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NOTE: The Missouri Journal of Health, Physical Education, Recreation and Dance began using volume numbers with the 1991 issue, which was designated volume 1. Earlier issues do not bear a volume number.
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Within-Day and Between-Day Variations in Hydration of College Football Players during the Season

Jenna L. Humphrey, Jana L. Arabas, Michelle Boyd, and Jerry L. Mayhew

The purpose of the study was to determine daily variation in hydration level of college football players during the competitive season. Twenty-three NCAA Division II football players volunteered to provide urine samples at early morning practice (T1), prior to afternoon practice (T2), and following practice (T3) on 2 days separated by a week. Environmental temperature and humidity were comparable on both days. Urine specific gravity (Usg) was measured using a digital refractometer. Comparison of the days produced no significant difference at each test period (p>0.13), and hence the samples were averaged to represent each time period. A repeated measures ANOVA revealed that players had significantly higher Usg at T1 (1.024 ± 0.004 g/cc) and T3 (1.025 ± 0.007 g/cc) than at T2 (1.017 ± 0.006 g/cc). Using 1.020 g/cc as the marker for athletic hydration, 83% of players could be considered dehydrated at T1, 30% at T2, and 78% at T3. Coaches and athletic trainers should constantly remind players to maintain adequate hydration.

Maintaining hydration is a major concern among athletes, coaches, and athletic trainers. Dehydration as little as 1.5% to 2.9% of body mass has been shown to adversely affect muscle strength (Schoffstall, Branch, Leutholtz & Swain, 2001), anaerobic power (Jones, Cleary, Lopez, Zuri & Lopez, 2008), and sprint performance (Davis, Laurent, Allen, Green, Stolworthy, Welch & Nevett, 2015). However, changes in body mass may not offer an adequate measure of hydration during exercise situations (Maughan, Shirreffs & Leiper, 2007). While the most sensitive approach is the measurement of plasma osmolality (Opplinger, Magnes, Popowski & Gisolfi, 2005), this method is impractical due to the need for blood sampling. Urine osmolality is also acceptable but is limited by the cost of the equipment for
analysis. A more acceptable method is the measurement of urine specific gravity (Usg; Opplinger, Magnes, Popowski & Gisolfi, 2005; Stuempl & Drury, 2003), which has been shown to be comparable to osomometry to indicate hydration (Radinsky, Carnelia, Boyd, Mayhew & Koch, 2003).

Despite efforts by coaches and athletic trainers, some athletes may not be sufficiently hydrated prior to practice sessions (Smith, Mayhew, Koch & Roberts, 2006; Volpe, Poule & Bland, 2009). A survey of 10 college football players during twice-a-day practice sessions noted all would have missed practice two-thirds of the time if they were held to the 1.020 g/cc Usg standard for hydration (Godek, Godek & Bartolozzi, 2005). Likewise, mean values for Usg in professional football players during preseason have exceeded the standard (Godek & Bartolozzi, 2009). Limited information exists, however, on the ability of college football players to rehydrate between training sessions during the regular season. Therefore, the purpose of this study was to determine the within-day and between-day variations in hydration level of college football players during the competitive season.

Methods

A convenience sample of twenty-three NCAA Division II football players (age = 20.2 ± 1.5 y, height = 185.5 ± 5.9 cm, weight = 106.5 ± 22.4 kg) volunteered to participate. All testing protocols were approved by the university’s Institutional Review Board for Studies Involving Human Subjects. Informed consent was secured from each player, and no players under the age of 18 years were included in the study.

Each player provided a urine sample upon arriving at the training facility at 0600 hours, prior to the morning weight training session (T1) during the 8th wk of practice. A second sample was collected prior to the start of the afternoon practice session at 1530 hrs (T2). A final sample was collected immediately after practice (T3) at 1800 hrs. This procedure was repeated one week later. Environmental temperature (84 and 85 deg F) and humidity (73% and 78%) were comparable on both days. All samples were allowed to equilibrate to room temperature before being measured for urine specific gravity (Usg) using a digital refractometer (Atago, Tokyo, Japan, model 3749-E02).

Results

Reliability coefficients between days ranged from poor (T1, ICC = 0.417) to moderate (T1, ICC = 0.629) to strong (T3, ICC = 0.810). Comparison between days produced no significant difference across test periods (p>0.13), and hence the samples were averaged to represent each time period.

A repeated measures analysis of variance (ANOVA) revealed that players had significantly higher Usg at T1 (1.024 ± 0.004 g/cc) and T3
(1.025 ± 0.007 g/cc) than at T2 (1.017 ± 0.006 g/cc). Using 1.020 g/cc as the upper limit for athletic hydration, 83% of players were considered dehydrated at T1. Prior to practice (T2), 30% of players were above the standard (dehydrated), and six of those seven had been dehydrated at the morning sampling. Following practice (T3), 78% of players were above the standard despite ad libitum water availability during the 2-hr practice. Six players (26%) were dehydrated at all 3 test periods. Body mass was significantly correlated with Usg at T1 ($r = -0.49$) but not at T2 ($r = 0.25$) and T3 ($r = 0.07$). There was no significant difference ($p>0.18$) in hydration level between players on the traveling squad ($n = 11$) and those on the practice squad ($n = 12$) at any test period, suggesting that practice repetitions were not a factor in the hydration pattern.

**Discussion**

Morning urine samples suggested the current sample of football players may not be fully rehydrated following mid-week practice days. Previous research on healthy, active men noted an average morning Usg identical to that of the current sample of football players (Stover, Petrie, Horswill, Murray & Wildman, 2006). Earlier work indicated that early morning samples may be more concentrated due to the lack of fluid intake overnight and hence may not be the best representation of hydration (Armstrong, Maresh, Castellini, Bergeron, Kenefick, LaGasse, & Riebe, 1994). Although our morning sample was probably not the first void of the day, most of the players were considered dehydrated entering the resistance training session. Previous studies have produced mixed results when considering the effect of hydration on strength and power, with some studies showing decrements (Ftaiti, Grelot, Coudreuse & Nicol, 2001; Hayes & Morse, 2010; Schoffstall et al., 2001) while others have shown no deleterious effects of dehydration (Grewe, Staffey, Melrose, Narve & Knowlton, 1998; Maughan, 2003; Periard, Tammam & Thompson, 2012). The approaches in these studies did not mimic a morning resistance training session as performed by the current players, and hence a comparison of the effect of the elevated Usg could not be determined.

Pre-practice samples showed most players (70%) had returned to satisfactory hydration levels in the intervening eight hours, which was similar to results noted previously (Stofan, Zachwieja, Horswill, Murray, Anderson & Eichner, 2005). However, 22% of players remained near (>1.017 g/cc) the dehydration cut-off, and each was dehydrated after practice. Since no standard measure of performance was conducted during practice, it was difficult to assess the effect of dehydration on their ability to execute specific sports skills. Armstrong et al. (2010) concluded that the full football uniform is most likely a major cause of heat problems. They subjected 10 football linemen to controlled exertion conditions (i.e., box lifting and treadmill walking) while wearing a full uniform versus shorts and T-shirts and showed a dramatic rise in rectal temperature and
exhaustion rate in over half the trials with full uniform, although there was no significant change in Usg. Interestingly, they did not allow a player to undergo testing if his initial Usg was greater than 1.028 g/cc, which is above the typical hydration standard but agreed with the value established by Armstrong et al. (1994). None of the current players began practice at or above 1.028 g/cc. In addition, since the exercise protocol utilized by Armstrong et al. (2010) was dissimilar to a standard practice as executed by our players, it is difficult to make adequate comparisons with the current study.

Most of the current players (78%) were dehydrated following the two-hour session despite the freedom to consume fluid whenever they wished. Stofan et al. (2005) noted that players lose significant amounts of sodium and sweat during practice, with cramp-prone players losing more of each. Godek, Bartolozzi, Burkholder, Sugarman & Dorshimer (2006) demonstrated that linemen had higher rectal temperatures but less percent dehydration than backs, which would suggest a negative relationship between body mass and dehydration. Other sources have indicated that body weight was significantly correlated with rise in rectal temperature (Armstrong et al., 2010), while Godek, Bartolozzi and Godek (2005) concluded that body surface area was a major determinant of sweat rate. Although body mass and body surface area were significantly negatively correlated with Usg prior to morning training among the current players, there was no significant correlation at the other test periods, suggesting that body size was not a major contributing factor to dehydration during a practice session in these players.

