-and-reach flexibility. **Methods:** 11 subjects (5 F, 6 M), ages 18-22 yrs, volunteered to participate. On day-1, subjects stretched for 15 seconds by performing toe touches, followed by 5 minutes of quiet sitting before performing a sit-and-reach test. On day-2, subjects repeated the same 15 seconds of toe touches, followed by a 5-minute ride on a stationary bike (at a self-selected pace that produced slight breathlessness) before completing a final sit-and-reach test. **Results:** The sit-and-reach distance on day-2 was 0.4 ± 0.3 cm greater (p<0.001) than on day-1. There was no significant difference between men and women in any of the flexibility measurements. The difference was equivalent to a 36 ± 52% improvement. Ten of the 11 subjects made positive gains in flexibility after the warm-up. **Conclusion:** This study supports the hypothesis that a non-specific leg warm-up will offer a slight improvement in sit-and-reach flexibility. A warm-up procedure may benefit people who are trying to increase their hamstring and lower back flexibility and suggests that individuals performing flexibility maneuvers following an exercise period are likely to receive greater benefit.

**Key Words:** dynamic performance, gender difference
Educational Background and its Effect on Dental Health
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Truman State University

Introduction: Dental health has become an easily overlooked area of health. Studies have shown the majority of people do not adequately practice dental hygiene, which leads to periodontal disease and general health problems. The American Dental Association reported only 56.8% of American females and 49% of males brush twice a day. Purpose: The purpose of this study was to examine how college students’ educational background affected their current dental health behaviors, knowledge, and attitudes. Methods: A 49-item survey was administered to 513 college-aged undergraduates attending a small, Midwest liberal arts university regarding their dental health behaviors, knowledge, and attitudes. Participants included 69.3% (n=354) female and 30.7% (n=157) male individuals. Results: The data collected from a Kruskal-Wallace test suggested no correlation between educational background and dental health behaviors, knowledge, or attitudes. An ANOVA test indicated a positive dental health attitude had a strong positive correlation (p=0.00) with regular dental checkups and vice versa. A Kruskal-Wallace test suggested no significant difference in dental hygiene behaviors between rural and urban backgrounds. Conclusion: These results suggest the participants practiced minimal dental hygiene, but failed to prioritize other areas of dental hygiene. As indicated by the data, there is no effect on dental hygiene behaviors in regard to educational background. Results suggest a higher dental attitude correlates with individuals who receive regular dental check-ups and cleansings. The data implied no effect on dental hygiene behaviors based on rural and urban backgrounds.

Key words: undergraduate college students, dental, dental health, dental hygiene, educational background

The Relationship between Physical Education Pre-service Teachers’ Teaching Styles and Value Orientations
Catherine Krebs
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The purpose of the study was to determine the relationship between pre-service teachers’ (PTs) teaching styles and value orientations. Participants included 26 PTs (16 males 10 females) enrolled in a middle physical education methods course at a regional university in Midwestern United States. The Grasha- Riechmann Teaching Style Survey and Value Orientation Inventory- Short Form (VOI-SF) were used for data collection. The Teaching Style Survey included these subscales: Expert, Personal Model, Facilitator, Delegator, and Formal Authority. The VOI-SF subscales were: Disciplinary Mastery (DM), Learning Process (LP), Ecological Integration (EI), Self Actualization (SA), and Social Responsibility (SR). The data was analyzed using descriptive and inferential statistics. The teaching style with the highest percentage of PTs with high preference was Formal Authority (92.31%) followed
by Delegator (84.62%), and Personal Model (80.77%). None of the PTs indicated low preference for any of the teaching styles. The highest percentage of PTs with high priorities was in DM (46.15%) followed by LP (34.62%). In contrast, PTs showed the highest percentage of low priority in SA (96.15%) followed by SR (46.15%). Pearson Correlation analysis showed significant positive correlation between the Personal Model and EI (r=.521; p=.016), and between Facilitator and DM (r=.438; p=.047). Independent t-Test analyses indicated males and females did not differ in their teaching styles or value orientations. Physical education teacher educators should emphasize the use of varied teaching styles, and the emotional and social aspects of development.