While the focus of hydration in this study was on college football players, higher Usg in exercising individuals may not be unusual. One survey showed as many as 46% of recreational exercisers may be dehydrated before exercising (Stover, Petrie, Passe, Horswill, Murray & Wildman, 2006). Another study that measured moderately trained individuals over a 5-day period, collecting samples each time they voided, found that 44% of the samples were about the 1.020 g/cc cut-off. The increase in Usg in the current study was comparable with previous studies on football players during summer training sessions (Yeargin, Casa, Armstrong, Watson, Judelson, Psthas & Sparrow, 2006), professional basketball players (Osterberg, Horswill & Baker, 2009), and college and high school wrestlers (Bledsoe, Smith, Lacy, Mayhew, Koch, Roberts & Schutter, 2007; Lacy, Miley, Arabas, Powell & Mayhew, 2011). Given the effect of dehydration on athletic performance (Cheuvront, Kenefick, Montain & Sawka, 2010; Davis et al., 2015; Jones et al., 2008; Schoffstall et al., 2001) and its contribution to heat illness (Casa, 1999; Howe & Boden, 2007), a concerted effort should be made by coaches and athletic trainers to remind athletes to maintain adequate hydration since the thirst mechanism may not be sufficient to prompt athletes to consume sufficient fluids (Opplinger & Bartok, 2002). Players should make a conscious effort to rehydrate during the hours following an afternoon practice before
retiring for the night (Murray, 2007). For football players, a critical phase of the rehydration process may be the early evening hours following an afternoon practice session where they should attempt to consume as much fluid as they comfortably can without over-drinking (Murray, 2007).

References


Journal of Athletic Training, 41, 8-17.
Research, 15, 102-108.

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Refereed Article

Horizontal vs Vertical Abdominal Skinfold Measurement Differences in College Men

Megan Frkovic, Evonne Bird, Jana L. Arabas, and Jerry L. Mayhew

The purpose of this study was to determine the effect of measuring abdominal skinfold in two planes on estimation of body composition performed by experienced skinfold testers. College men (n = 82) were randomly assigned to three groups and measured by three experienced testers at the chest, abdomen, and thigh sites. Chest and thigh skinfolds were measured according to standard practice. The abdominal skinfold was measured vertically and horizontally. Relative body fat (%fat) was estimated from the sum of the three measurements. Analysis of variance (ANOVA) indicated that the groups were not significantly different in age, height, weight or BMI. Abdominal skinfolds measured horizontally or vertically were not significantly different for two testers but was significantly higher when measured horizontally by one tester. This resulted in a significantly higher sum of three skinfolds and higher %fat estimate by that tester. However, the effect size for the difference between %fat estimates for each tester did not exceed 0.07, indicating no practical difference between estimates. Therefore, measuring abdominal skinfold horizontally or vertically does not appear to have a major impact on %fat estimate.

Sknfold measurement is among the most common methods of assessing body composition on a wide variety of individuals. This technique is most often used to estimate relative body fat (%fat) using various prediction equations. The most popular skinfold prediction equation for men was developed by Jackson and Pollock (1978) using the sum of chest, abdomen, and thigh sites in a polynomial equation to estimate body density which is converted to %fat. While the chest and thigh sites have common descriptions in anthropometry manuals, abdominal skinfold measurement technique is described as horizontal in one (Harrison,
Buskirk, Carter, Johnston, Lohman, Pollock, et al., 1988) and vertical in another (Norton, Whittingham, Carter, Kerr, Gore & Marfell-Jones, 1996). An early study suggested that while testers of differing experience might show slight variation among individual skinfolds, the difference among the sum of skinfolds was within random variation (Jackson, Pollock & Gettman, 1978). A recent study assessing inter-investigator reliability for skinfold measurement noted that despite considerable experience, testers may have a significant difference in the sum of skinfolds and hence in predicted %fat (Bird, Mayhew, Schwegler, Crossgrove, Etemady & Peterson, 2009).

In order for skinfold assessment to have a high degree of generalizability, measurement procedures should be consistent among testers. If different test procedures for abdominal skinfold measure produce significantly different values, it could impact estimations of %fat and the advice given to individuals relative to their ideal weight. Currently, there is limited information on the influence of different abdominal test procedures on prediction of %fat. Therefore, the purpose of this study was to determine the degree of difference measuring abdominal skinfold in two planes had on the estimation of body composition in college men.

Methods

Eighty-two college men from a small, Midwestern university volunteered to participate. The study was approved by the University Institutional Review Board, and all participants gave their consent to be measured. Data were recorded anonymously, and no participants under the age of 18 years were included in the study. Demographic profiles of the participants are given in Table 1.

Skinfold measurements were taken at three sites by each of three experienced testers using Lange calipers. The different sets of calipers had been calibrated to insure consistent instrumentation. The testers had a combined 80 years of skinfold testing experience (i.e., Tester 1 = 21 yrs, Tester 2 = 15 yrs, Tester 3 = 44 yrs). Participants were randomly assigned to testers, and no collective discussion of individual measurement techniques was performed prior to or during testing.

Skinfolds were measured on the right side of the body at the chest, abdomen, and thigh sites. The chest site was measured midway between the axillary fold and the nipple along the line of the muscle (Harrison et al., 1988). The thigh site was measured on the anterior side midway between the inguinal fold and superior border of the patella (Harrison et al., 1988). The abdominal sites were measured two centimeters to the right of the umbilicus in both a vertical (Norton et al., 1996) and horizontal fold (Harrison et al., 1988). Three measurements were taken at each site, and the average was used to represent that site. The sum of the three skinfolds was used to estimate body density (Jackson & Pollock, 1978). Predicted density was converted to percent fat using the Siri equation (Siri, 1956).
## Table 1
Demographic Characteristics Of The Participants (n = 82)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Tester 1 (n = 23)</th>
<th>Tester 2 (n = 29)</th>
<th>Tester 3 (n = 30)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M ± SD</td>
<td>M ± SD</td>
<td>M ± SD</td>
</tr>
<tr>
<td>Age (yrs)</td>
<td>19.7 ± 1.3</td>
<td>19.7 ± 2.3</td>
<td>19.6 ± 1.1</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>176.3 ± 8.1</td>
<td>175.2 ± 6.7</td>
<td>177.3 ± 8.0</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>78.4 ± 15.3</td>
<td>79.6 ± 19.0</td>
<td>78.7 ± 18.7</td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>25.2 ± 4.3</td>
<td>25.8 ± 5.5</td>
<td>24.9 ± 5.0</td>
</tr>
<tr>
<td>Chest (mm)</td>
<td>16.9 ± 9.4</td>
<td>10.6 ± 5.0</td>
<td>13.5 ± 8.1</td>
</tr>
<tr>
<td>Abdomen (mm) – Vertical</td>
<td>28.7 ± 10.0</td>
<td>19.0 ± 5.8</td>
<td>24.7 ± 13.4*</td>
</tr>
<tr>
<td>Abdomen (mm) – Horizontal</td>
<td>29.3 ± 10.8</td>
<td>19.0 ± 5.7</td>
<td>26.5 ± 13.9*</td>
</tr>
<tr>
<td>Thigh (mm)</td>
<td>17.4 ± 7.7</td>
<td>14.1 ± 5.3</td>
<td>15.9 ± 10.3</td>
</tr>
<tr>
<td>Σ3SKF – Vertical</td>
<td>63.0 ± 25.5</td>
<td>43.6 ± 14.7</td>
<td>54.1 ± 29.1*</td>
</tr>
<tr>
<td>Σ3SKF – Horizontal</td>
<td>63.5 ± 26.0</td>
<td>43.6 ± 14.4</td>
<td>55.9 ± 29.8*</td>
</tr>
<tr>
<td>%fat – Vertical</td>
<td>21.7 ± 8.9</td>
<td>14.9 ± 5.5</td>
<td>18.4 ± 10.1*</td>
</tr>
<tr>
<td>%fat – Horizontal</td>
<td>21.9 ± 9.1</td>
<td>14.9 ± 5.4</td>
<td>19.1 ± 10.2*</td>
</tr>
</tbody>
</table>

*Significantly different between vertical and horizontal measurements (p<0.05)

## Table 2
Intraclass Correlation Coefficients And Coefficients Of Variation For Testers

<table>
<thead>
<tr>
<th>Variable</th>
<th>Intraclass Correlation Coefficient</th>
<th>Coefficient of Variation (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Tester 1 (n = 23)</td>
<td>Tester 2 (n = 29)</td>
</tr>
<tr>
<td></td>
<td>Tester 1 (n = 23)</td>
<td>Tester 2 (n = 29)</td>
</tr>
<tr>
<td>Abdominal SKF (mm)</td>
<td>0.954</td>
<td>0.954</td>
</tr>
<tr>
<td>(Vertical vs Horizontal)</td>
<td>8.0</td>
<td>6.4</td>
</tr>
<tr>
<td>Σ3SKF (mm)</td>
<td>0.993</td>
<td>0.993</td>
</tr>
<tr>
<td>(Vertical vs Horizontal)</td>
<td>3.7</td>
<td>2.9</td>
</tr>
<tr>
<td>%fat (Vertical vs Horizontal)</td>
<td>0.993</td>
<td>0.993</td>
</tr>
<tr>
<td></td>
<td>3.9</td>
<td>3.2</td>
</tr>
</tbody>
</table>
One-way analysis of variance (ANOVA) was used to determine differences among test groups for basic demographic variables. Agreement between the two abdominal skinfolds, sums of skinfolds using each abdominal measurement, and %fat for each tester was evaluated using paired t-tests and intraclass correlation coefficients (ICC). Coefficient of variation (CV%) for the two abdominal skinfold measurements, sum of three skinfolds, and %fat estimates were determined by dividing the SD between trials by the mean of the two trials for each tester; this is also known as the technical error of measurement (Pederson & Gore, 1996).