**Effect of Exercise with Music on Immediate and Delayed Hearing Loss**

_Ellyn Poisson, Sarah Englekamp, and Karen Voss_

_Truman State University_

The effect of music on hearing is a controversial issue among adolescents and adults. Despite both negative and positive findings in the literature, adolescents disregard the potential damage associated with loud music exposure and utilize delivery systems that present loud music directly into the ear via ear phones or buds. **Purpose:** To determine the effects of immediate and delayed hearing response to loud music in college-age adults. **METHODS:** College-age individuals (n= 8, age = 19 ± 1 yr) volunteered to participate in two PureTone hearing tests. The hearing test was administered immediately prior to exercise and immediately following a 10-minute stationary bike ride. A 10-question survey was given to understand the exercise and music background of participants. Half the participants listened to music while riding the stationary bike and half did not. **RESULTS:** No significant differences (p>0.05) in hearing levels at 5 different frequencies were noted between the 2 groups prior to or after exercise. There was also no significant difference (p>0.05) on hearing levels immediately after listening to music. Changes within a 5 dB shift were considered as no change in hearing. At higher frequencies all subjects hearing improved. **CONCLUSION:** There was no hearing decrement documented between the PureTone tests prior to and immediately after exercise. Within this study, participants that listened to music and those that did not also displayed no hearing threshold shift.

**Key Words:** Auditory evaluation, sensory perception, deafness

**The Response Of Heart Rate In Individuals With Developmental And/Or Intellectual Disabilities When Performing A Walking Exercise With And Without Walking Sticks**

_Jessie Stout_

_University of Central Missouri_

Individuals with developmental and/or intellectual disabilities need just as much if not more physical activity when compared to individuals...
without developmental and/or intellectual disabilities. **Purpose:** To promote a healthy lifestyle behavior in individuals with developmental and/or intellectual disabilities by comparing the average heart rates with and without walking sticks. **Methods:** For this study, Transformation Health Responsibility Independence Vocation Education (THRIVE) students \((N=20)\) at the University of Central Missouri (UCM) walked 1.5 miles on an indoor track for three different trials without walking sticks, and then 3 trials with walking sticks. Trials took place in an Adaptive Physical Education class setting. Each student wore a heart rate monitor and walked with their student mentors, previously assigned. After each trial was completed, the average heart rate was recorded. The mean of the average heart rates was recorded for the trials with and without walking sticks. **Results:** A paired T-test was used in order to compare the means of the average heart rates. The results indicated that THRIVE students achieved a significantly higher average heart rate 138.3 bpm ±17.8 versus 130.3 bpm ± 14.6 \((p<0.05)\) when using walking sticks. **Conclusion:** Participants achieved a higher average heart rate when using walking sticks, compared to walking without walking sticks. Based on this data, the use of walking sticks may benefit individuals with developmental challenges by safely increasing the intensity of physical activity.

**Examination of Bilateral Deficit in Biceps Flexion Strength**

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Studies have shown that maximal voluntary strength of simultaneous bilateral exertion is typically less than the sum of the unilateral exertions. However, there is some controversy whether a bilateral deficit exist for all exercises. **Purpose:** To determine the degree of bilateral deficit in the biceps curl exercise. **Methods:** Moderately resistance-trained men \((n = 4)\) and women \((n = 9)\) volunteered to participate after having the conditions of the study fully explained. The participants completed unilateral 1RM biceps curls with a dumbbell while the back was supported against a solid surface. Following unilateral testing, participants performed bilateral biceps curls using a straight weight-lifting bar. All curl movements were required to pass through a 90° arc in order to be acceptable. **Results:** Right-arm curl \((14.2 ± 5.2 \text{ kg})\) was significantly greater than left-arm curl \((12.9 ± 5.6 \text{ kg})\), with a strong correlation between the two \((r = 0.95)\). Eight of the subjects had 0% difference between right- and left-arm curl, 5 subjects differed by 28.3 ± 7.3% to produce an overall percent difference of 10.9 ± 14.9%. The sum of right- and left-arm curl \((27.1 ± 10.6 \text{ kg})\) was not significantly different \((p = 0.49)\) from double-arm curl \((26.0 ± 11.9 \text{ kg})\), with a significant correlation between the two \((r = 0.90)\). **Conclusion:** This study illustrated that bilateral deficit may not exist in all exercises. It is possible that in activities where individuals commonly use both limbs, it may reduce the likelihood of a deficit.