Results

ANOVA indicated that age, height, weight, and BMI were not significantly different among test groups. There was no significant difference between horizontal and vertical skinfold measurements for testers 1 and 2; however, horizontal measurement was significantly higher than vertical measurement for tester 3 (Table 1). This resulted in a significantly greater sum of three skinfolds for tester 3 when abdominal skinfold was measured horizontally and a higher estimate of %fat. However, the effect size for %fat difference for tester 3 was trival (ES = 0.03).

The intraclass correlation coefficients for the two abdominal measurements, sums of skinfolds, and estimated %fat were high and consistent across testers (Table 2). The coefficients of variation were not remarkably different among testers for any measurement, although there was increasing amplitude for testers with more experience. The average differences among skinfold measurements and body composition estimates are shown in Table 3. None of the differences were significantly different from zero for testers 1 and 2. However, each of the differences were significantly different from zero for tester 3. The 95% confidence interval on the difference between %fat estimates for the testers ranged from 1.8 to 2.9%.

Discussion

The results of this study suggest that while extremes between vertically and horizontally measured abdominal skinfolds for experienced testers could be as high as 12 mm, 95% of the time differences did not exceed 3 to 6 mm. Thus, the effect of this difference on estimation of %fat is likely to be inconsequential (<4% difference between methods). Ironically, it appears the greater experience of the tester, the more difference there is between vertical and horizontal measurement of abdominal skinfolds. Vegelin, Brukx, Waelkens and Van den Broeck (2003) noted more experience would likely bring testers closer together in their measurement for similar skinfolds. Bird et al. (2009) found testers with more experience still differed significantly in estimated %fat values in young adults. The current study
### Table 3
Mean Difference And Range For Abdominal Skinfold, Σ3skf, And %Fat Among Testers With Difference Experience

<table>
<thead>
<tr>
<th></th>
<th>Tester 1</th>
<th></th>
<th>Tester 2</th>
<th></th>
<th>Tester 3</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean ± SD</td>
<td>Range</td>
<td>Mean ± SD</td>
<td>Range</td>
<td>Mean ± SD</td>
<td>Range</td>
</tr>
<tr>
<td>Abdominal SKF (mm)</td>
<td>-0.55 ± 4.34</td>
<td>-7.0 – 12.0</td>
<td>-0.05 ± 2.42</td>
<td>-8.6 – 5.0</td>
<td>-1.75 ± 4.2</td>
<td>-12.4 – 5.4</td>
</tr>
<tr>
<td>(Vertical vs Horizontal)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Σ3SKF (mm)</td>
<td>-0.55 ± 4.34</td>
<td>-7.0 – 12.0</td>
<td>-0.05 ± 2.42</td>
<td>-8.6 – 5.0</td>
<td>-1.75 ± 4.2</td>
<td>-12.4 – 5.4</td>
</tr>
<tr>
<td>(Vertical vs Horizontal)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>%fat</td>
<td>-0.18 ± 1.5</td>
<td>-2.5 – 4.0</td>
<td>-0.02 ± 0.9</td>
<td>-3.3 – 1.8</td>
<td>-0.62 ± 1.5</td>
<td>-4.7 – 1.9</td>
</tr>
<tr>
<td>(Vertical vs Horizontal)</td>
<td></td>
<td></td>
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</tbody>
</table>
found larger differences between abdominal skinfolds in more experienced testers, thus suggesting the need for further investigation comparing testers with varying amounts of experience. However, testing longevity may have little to do with agreement among testers who received different instruction when initially learning to measure skinfolds.

One possible explanation for the current results could be slight variations among the testers in the location for each skinfold measurement. The sites used in the current study were not marked in any way, and each tester was allowed to locate the site as he or she typically did. Variance in placement of the calipers by one inch has been shown to alter skinfold reading by 1-2 mm (Ruiz, Colley & Hamilton, 1971; Hume & Marfell-Jones, 2008; Marfell-Jones & Hume, 2010). Thus, accuracy in consistent location of skinfold sites may have played a part in contributing to a lack of agreement between the two abdominal skinfold measurements for these testers. However, Durnin, De Bruin and Feunekes (1997) found that substantial deviation in skinfold location had only a minor effect (<1%) on estimated %fat. It would seem that the differences noted in the current study might be more a factor of tester difference in measurement technique than difference in skinfold location.

The differences in %fat estimation noted for the two abdominal techniques among these experienced testers could have implication when skinfold testing is used to establish an ideal body weight. If the widely use 10% ideal fat standard for men was accepted to estimate ideal body weight (Brozek & Keys, 1951), the percent difference between the two measurement techniques would have been minimal for each tester (<5%). The practical impact of difference in abdominal measurement on predicted %fat would have been trivial fat (ES <0.06).

A major limitation of this study which could have impacted the difference among testers was the fact that each tester did not measure every subject. Despite the fact that the three subject groups did not differ in any demographic characteristics, they could possibly have differed in skinfold measurements. In a previous study where all subjects were measured by each of four experienced testers (Bird et al., 2009), the differences in demographic characteristics compared to the current sample were not significant but did have moderate effect sizes for height (ES = 0.33), body mass (ES = 0.22), and BMI (ES = 0.38). Future research might focus on having all testers perform evaluations on the same subjects to determine the impact of differences in measurement technique on abdominal skinfold estimation and predicted %fat.

In summary, it can be stated there is both an art and a science to skinfold testing. A skinfold tester must be competent in accurately locating the site for a given skinfold, consistent in the amount of subcutaneous fat that is pinched for each skinfold, and careful in the procedure of reading the caliper to obtain the skinfold value (Going & Davis, 2001; Heyward & Stolarczyk, 1996). Despite following these procedures, difference may exist among testers due to variations in their measurement techniques.
even when they have years of experience. Such differences could have a significant impact on weight adjustment recommendations when projecting an individual’s ideal body weight for health or athletic competition (Wagner, 1996). Furthermore, when tracking changes in body composition across training or diet programs, the same skinfold tester should be used and follow the same procedures to reduce variation in measurement in order to enhance accuracy (Hume & Marfell-Jones, 2008).

References


Obesity levels at the time of this study continued to dramatically rise in the United States. Lytle’s (2012) research concluded current obesity rates of our nation’s youth continue to escalate at an alarming rate due to inactivity, poor nutrition, and lifestyle changes in the United States. Additional research has confirmed an increase in obesity levels among youth in the United States. Research by Grossklaus and Marvicsin (2014) found obesity rates doubled in the 1980’s. “Childhood obesity is now one of the most frequently seen chronic diseases in children and is considered an epidemic with serious financial implications” (p. 69).

The traditional teaching of physical education in the United States consisted of instruction in the areas of individual sports, team sports, cooperative games, and basic locomotor skill development (Capel, 2007). This traditional pedagogy left students without a purpose for improving and developing a commitment towards a healthy lifestyle. The traditional method limited students’ opportunities to improve their fitness levels. Students often began to see their fitness levels decline.

The use of incorporating fitness activities was not a new idea in physical education. Teachers were looking for programs that improve students’ fitness levels. Many teachers added programs to promote healthy lifestyles with the belief fitness levels would improve. These programs were often units embedded with the curriculum for three to four weeks. The majority of teachers did not study the effects of the fitness program (Culpepper, Tarr, & Killion, 2011).

School districts faced with increasing accountability for academic standards and a reduction in school funding have in some cases eliminated recess or reduced physical activities. The rising obesity rates coupled with school districts reducing physical activity have led to the Missouri legislature enacting a physical activity requirement as part of Missouri Senate Bill 291 (2009). Analysis by Robertson-Wilson, Dargavel, Bryden and Giles-Corti (2012) concluded state education policies requiring physical activity impacts fitness levels and the need to further study each policy. Physical activity mandates enacted by state legislatures
and implemented by schools endorse increased physical activity levels. Cradock et al. (2013) found state policies can be an effective step to expand physical activity leading to better health for the nation’s youth. The research and monitoring the implementation of the policies is a vital component towards improving our youth’s health. States with enacted physical activity polices need an effective system for inspection of the mandates.

The purpose of this research study was to examine the effects of Missouri Senate Bill 291 on Missouri physical fitness scores as assessed by the Missouri Physical Fitness Assessment. Key questions guiding the research included: a) does Missouri’s Senate Bill 291 section relating to physical activity contribute to, and continue to add to, improvement in youth’s fitness levels? b) Does a minimum of 150 minutes per week of physical activity lead to improvement in student’s fitness achievement levels? c) Does the research examined in this study indicate improvement in student’s fitness passing scores for fifth and ninth grades regarding the passage of Missouri Senate Bill 291 in 2009?

**Background and Literature Review**

The literature review includes an historical perspective, background on Missouri Senate Bill 291, and information about the Missouri Physical Fitness Assessment Manual.

**Historical Perspective**

Physical education has evolved over the course of time since its early origination from the Greeks. The 1800’s evidenced physical education in European schools, with physical education spreading to the United States in the mid 1800’s. Dewey began the idea of restructuring customary education and advocated for the educational system to incorporate physical education toward the end of the 19th century (“Physical Education”, 2013).

The 1900’s included females and handicapped students in physical education, as a result of federal legislation. The passage of Title IX in 1972, in the United States, allowed for females to equally participate in athletics, alongside male athletes. VanSickle (2013) noted this impactful mandate improved the opportunities for females to take part in sports, and to be considered for duties in sports that had been predominately for male athletes. Public Law 94-142 was federal legislation that was enacted in 1975. The law, named the Education for All Handicapped Children Act, assisted students with challenging disabilities to gain an appropriate physical education experience through socialization, goal setting and skill development (Tarr, 2011).

The 2000’s brought new technology and an urgency to increase educational knowledge for children by implementing standards-based curricula. According to Blair and Powell (2014), increases in technology
reduced the amount of physical activity in everyday life activities, which decreased human energy expenditure. France, Moosbrugger, and Brockmeyer (2011) concluded that physical education programs and teachers were held to national standards constructed by the National Association of Sport and Physical Education (NASPE) that matched with the state standards to specify curricula content that produced accountability for students and physical education teachers.

Physical education has evolved to educating all students through national and state standards with properly trained educators. Promoting life-long healthy habits in conjunction with life-long learning was also a prevalent theme among education. Findings by the Centers for Disease Control and Prevention (2014) in the Policy and Environmental Indicators section of the State Indicator Report on Physical Activity, established guidelines on physical activity requirements for 28 states and the District of Columbia. The same report indicated requirements, such as Missouri Senate Bill 291, were enacted to ensure students were getting the stated minimum amount of physical activity. As society became more reliant on technology, the levels of physical activity among students appeared to decrease.

A common thread throughout the research found children need 60 minutes of physical activity per day. A health and physical education survey conducted by the Missouri Association for Health, Physical Education, Recreation, and Dance (2005) analyzed the minutes of physical activity in the Missouri schools. The findings included that approximately 50% of Missouri elementary schools schedule physical education two times per week, 8% utilize three times per week, and 8% meet daily. The study went on to report that 68% of secondary schools had a one year physical education course requirement and 13.3% have a two year arrangement. The majority of elementary students are getting physical education with a certified instructor two times per week, while most high schools only require one year or one credit of physical education.

The National Physical Activity Plan (2014) report card contained a rubric scoring guide that would give Missouri students an overall grade of a B. The National Physical Activity Plan stipulated a benchmark of 61% to 80% as a B.

**Background of Missouri Senate Bill 291**

Missouri Senate Bill 291 (2009), with regard to physical education in 2009, was legislation that went into effect during the 2010-2011 school year. Section 167.720.2(1) of Missouri Senate Bill 291 mandated that school districts across the state of Missouri verified elementary students were taking part in physical activity for the full school year. Elementary students were expected to be exposed to moderate physical activity a minimum of 150 min/wk or 30 min/da for a complete five-day school week. The policy stipulated that school districts were to give elementary students one 20 min recess per day. The mandate also encompassed
inclusion of students with disabilities in accordance with the Individuals with Disabilities Education Act, or Section 504 of the Rehabilitation Act.

The Missouri Department of Elementary and Secondary Education (MODESE) developed an *Interpretation of Law Relating to Physical Activity* (2010) to address the physical activity requirements of Missouri Senate Bill 291. The new Missouri mandate did not alter the requirement of elementary students’ expectation of receiving 50 min of physical education instruction from a certified teacher per week. The 50 min of physical education activities per day were included as part of the mandated 150 min/wk. Clarification was provided that recess or other physical activities included toward the mandated 150 min/wk could be supervised by any certificated teacher. The mandate may have forced schools that were not providing a 20 min recess to implement this provision as a 20 min recess became a part of the bill.

**Missouri Physical Fitness Assessment Manual**

The *Missouri Physical Fitness Assessment Manual* (2000) was developed as part of the Missouri Outstanding Schools Act of 1993 in conjunction with the Missouri Assessment Program. The fitness test was voluntary starting in the year 2000 and became a requirement in the year 2001. The goals of the assessment were to collect data, promote lifetime fitness and to assess student’s healthy indicators. The *Missouri Physical Fitness Assessment* was administered to fifth and ninth grade students. The test measured aerobic capacity, abdominal strength/endurance, upper body strength/endurance and flexibility.

The *Missouri Physical Fitness Assessment Manual* (2000) specified the tests used to assess students. Aerobic capacity was measured with the one mile run or Progressive Aerobic Capacity Endurance Run. Abdominal strength and endurance was measured by students performing timed curl-ups for one minute, curl-ups or partial curl-ups to a cadence. Upper body strength and endurance was assessed by push-ups, pull-ups, modified pull-ups or the flexed arm hang. Flexibility was administered by utilizing the sit and reach, back-saver sit and reach or the v-sit and reach test.

**Methods**

**Sample/Participants**

Data sets analyzed in this study were secondary in nature. Indirect study participants who contributed to the secondary data included all fifth and ninth grade students participating in the Missouri statewide Physical Fitness Assessment for the years 2002 through 2012. The state of Missouri mandated reporting of physical fitness scores from school districts beginning in 2001. There were 525 schools in 2002 across the state of Missouri that submitted fitness scores to MODESE (MODESE, personal communication, June 5, 2014). Much of the data was incomplete for some school districts. Over the course of the next twelve years, despite
mandatory reporting requirements, some school districts continued to not submit annual fitness testing scores. There were 561 school districts in 2012 listed on MODESE (MODESE, personal communication, June 5, 2014) fitness report sheet. A large number of these school districts had incomplete or missing data. After data cleaning, it was found that 242 school districts completed full remittance of fitness testing reports for the 11 years (2002-2012). For the purposes of this study, only these 242 school districts, representing approximately 50% of total number of Missouri school districts, were retained for data analysis.

Setting

Data for this study was obtained from MODESE, for the years 2002 through 2012. Based upon the National Education Association Annual Report (NEA, 2014), Missouri ranked ninth in the nation in number of total school districts with 524, for 2012-2013 school year. The NEA report listed Missouri as the 18th largest state in terms of public school enrollment, with 906,811 students during the 2012-2013 year. Missouri also ranked 16th in total number of high school graduates for the academic school year 2012-2013. Data were collected by certified physical education teachers employed through public school districts across the state and submitted to MODESE for official record keeping.

According to the Missouri Physical Fitness Assessment Manual (2000), fifth and ninth grade students in the Missouri public school district were tested yearly by using the Missouri Physical Fitness Assessment. Students were determined by their individualized scores to be in one of three categories: Number Tested, Number Not Tested and Number Meeting or Exceeding the Healthy Fitness Range. The fitness data were sent to MODESE as part of the June core data cycle. Since 2002, MODESE has kept records for school district physical education standards, at the fifth and ninth grade levels.

Design

This study was a quantitative exploratory study using a secondary data set provided by MODESE. Physical fitness scores on the state-mandated Missouri Physical Fitness Assessment were collected by physical education specialists once/yr for 5th and 9th grade. The Missouri Physical Fitness Assessment provided four sub-categories of physical fitness: aerobic capacity, abdominal strength, upper body strength, and flexibility. Data were subjected to a comparative design assessing differences between scores for years 2002-2009, pre-Missouri Senate Bill 291, and 2010-2012, post-Missouri Senate Bill 291. The 524 school districts identified as such by MODESE, 242 school districts were included in the analysis. These were the schools submitting complete data for the 11-yr period under study. This represents 46% of the total districts in Missouri that provided complete data sets for the research for the years 2002 – 2012. Approximately 54% of school districts failed to provide complete data sets.
Statistical Treatment of Data

Data were submitted by MODESE to the researcher in an EXCEL spreadsheet format. In the spreadsheet, all schools with corresponding fitness data were listed by academic year for fifth grade and ninth grade students. Data were then converted to a format appropriate for Statistical Package for the Social Sciences 21.0. Variable string formatting was changed to reflect total number of students taking fitness assessment and total number of students passing fitness assessment. Passing scores were dictated by meeting the Healthy Fitness Range as delineated by MODESE (Table 1). For the purposes of analysis, comparison between groups was handled by using total percentage of students who successfully passed the Missouri state physical fitness assessment standard for each dimension. Data were also dummy coded to reflect the year’s pre-Missouri State Senate Bill 291 and post-Missouri State Senate Bill 291. Data were analyzed using basic frequencies and descriptive statistical analysis. Comparisons were handled using Independent Sample \( t \)-tests using the year period as the grouping variable and percentage of students passing each fitness dimension as the testing variable. Equal variances were assumed and the statistical significance for the study was set at \( p < .05 \). The potential for relationships between the variables was examined through use of the Pearson Product Moment Correlation Coefficient after coding of the data.