**Key Words:** unilateral muscle strength, muscle imbalance
Relationships of Anthropometric Dimensions to Strength Performance in NCAA Division II Wrestlers

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Previous research supports a moderate to strong connection between anthropometric dimensions and muscular strength. **Purpose:** To determine the relationship between selected anthropometric dimensions and strength performance. **Methods:** Seventeen college wrestlers volunteered to be measured during their pre-season for height, weight, 2 muscle circumferences, 2 skeletal lengths and 4 skinfolds. Height was determined using a wall stadiometer, and weight was determined on a certified scale. Flexed arm and relaxed chest circumferences were determined with a standard tape measure. Arm length was measured from the acromion process to the olecranon process, and forearm length was measured from the olecranon process to the styloid process. Skinfolds were measured at the triceps, biceps, subscapular and abdominal area. All measurements were made in triplicate and averaged for analysis. 1RM bench press was determined using free weights. Following adequate warm-up, each wrestler selected a starting weight and performed one repetition. Weight was added depending on ease of completing the single repetition. A minimum of five minutes recovery was given between attempts. **Results:** Arm Circumference ($r = 0.77$), chest circumference ($r = 0.63$), and LBM ($r = 0.65$) were the only anthropometric variables significantly related to 1RM bench press. Multiple regression selected only arm circumference to predict 1RM (SEE = 21.5 kg, CV% = 19.1%). A previous equation developed on athletes produced predicted 1RM values that were significantly related to actual 1RM ($r = 0.82$). **Conclusion:** The results indicate that 1RM bench press can be predicted with reasonable accuracy from anthropometric variables in Division II wrestlers.

**Key Words:** 1RM, bench press, muscle circumferences

Correlation of Body-Weight Endurance Push-Ups and 1RM Bench Press in Male Athletes

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Truman State University

Athletes train with multiple forms of resistance exercise in order to increase and test their muscular strength. They often alternate between exterior-weight resistance and body-weight resistance exercises. Bench press repetitions and push-ups represent one version of this alternation between resistance methods. While these methods have been widely used in average college men, little information is available for college athletes. **Purpose:** To determine the relationship between one-repetition maximum bench press (1RM) and maximum repetition push-ups in untrained men and college athletes. **Methods:** Male athletes ($n = 15$, age $= 19.9 \pm 1.3$ yrs, height $= 177.3 \pm 1.3$ cm, weight $= 82.4 \pm 16.9$) were measured...
for standard 1RM bench press using free weights and for maximum push-ups to fatigue. **Results:** Body weight was the only variable significantly correlated with 1RM ($r = 0.60, p<0.004$), but was not significantly correlated with push-ups ($r = -0.47, p = 0.08$). Height ($r = -0.42$) and weight ($r = -0.47$) were negatively but non-significantly correlated with push-ups. Products of height x pushups ($r = -0.04$) and weight x pushups ($r = 0.35$) were also not significantly correlated with 1RM performance. Using multiple regression analysis to combine push-ups and body weight to predict 1RM produced a moderately accurate equation ($R = 0.74$, SEE = 18.7 kg, CV% = 14.9). **Conclusion:** Maximum push-ups to fatigue do not appear to be an acceptable predictor of one-repetition maximum bench press performance in athletes.

**Key Words:** strength prediction, anthropometry, sports performance

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**The Accuracy of Repetition Prediction Equations to Estimate 1RM Bench Press**

*Dominic Bisesi, Madeline Burnett, Katie Lavery and Cole Epperson*  
*Truman State University*

Lifters frequently estimate 1 repetition maximums (1RM) performance using a submaximal repetition approach. As a result, numerous equations exist to determine 1RM from a maximal repetition performance using a submaximal weight. However, the accuracy of these equations may still be in question. **Purpose:** To determine the accuracy of three 1RM prediction equation to estimate 1RM bench press.  