Table 1 represents the minimum standards for the Missouri healthy fitness range passing scores for 5th grade and 9th grade boys and girls, at the time of the assessment. The fitness assessments are listed with each minimum standard for the Missouri Physical Fitness Assessment.

### Table 1
Healthy Fitness Standards

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Aerobic Capacity</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 Mile Run/Walk</td>
<td>11:30</td>
<td>12:30</td>
<td>10:00</td>
<td>11:30</td>
</tr>
<tr>
<td>PACER TEST</td>
<td>23</td>
<td>15</td>
<td>41</td>
<td>23</td>
</tr>
<tr>
<td><strong>Abdominal Strength</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Curl-Up Timed</td>
<td>35</td>
<td>30</td>
<td>42</td>
<td>37</td>
</tr>
<tr>
<td>Curl-Up Cadence</td>
<td>12</td>
<td>12</td>
<td>21</td>
<td>18</td>
</tr>
<tr>
<td>Partial Curl Up</td>
<td>24</td>
<td>24</td>
<td>39</td>
<td>40</td>
</tr>
<tr>
<td><strong>Upper Body Strength</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Push-Up Completed</td>
<td>7</td>
<td>7</td>
<td>12</td>
<td>7</td>
</tr>
<tr>
<td>Pull-Up Completed</td>
<td>1-3</td>
<td>1</td>
<td>1-6</td>
<td>1</td>
</tr>
<tr>
<td>Modified Pull-Up</td>
<td>5</td>
<td>4</td>
<td>8</td>
<td>4</td>
</tr>
<tr>
<td>Flexed Arm Hang</td>
<td>4-12s</td>
<td>4-8s</td>
<td>12-13s</td>
<td>8s</td>
</tr>
<tr>
<td><strong>Flexibility</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sit’n’Reach (cm)</td>
<td>25</td>
<td>28</td>
<td>26</td>
<td>31</td>
</tr>
<tr>
<td>Back Saver (inches)</td>
<td>8</td>
<td>9</td>
<td>8</td>
<td>10</td>
</tr>
<tr>
<td>V-Sit reach (inches)</td>
<td>1.0</td>
<td>3.0</td>
<td>0.5</td>
<td>3.5</td>
</tr>
</tbody>
</table>
Results

Table 2 represents data for fifth graders taking the Missouri Physical Fitness Assessment for the years 2002-2009 and 2010-2012. Pre and post Missouri Senate Bill 291 fitness scores using a t-test for difference in passing rates were calculated by the Statistical Packages for Social Sciences 21.0 to ascertain the extent to which Missouri Senate Bill 291 impacted physical fitness standards of fifth and ninth grade students in the state of Missouri. Mean scores represent the average percentage of students passing each component of physical fitness in their respective school districts.

Table 2
Fifth Grade Missouri Physical Fitness Passing Percentages by Year

<table>
<thead>
<tr>
<th>Fitness Variable</th>
<th>N</th>
<th>M (%)</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Aerobic Capacity</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2002-2009 Group</td>
<td>225</td>
<td>62.68</td>
<td>19.28</td>
</tr>
<tr>
<td>2010-2012 Group</td>
<td>225</td>
<td>64.35</td>
<td>20.60</td>
</tr>
<tr>
<td><strong>Abdominal Strength</strong></td>
<td>225</td>
<td>71.61</td>
<td>17.63</td>
</tr>
<tr>
<td>2002-2009 Group</td>
<td>225</td>
<td>72.39</td>
<td>18.74</td>
</tr>
<tr>
<td>2010-2012 Group</td>
<td>225</td>
<td>72.39</td>
<td>18.74</td>
</tr>
<tr>
<td><strong>Upper Body Strength</strong></td>
<td>225</td>
<td>63.87</td>
<td>18.65</td>
</tr>
<tr>
<td>2002-2009 Group</td>
<td>225</td>
<td>65.42</td>
<td>19.29</td>
</tr>
<tr>
<td>2010-2012 Group</td>
<td>225</td>
<td>65.42</td>
<td>19.29</td>
</tr>
<tr>
<td><strong>Flexibility</strong></td>
<td>225</td>
<td>67.10</td>
<td>18.36</td>
</tr>
<tr>
<td>2002-2009 Group</td>
<td>225</td>
<td>67.40</td>
<td>20.80</td>
</tr>
<tr>
<td>2010-2012 Group</td>
<td>225</td>
<td>67.40</td>
<td>20.80</td>
</tr>
</tbody>
</table>

Relationships among performance on dimensions of physical fitness measured for aerobic capacity, abdominal strength/endurance, upper body strength/endurance, and flexibility were checked with the Pearson Product Moment Correlation analysis. Data suggested a statistically significant correlation between fitness scores for students taking the statewide fitness tests in fifth and ninth grades for pre and post passing of Senate Bill 291. Aerobic capacity, abdominal strength/endurance, upper body strength/endurance, and flexibility performance were represented by student physical fitness assessment scores.

Table 3 represents data for ninth graders taking the Missouri Physical Fitness Assessment for the years 2002 – 2009 and 2010 – 2012. Mean scores represent the average percentage of students passing each component of physical fitness in their respective school districts.
Table 3
Ninth Grade Missouri Physical Fitness Passing Percentages by Year

<table>
<thead>
<tr>
<th>Fitness Variable</th>
<th>N</th>
<th>M (%)</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Aerobic Capacity</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2002-2009 Group</td>
<td>220</td>
<td>64.78</td>
<td>18.78</td>
</tr>
<tr>
<td>2010-2012 Group</td>
<td>220</td>
<td>65.34</td>
<td>20.17</td>
</tr>
<tr>
<td><strong>Abdominal Strength</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2002-2009 Group</td>
<td>220</td>
<td>73.27</td>
<td>18.07</td>
</tr>
<tr>
<td>2010-2012 Group</td>
<td>220</td>
<td>74.38</td>
<td>19.70</td>
</tr>
<tr>
<td><strong>Upper Body Strength</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2002-2009 Group</td>
<td>220</td>
<td>69.54</td>
<td>18.26</td>
</tr>
<tr>
<td>2010-2012 Group</td>
<td>220</td>
<td>71.10</td>
<td>18.82</td>
</tr>
<tr>
<td><strong>Flexibility</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2002-2009 Group</td>
<td>220</td>
<td>70.08</td>
<td>17.6</td>
</tr>
<tr>
<td>2010-2012 Group</td>
<td>220</td>
<td>72.28</td>
<td>19.38</td>
</tr>
</tbody>
</table>

The mean scores did increase for each category of physical fitness from the 2002 – 2009 group to the 2010 – 2012 group. Flexibility statistically had the largest mean percentage increase at 2.2%. Upper body strength had the second most mean percentage increase for ninth grade with 1.56%.

Table 4 represents results found for an Independent Samples $t$-test run to determine whether statistically significant differences exist between ninth grade students in the years 2002-2009 and 2010-2012 groups on the four dimensions of physical fitness as assessed by the Missouri Physical Fitness Assessment. Data did support a statistically significant increase in flexibility for the percentage of Missouri ninth grade students with passing scores when comparing the years 2002 – 2009 to 2010 – 2012. Data represented prior Missouri Senate Bill 291, 2002 through 2009 and post Missouri Senate Bill 291, 2010 through 2012.

Table 4
Pre-to- Post Fitness: Missouri Ninth Grade Passing Scores

<table>
<thead>
<tr>
<th>Fitness Variable</th>
<th>$t$</th>
<th>$df$</th>
<th>$p$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aerobic Capacity</td>
<td>-.582</td>
<td>2018</td>
<td>.561</td>
</tr>
<tr>
<td>Abdominal Strength</td>
<td>-1.191</td>
<td>2018</td>
<td>.234</td>
</tr>
<tr>
<td>Upper Body Strength</td>
<td>-1.679</td>
<td>2018</td>
<td>.093</td>
</tr>
<tr>
<td>Flexibility</td>
<td>-2.417</td>
<td>2018</td>
<td>.016*</td>
</tr>
</tbody>
</table>

*Note: $^*p<.05$
Data did support a significant increase in the percentage of Missouri fifth and ninth grade with passing physical fitness assessment scores for overall fitness when comparing the years 2002-2009, pre-Missouri Senate Bill 291, to the years 2010-2012, post-Missouri Senate Bill 291.

An Independent Sample $t$-test for Comparison of pre-Missouri Senate Bill 291 and post-Missouri Senate Bill 291 fitness scores for Missouri fifth and ninth graders across all four dimensions of physical fitness was administered and suggested that there was a statistically significant difference in total passing rates for students across all four dimensions of physical fitness when comparing the pre-Missouri State Senate Bill 291 set to the post-Missouri State Senate Bill 291 set.