**Methods:** Participants of varying age, gender, and training experience ($n = 25, 18$ F, $8$ M) initially performed a 1RM bench press. After at least two days of rest, subjects were selected a weight with which they could comfortably performed maximum repetitions. Repetition groups were subsequently determined as: RG1 = 2-5RM, RG2 = 6-10RM, RG3 = 10+RM. Subjects were also divided by training experience: training once/week or performing no resistance training. 1RM was estimated using 3 formulas [GymKit (GK), Bryzcki (BZ), and Elpsy (EP)].  

**Results:** For the entire group, GK was the most accurate (mean difference = 2.3 ± 9.6 lbs). The difference between GK estimates and 1RM were not significantly different among the three repetition groups. In addition, training groups were not statistically different from each other in prediction accuracy ($p>0.14$). **Conclusion:** The 2-5 repetition range appears to be optimal for predicting 1RM, and the on-line GymKit equation was the most accurate. Training did not appear to influence the accuracy of these equations for estimating 1RM bench press.

**Key Words:** muscular endurance, cross-validation, muscular strength
Correlation between Physical Activity Factor and Bone Mineral Density in College-Age Women
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Truman State University

Studies have shown that regular physical activity helps to maintain bone mineral density (BMD), a topic generally associated with young females due to their risk for amenorrhea and osteopenia. Currently, dual-energy X-ray absorptiometry (DXA) is the highest standard to measure BMD.

**Purpose:** To assess the relationship between physical activity level within the past six months and BMD of college-age females. **Methods:** College women ($n = 32$, age $= 19.4 \pm 0.8$ y) completed the Minnesota Heart Health Program (MHHP) Leisure Time Physical Activity survey to assess frequency, duration, and intensity of physical activity per week within the past six months. The MHHP provides a numerical “activity factor”, ranging from 0-45. Each subject was measured for height ($165.4 \pm 6.1$ cm) and weight ($62.9 \pm 14.8$ kg) before undergoing a total body DXA scan. **Results:** Pearson correlations indicated significant correlations ($p < 0.01$) of BMD with height ($r = 0.61$) and weight ($r = 0.56$). There was not a significant correlation between MHHP and BMD ($r = -0.002$, $p = 0.990$). The mean Z-score for BMD ($1.1 \pm 1.2$) indicated high BMD for most subjects, with 59% scoring $>1$ standard deviation above the norm for age. Only one subject had a BMD $<-1$ standard deviation below the norm. **Conclusion:** Activity level within the past six months is not a significant factor in determining BMD in college-age women. A greater duration of physical activity might need to be assessed in order to understand its contribution to bone density in college-age females.

**Key Words:** exercise, bone health

Relationship of Anthropometric Characteristics to Force Output in Collegiate Sprint and Distance Swimmers
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There have been contrasting opinions on the amount of contribution made by anthropometric dimensions to swim performance. Studies have shown that height is one of the only characteristics to have a direct correlation to swim performance. **Purpose:** To determine the relationship of selected anthropometric characteristics to force output in collegiate sprint and distance swimmers. **Methods:** 21 collegiate swimmers (10M, 11F) recorded their force output on a swim bench (Vasa trainer). Anthropometric dimensions were determined for hand length, arm length, sitting height, standing height, weight, and chest circumference. **Results:** Holding gender constant by partial correlation, the only anthropometric variable significantly correlated with swim bench power was standing height ($r = 0.48$, $p = 0.02$). Body weight ($r = -0.22$), hand length ($r = -0.09$), chest circumference ($r = 0.00$), sitting height ($r = 0.04$), and arm length ($r = 0.11$) were not significantly related to...
swim bench power. Sprint swimmers \((n = 12)\) had significant correlations of sitting height \((r = 0.83)\) and height \((r = 0.88)\) with swim bench power, while distance swimmers \((n = 12)\) showed a trend towards a significant relationship \((r = 0.53, p = 0.08)\). **Conclusion:** These findings appear to indicate that height may be the only anthropometric dimension that is related to a collegiate swimmer’s force output, and it may more highly related in sprint swimmers than in distance swimmers. However, since this force was recorded out of the water, it may not be directly related to force output in the water.