Table 5 suggests that there is a statistically significant difference in total passing rates for students across four dimensions of physical fitness when comparing the pre-Missouri State Senate Bill 291 group ($\mu = 67.88, s = 11.98$) to the post-Missouri State Senate Bill 291 group ($\mu = 69.05, s = 13.67$).

This may have been due to the passage of Missouri Senate Bill 291 in 2009, which mandated physical activity requirements. The physical activity component of Missouri Senate Bill 291 requirement included a minimum of 150 minutes of physical activity per week for elementary students and at least one 20 minute recess per day.

### Table 5
Pre-to-Post Fitness: Missouri Fifth and Ninth Grade Fitness

<table>
<thead>
<tr>
<th>Variable</th>
<th>$t$</th>
<th>$df$</th>
<th>$p$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average Total Passing Students</td>
<td>-2.168</td>
<td>2018</td>
<td>.030*</td>
</tr>
</tbody>
</table>

*Note: $p<.05$.

### Limitations
While this study provided a sound design, as with any research there were limitations to the study that should be addressed. The first limitation of the study was the uniformity of the Missouri Physical Fitness Assessment. A difference in testing administration was a threat to the validity of this study. Different instructors were used to administer the fitness assessments, affecting the uniformity of the assessments provided to the students. Since this study utilized longitudinal, secondary data, the researcher could not control for this limitation. Secondly, implementation is also a limitation of this study. The same administrator was not used in the teaching of all students for the physical education activities. Diverse teachers across the state of Missouri conducted the fitness assessments in
different settings. Another variable to the limitations of this study were the varying minutes of physical activity offered in each school district. Some schools met the required mandated minutes, while other schools exceeded them in regards to Missouri Senate Bill 291. Once again, due to the longitudinal, secondary nature of this study, the researcher could not control for this limitation.

The final limitation existed with varying curricula across the state of Missouri school districts. Various curriculums are utilized throughout the state, a uniform curriculum has not been implemented statewide. A curriculum model that is adopted by the state and implemented with each school district would allow for more comprehensive research as opposed to each school district approving their own curriculum to meet state and national standards. A large sample of school districts across the state contributed to the secondary data set used for study.

Discussion and Conclusion

Following analysis of the data set, a number of important findings became apparent. First and foremost, every physical fitness variable experienced an increase in terms of total average number of passing students in the post-Missouri State Senate Bill 291 group. This was true of fifth graders and ninth graders across the four dimensions of physical fitness incorporating aerobic capacity, abdominal strength, upper body strength, and flexibility. However, flexibility in the ninth grade was the only individual variable found to be statistically significant. Post 2010 students scored over two points higher than the pre 2010 student group for flexibility. When total passing rates across all four fitness variables were taken into consideration, the post 2010 group scored significantly higher than the pre-2010 group.

The Missouri Physical Fitness Assessment data for fifth grade percentage of passing scores improved in all four fitness dimensions between the years of 2003 and 2010. In addition, the Missouri Physical Fitness Assessment data for ninth grade percentage of passing scores improved in all four fitness dimensions between the years of 2003 and 2010. However, approximately 30% of students failed to meet the required standard for a passing score.

Research to determine the status of U.S. children’s fitness levels is needed to provide data to effectively determine and monitor physical activity levels. The intent of this study was to further investigate the potential contribution of legislation in determining and monitoring physical activity levels, through the use of the Missouri Physical Fitness Assessment scores, since the passage of Missouri Senate Bill 291, which went into effect for the 2010 – 2011 school year.

The results may provide valuable information to MODESE and to school districts across the state of Missouri. Specifically, the statistically significant relationships between all four fitness assessments for fifth grade and ninth grade post-mandate Missouri Senate Bill 291 provides
a point for analysis of curriculum activities utilized during mandated physical activity time periods. The significant improvement in flexibility of ninth grade students pre- to post-Missouri Senate Bill 291 indicates a possible contribution of legislation to improve youth’s physical fitness. This research provides a foundation for the state of Missouri to report fitness assessment results to the nation to complete a national report card regarding our youth’s fitness levels. The National Physical Activity Plan (2014) did not have adequate data to prepare a grade for fitness scores of our nation’s children which resulted in an incomplete status.

The research also has the potential to provide school districts across the state of Missouri with valuable information in regard to how each district is performing since the passage of Missouri Senate Bill 291. This research may provide the foundation for each Missouri school district to receive its own physical fitness report card. A local physical fitness report card could potentially be compared to a state physical fitness report card to assist school districts with data to guide curricula and wellness activities.

This study indicated an approximate 70% pass rate for Missouri fifth graders and ninth graders on the four physical fitness dimensions in the state of Missouri (Pre-2009 State Bill, 67.88% pass rate; Post-2009 State Bill, 69.05% pass rate). The idea of a 70% pass rate in other academic disciplines, such as math or communication arts, would create concerns to address the need for remediation or programs to improve those types of scores. The analysis of this study suggests that 30% of Missouri students are still struggling to meet the minimum fitness requirements for the Missouri Physical Fitness Assessment and should provide some motivation to explore further research to administer improvements.

Since 2002, MODESE has collected data from school districts across the state, many of which have failed to submit complete data sets as required. Complete data sets were submitted by 242 school districts for the years 2002 to 2012. This is less than 50% of Missouri school districts required to submit physical fitness data. A recommendation would be for MODESE to collect data from more than just fifth grade and ninth grade. MODESE planned to start collecting fitness data for seventh grade starting in the 2014 – 2015 school year. Valuable data should be collected for fifth grade, seventh grade, ninth grade, and 11th grade. Adding an additional grade at the secondary level, such as 11th grade, would allow for research to be conducted to analyze the contribution to physical activity at the secondary level. MODESE should also consider compiling a comprehensive statistical fitness report available to all school districts, and the public, that could benefit curricula modifications for a school district. A complete and accurate summative report may also prove beneficial in providing valuable data for a national report. A comprehensive physical fitness report card for each district may provide benefits for school districts and communities to work together to improve fitness levels for youth throughout the state of Missouri.

A recommendation is also made to update the Missouri Physical
Fitness Assessment Manual. The last revision occurred in 2000. Part of this recommendation is for a more uniform assessment. The year 2000 version of the tests manual had many options for conducting the fitness testing. For example, to evaluate aerobic capacity, the administrator could choose the mile run or Progressive Aerobic Capacity Endurance Run. Upper body strength/endurance could be assessed by choosing push-ups, pull-ups, modified pull-ups, or the flexed arm hang. Flexibility testing could be conducted with a sit and reach, back-saver sit and reach, or v-sit and reach assessment. The abdominal strength/endurance test could be administered by timed curl-ups, curl-up to a cadence, or partial curl-up test. Uniform testing could result in more accurate analysis of test scores. Statewide training on physical fitness testing would also assist in gathering accurate data sets.

School districts, at the time of this writing, were in a time of meeting common core state standards and accountability for demonstrating proficient academic achievement. The cross-referencing of a district’s physical fitness assessments with academic test scores may prove beneficial in determining appropriate time allotments for physical education and recess. The monitoring and referencing of physical fitness test results would enhance curricular changes and assist with building schedules to construct appropriate physical activity times.

States with mandated physical activity requirements and required reporting of physical fitness scores to the state department may want to consider cross examining fitness scores with academic scores. The comparison could aid in determining appropriate physical activity needs. Many physical education teachers may voice that those youth who are physically fit perform better academically; however, more research needs to be conducted to determine the validity of this type of statement.

It is also recommended to continue to track the Missouri physical fitness data to examine trends beyond the scope of 2012. An updated study to determine applicable minutes of physical activity across the state of Missouri may prove useful for further research. The implementation of collecting fitness data for seventh grade, starting with the 2014 – 2015 school year may provide an opportunity to examine trends as youth move from elementary-to-high school settings.

In conclusion, this study may provide valuable research on the effects of Missouri Senate Bill 291 towards fifth and ninth grade physical fitness levels and an understanding of the alignment of physical fitness standards with youth fitness. The research revealed a positive correlation between the mandate and the physical fitness assessments for ninth grade flexibility. All four dimensions of the Missouri Physical Fitness Assessment, when analyzed as a group, were statistically significant in relation to each other both pre- and post-Missouri Senate Bill 291.

This study also discovered that three out of ten students in Missouri were not passing the Missouri Physical Fitness Assessment. The findings of 30% of Missouri students failing the Missouri Physical Fitness Assessment,
provides a valuable baseline of data that lends itself to further research to search for data driven actions to improve physical fitness levels measured by physical fitness scores.

The 30% failure of passing rate was a concern that can be further evaluated by MODESE and school districts across the state of Missouri. This research may be used in order to motivate the design and implementation of strategies or best practices to improve the passing rate on the Missouri Physical Fitness Assessment.

Evidence suggests physical activity is paramount to youth’s overall well-being. Society must therefore continue to research and implement new physical activity and physical education practices, further allowing youth to continue to develop in all three learning domains. School districts need trained physical educators implementing curriculum designed to optimize physical activity. MODESE, school districts, and communities must collaboratively work together to research and develop policies to improve youth physical fitness. Missouri Senate Bill 291’s impact should continue to be tracked to determine data trends of physical fitness levels of Missouri’s youth.

The research supports 60 minutes of physical activity per day as part of a healthy lifestyle. School districts may want to consider not only meeting the Missouri Senate Bill 291 mandate, but striving toward exceeding the state minimum requirements due to the potential benefits. The benefits offered by increasing the minutes of physical activity may include improved student academic performance, better student behavior, enhanced social skills, and an overall awareness of a healthy lifestyle.

Although Missouri Senate Bill 291 generated some statistical improvement in passing scores of the Missouri Physical Fitness Assessment, further research may encourage an increase in mandated minutes of student physical activity. Further research could indicate the need for changes in curricula to improve physical fitness passing scores. Research may be needed to determine the quality of minutes devoted to physical fitness activities to maximize the benefits of passing scores of the Missouri Physical Fitness Assessment.

References


VanSickle, J. (2013) Leave a legacy: Follow the example of Title IX. *Journal*
ROBERT JOHNSON graduated from Scotland County R-1 High School in Memphis, Missouri in 1988. Robert attended Iowa Wesleyan College and received a Bachelor of Arts Degree in 1992. He received a Master of Science Degree from Drake University in Education Leadership in 2000. He earned an Education Specialist Degree from Lindenwood University in 2004. He attained his Doctorate of Education Degree from Lindenwood University in 2014. Robert has served as a superintendent, principal, teacher and coach. Robert currently teaches elementary physical education and is a basketball coach in the Fort Zumwalt School District. Robert is a registered representative with Primerica, a financial services company. Robert is married to Kendal Johnston and they live in Lake Saint Louis, Missouri with their four children, Caroline, Samuel, Kate and Nicholas.
Influencing knowledge to establish healthy habits and behaviors in our youth is the cornerstone to the necessity of health education as a skill set. Research has shown that adequate K-12 health education can reduce risk behaviors in adolescents (Freudenberg & Ruglis, 2007). Health teachers desire specific training in particular health education domains and professional development improves teaching knowledge and skills (Summerfield, 2001).

The School Health Profiles is a collection of bi-annual surveys measuring school health policies and practices in state and educational systems. The profiles collect data on the status of the school’s health education requirements and content; school health coordination; school health policies (HIV/AIDs, tobacco, nutrition, etc.); asthma management policies; physical education and physical activity; and family and community participation in school health programs. State survey sample was from randomly selected secondary schools (grades 6 – 12) within a school district, territory, or tribal government. Health profile data were retrieved from self-administered questionnaires of principals and lead health education teachers (CDC DASH 2012).

In 2014, the Missouri School Health Profile response rate was 75% for principals and 76% for lead health education teachers. The profile revealed that 88.4% of Missouri secondary schools reported offering their health education with health education goals, objectives, and expected outcomes, which is a decline from 2008 (94.1%). A downward trend of health topics being taught in the Missouri secondary schools was also reported in the 2014 profile. Health topics such as emotional and mental health, human sexuality, human immunodeficiency virus (HIV) prevention, nutrition and dietary behavior, physical activity and fitness, pregnancy prevention and sexually transmitted disease (STD) prevention exhibited a statistically significant instructional decline from 2008. In fact, 11 of the 15 health topics declined in time of instruction in Missouri secondary schools resulting in less health education information disseminated to the students (see Table 1; MO DESE, 2014).

A downward trend for health education professional development training received and desired by Grades 6-12 lead health education
teachers was also reported in the Missouri School Health Profiles. From 2008 to 2014, a significant decline in received training was experienced in health topics such as HIV prevention, human sexuality, nutrition and dietary behaviors, physical activity and fitness, pregnancy prevention, STD prevention and tobacco-use prevention. Additionally, lead health education teachers who would like training also significantly declined in these specified health topics (MO DESE, 2014).

The health concerns that plague our youth are those that come to the forefront in the health education secondary classroom. Unlike other school subject matters, health education is not only instituted to encourage specific advanced knowledge while preparing a student for personal application, it is a moving target of evidence integrated into the complexity of human behavior (Jourdan, 2011). The decline of health education subject content delivered to our Missouri students and educators should be of grave concern. The obesity rate for Missouri high school students is 14.9%, which ranks 8th in the nation (Trust of America’s Health & Robert Wood Johnson Foundation, 2013). According to Missouri Institute of Health (2013), suicide was the 2nd leading cause of death in Missouri’s youth (15 – 24 years), which ranks 18th in the nation. Underage drinking in Missouri cost taxpayers $1.3 billion dollars in 2013 (PIRE, 2011).

To be effective, health education should take place before risk behavior participation in an organized, structured curriculum from a trained professional (WHO, 2013). Providing health awareness through a comprehensive health education program for the youth of Missouri is the investment we must be willing to make.

Review of the Literature

Most Health Education curricula are district-wide, and their content is created and influenced by the National Health Education Standards (NHES), Youth Risk Behaviors Surveillance System (YRBSS), the Health Education Curriculum Analysis Tool (HECAT) and any state specific guidelines. Scientific evidence, best practices, state laws and policy (CDC SHPPS, 2012), time constraints due to standardized tests (Wechsler, McKenna, Lee, & Dietz, 2004), and the 15 content areas are also integral parts of health education curricula across the United States (CDC SHPPS, 2012). Over two-thirds of the 15 health content areas recommended for implementation of a successful health education curriculum fall under the three broad areas of Emotional and Mental Health, Physical Health and Sexual Health. These three subtopics also have encompassed a large number of reported health risk behaviors by Missouri middle and high school students (MO HRBS, 2013) and, therefore, will be the focus of this analysis.
Table 1
Health Topics Taught in Missouri Secondary Schools

<table>
<thead>
<tr>
<th>Percentage of schools teaching health topic:</th>
<th>2008</th>
<th>2010</th>
<th>2012</th>
<th>2014</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emotional and mental health</td>
<td>95.2</td>
<td>94.1</td>
<td>94.7</td>
<td>87.8*</td>
</tr>
<tr>
<td>Human immunodeficiency virus (HIV) prevention</td>
<td>93.1</td>
<td>93.4</td>
<td>92.7</td>
<td>86.5*</td>
</tr>
<tr>
<td>Human sexuality</td>
<td>82.8</td>
<td>84.6</td>
<td>79.8</td>
<td>71.3*</td>
</tr>
<tr>
<td>Nutrition and dietary behavior</td>
<td>99.7</td>
<td>99.0</td>
<td>98.3</td>
<td>95.3*</td>
</tr>
<tr>
<td>Physical Activity and fitness</td>
<td>100.0</td>
<td>100.0</td>
<td>99.3</td>
<td>96.1*</td>
</tr>
<tr>
<td>Pregnancy prevention</td>
<td>83.0</td>
<td>86.6</td>
<td>83.1</td>
<td>76.3*</td>
</tr>
<tr>
<td>Sexually transmitted disease (STD) prevention</td>
<td>91.7</td>
<td>91.9</td>
<td>92.2</td>
<td>85.5*</td>
</tr>
<tr>
<td>Suicide prevention</td>
<td>80.3</td>
<td>79.2</td>
<td>78.6</td>
<td>78.9</td>
</tr>
<tr>
<td>Violence prevention (e.g., bullying, fighting, or dating violence prevention)</td>
<td>92.1</td>
<td>91.4</td>
<td>93.1</td>
<td>90.2</td>
</tr>
</tbody>
</table>

Note: * Statistically significant (MO DESE, 2014)

Emotional and Mental Health
The lack of any positive change over the past ten years in Missouri high school students who have experienced depression or attempted suicide should suggest the importance of educating Missouri adolescents about their emotional and mental wellness (MO HRBS, 2013). Almost one-third (27.3%) of high school students in Missouri reported feeling sad or hopeless almost every day for two weeks during the past year, and this number was even higher for female adolescents (38.2%). Furthermore, a total of 14.2% of Missouri adolescents reported considering suicide (MO HRBS, 2013). While the number of suicide attempts resulting in injury was very low at 1.9% (MO HRBS, 2013), suicide still remains the second leading cause of death for Missouri Youth (15 – 24 yrs; Missouri Institute of Mental Health, 2015).