**Comparison of DXA %fat Readings between Different Layers of Clothing**  
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*Truman State University*

The purpose of this study was to determine the effect of different layers of clothing on %fat estimated from DXA measurement. Participants \((n = 15)\) were measured wearing one layer of clothes versus multiple layers of clothes. Minimal clothing consisted of one layer (T-shirt and shorts) while multi-layers included additional layers over the arms, legs, and torso. A new weight measurement was taken with the new layers, and participants were re-measured. The %fat was significantly lower when wearing multiple layers \((19.8 ± 7.7\%)\) compared to wearing one layer \((22.25 ± 8.5\%)\). Clothing appears to attenuate the x-ray resulting in a lower fat estimate from DXA. It is possible that the different weight when wearing multiple layers may be a factor in the %fat algorithms used by the computer for calculation. Additional assessments might include determination of fat mass and fat-free mass estimates when wearing different layers. In addition, weight difference between the minimal clothing and multi-layer condition should be considered.

**Correlations between Lean Muscle Mass and Unilateral and Bilateral One-Repetition Maximum Leg Extensions**  
*Sarah E. Dieckgraefe*  
*Truman State University*

Previous investigations have found differing results concerning the effect body composition components on leg strength. **PURPOSE:** To determine the relationship of lower-body anthropometric dimensions to maximum unilateral and bilateral quadriceps extension strength and jump performance. **METHODS:** Subjects \((n = 34, 13 M, 21 F)\) performed one-repetition maximum (1RM) leg extensions for each leg individually and both legs simultaneously following adequate warm-up. Single- and double-leg vertical jumps were measured using an automated jump mat. In addition, basic demographic variables of age, height, and weight were recorded. Participants were measured for regional
and total body composition using dual-energy X-ray absorptiometry (DXA). **RESULTS:** Bilateral strength deficit was not significantly correlated with bilateral jump deficit \( r = -0.28 \) or lean tissue deficit \( r = 0.00 \). In women, bilateral strength deficit was significantly correlated with bilateral jump deficit \( r = -0.46, p<0.05 \) but not with lean tissue deficit \( r = -0.02 \). In men, bilateral strength deficit was not significantly correlated with either bilateral jump deficit \( r = -0.11 \) or lean tissue deficit \( r = 0.10 \). In women, unilateral lean masses were significantly correlated with unilateral jumps (right leg, \( r = 0.69 \); left leg, \( r = 0.70 \)). In men, unilateral lean masses were significantly correlated with unilateral jumps (right leg, \( r = 0.45 \); left leg, \( r = 0.26 \)). **CONCLUSION:** The results of this study seem counterintuitive. A possible explanation might be the nonspecific nature of a leg extension strength test compared to a leg press strength test.

**Key Words:** muscle strength, DXA, body composition

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**Effect of Listening to 140 Beat/Minute Music on Stationary Cycling Time**

*Victoria Halfmann and Samantha Daniels with Dr. Jerry Mayhew*

*Truman State University*

Previous studies have concluded that music acts as a distraction for the performer during low intensity exercise to help maintain exercise pace. Less attention has been paid to the effect of fast music to produce fast pace during activity. **PURPOSE:** To determine the effect of listening to music on length of time required to cycle 5K on a stationary bicycle. **METHODS:** University students (8 M, 9 F) were evaluated for 5K ride time while listening to music at 140 beats/min (BPM) or not listening to music. Treatment conditions were randomly assigned. Following a 3-minute warm-up, subjects performed a 5K ride on a stationary ergometer as fast as possible against a self-selected resistance. The same resistance was utilized for the second trial. Each subject rated exertion on the RPE scale after each ride. **RESULTS:** Subjects had significantly faster times \( p<0.02 \) when cycling to music \( (8.89 \pm 2.09 \text{ min}) \) than without music \( (9.54 \pm 1.90 \text{ min}) \), regardless of gender or resistance. Subjects reported no significant difference \( p = 0.61 \) in RPE level after riding with music \( (13.4 \pm 1.5) \) compared to without music \( (13.7 \pm 2.6) \). **CONCLUSION:** Fast music appears to improve stationary ergometer ride times by an average of 7% compared to no music. Furthermore, the perception of effort was significantly less during the music trial. Future studies might determine the effect of fast music while performing other forms of exercising such as outdoor bicycle riding, treadmill running, track running, or swimming.

**Key Words:** perceived exertion, ergogenic aid, motivation
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Editors, 2014

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