Bullying negatively impacts adolescents’ mental health (NIH NICHD, 2014; Nixon, 2014). Over half of all Missouri middle school students and one-quarter of Missouri high school students were bullied on school property in the past 12 months (MO HRBS, 2013). While the reported negative consequences for bullying victims may not be shocking, similar
or other negative consequences also have occurred for adolescents who either bullied others or were bystanders when the bullying occurred (NIH, NICHD 2014; Rivers, Poteat, Noret, & Ashurst, 2009). Due to the use of electronic technology and social media, school property is not the only place where bullying takes place. The Internet has expanded opportunities for bullying outside the traditional school environment with over 25.4% of Missouri middle school students reported being victims of cyberbullying (MO HRBS, 2013). Cyberbullying according to Nixon (2014) also has been found to pose a major threat to adolescents’ health and well-being with cyberbullying victims reporting increased depressive affect, anxiety, loneliness, suicidal behavior and somatic symptoms (i.e., headaches, stomach aches, poor appetite and sleep disturbances).

A large number of Missouri adolescents have reported struggling with mental health issues such as depression, suicide, and bullying (MO HRBS, 2013). A significant decline between 2008 and 2014 occurred in the percentage of secondary schools that taught health topics related to emotional and mental health as well as the percentage of Missouri teachers who received any professional development about them (MO DESE, 2014). One potential reason for the decrease in classroom instruction is explained by the sensitivity of the issue and the lack of knowledge and understanding by teachers on how to approach complex topics while developing and implementing successful lesson plans. This issue, however, cannot be corrected when the number of lead health educators who received training on emotional and mental health has decreased by 11% between 2008 and 2014 (MO DESE, 2014). With zero improvements occurring in the reported number of Missouri secondary students experiencing depression, suicide, and bullying, it appears the lack of professional development opportunities for teachers should become a greater priority in Missouri school districts.

Physical Health

Regular physical activity and quality dietary habits promote positive physical health in people of all ages. Cultivating healthy physical habits in our youth is of vital importance as it is a time of growth and development. The rise in childhood obesity is related to faulty energy balance from an increased sedentary lifestyle and overconsumption of dietary nutrients.

When a child’s weight is over 10% of recommended weight (specific to age, height, and body type), the child is then considered obese. Obesity most commonly develops between five and six years or during the adolescent years of growth (AACAP, 2011). In 2012, nearly 12.7 million (17%), 2 – 19-yr-olds were considered obese in the United States (Ogden, Carroll, Kit, & Flegal, 2014). Evidence also links childhood obesity to adult obesity. Obese 10 to 13-yr-olds have an 80% chance of becoming obese adults (AACAP, 2011).

The financial burden of obesity through accrued medical costs is another consequence that our young people face. Annually, the U.S.’s childhood obesity direct costs are estimated to be 14.3 billion. Obese
individuals also pay 42% more for medical costs as compared to those of healthy weight individuals (CDC DNPAO, 2010; Hammond & Levine, 2010). In 2011, 13.5% of Missouri’s youth (ages 10 – 17) were considered obese, which ranked 36th in the U.S. and is a clear indicator that Missouri’s youth struggle with physical health indicators (Trust of America’s Health & Robert Wood Johnson Foundation, 2013).

Key findings in the Missouri School Health Profile (2014) physical activity & fitness revealed the percentage of secondary schools that offered intramural sports, or physical activity clubs declined from 58.8% (2008) to 52.2% (2014); and interscholastic sports offerings declined from 90.0% (2012) to 79.7% (2014). Secondary schools where their Physical Education (PE) teachers received professional development in physical education or activity in the past two years also declined from 90.1% (2008) to 77.5% (2014).

The Physical Activity Guidelines for Americans recommends that youth between the ages of 6 and 17 yrs receive 60 min (1 hr) or more of physical activity each day (US DHHS, 2008). Missouri secondary schools that offer physical activity breaks in the classroom, outside of PE class, are 42.6% (MO DESE, 2014). With the decline of physical activity opportunities and instructional emphasis in our schools, the state of Missouri should consider efforts to refocus curriculum and training to include an emphasis on active lifestyles and promote life skills for positive physical health.

Nutrition and dietary intake curricular content in health education are of utmost importance as many of our dietary habits are formed during our childhood years. Health instruction on food and nutrition is recommended in Missouri K-12 classrooms as described in the Missouri’s Learning Standards for Health Education (MO DESE, 2007).

Based on knowledge gained in the Missouri School Health Profiles (2014), there was a significant decline in the percentage of secondary schools teaching nutrition and dietary behaviors from 2008 (99.7%) to 2014 (95.3%). Of Missouri health education teachers, 30% reported receiving professional training in nutrition and dietary behavior in 2014, which is significantly down from 46.9% receiving training in 2008.

Missouri schools who sell foods and beverages of low nutrient quality are decreasing in number. In 2004, 61.8% of Missouri secondary schools sold chocolate candy compared to 30.8% in 2014. Schools selling soda pop has also declined sharply. In 2006, 74.2% of Missouri secondary schools sold soda pop compared to 36.2% in 2014 (MO DESE, 2014). Please see Table 2 for additional food and beverage sales.
### Table 2
Food and Beverages Sold in Missouri Secondary Schools

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Chocolate candy</td>
<td>61.8</td>
<td>50.8</td>
<td>31.3</td>
<td>33.2</td>
<td>38.3</td>
<td>30.8*</td>
</tr>
<tr>
<td>Salty snacks (high fat)</td>
<td>68.8</td>
<td>60.9</td>
<td>38.9</td>
<td>38.7</td>
<td>41.4</td>
<td>36.8*</td>
</tr>
<tr>
<td>Soda pop</td>
<td>-</td>
<td>74.2</td>
<td>54.9</td>
<td>43.8</td>
<td>46.0</td>
<td>36.2*</td>
</tr>
<tr>
<td>Sports drinks</td>
<td>-</td>
<td>76.2</td>
<td>75.6</td>
<td>63.9</td>
<td>65.8</td>
<td>56.0*</td>
</tr>
</tbody>
</table>

*Note: *Statistically significant
(MO DESE, 2014)

### Table 3
Lead Health Teacher Received Training and Preference for Training

<table>
<thead>
<tr>
<th>Health Topic</th>
<th>Received training</th>
<th>Would like training</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2008</td>
<td>2014</td>
</tr>
<tr>
<td>Emotional and mental health</td>
<td>44.5</td>
<td>33.2</td>
</tr>
<tr>
<td>HIV prevention</td>
<td>35.6</td>
<td>16.8*</td>
</tr>
<tr>
<td>Human sexuality</td>
<td>29.1</td>
<td>13.9*</td>
</tr>
<tr>
<td>Nutrition and dietary behavior</td>
<td>46.9</td>
<td>30.0*</td>
</tr>
<tr>
<td>Physical activity &amp; fitness</td>
<td>60.4</td>
<td>38.8*</td>
</tr>
<tr>
<td>Pregnancy prevention</td>
<td>29.1</td>
<td>12.9*</td>
</tr>
<tr>
<td>STD prevention</td>
<td>32.5</td>
<td>17.2*</td>
</tr>
<tr>
<td>Suicide prevention</td>
<td>33.1</td>
<td>29.4</td>
</tr>
<tr>
<td>Violence prevention (bullying, fighting)</td>
<td>66.6</td>
<td>54.9</td>
</tr>
</tbody>
</table>

*Note.* *Statistically significant
(MO DESE, 2014)
Sexual Health

Many adolescents engage in risky sexual behaviors that can result in unintended health outcomes (CDC DASH 2015). According to CDC’s Division of Adolescent & School Health (2015), examples of sexual risk behaviors include: ever having sexual intercourse; having had sexual intercourse during the previous three months without the use of a condom; having sex with four or more people during their life; or never having been tested for HIV. In the state of Missouri, over 43% of teens reported having engaged in sexual intercourse at some point in his or her life. While this percentage has lowered by 9% since 2003, almost 1/3 of Missouri high school students (32%) admitted to having sexual intercourse with at least one person during the past three months, and over 16% of Missouri teens did not use any method of birth control at last intercourse. The overall use of condoms by Missouri teens decreased from 67.3% in 2003 to 58.1% in 2013 with an astonishing 42% of Missouri adolescents reporting a lack of condom use during last intercourse (MO HRBS, 2013).

Poor health outcomes from engaging in risky sexual behaviors such as teenage pregnancy and infection from HIV and STDs have been reported by Missouri teens (CDC DSTDTP 2014; CDC NCHHSTP, 2015; US DHHS, 2011). In the state of Missouri, the teen pregnancy rate in 2011 was 34.5 per 1,000 teenage girls aged 15-19, which was slightly higher than the national teen pregnancy rate of 31.3 per 1,000 teenage girls (US DHHS, 2011). Besides unintended pregnancies, adolescents also are at risk for infection from STDs and HIV. According to the CDC’s Division of STD Prevention, (2014), young people aged 15-24 acquired half of all new STDs cases and one in four sexually active adolescent females have had an STD such as chlamydia or human papillomavirus (HPV). In the state of Missouri, almost 7,000 females aged 15-19 were diagnosed with Chlamydia according to the 2015 Missouri State Health Profile (CDC NCHHSTP, 2015). The transmission of HIV can also occur from unprotected sexual activity and in the state of Missouri, an estimated 482 adults and adolescents were diagnosed with HIV in 2013 (CDC NCHHSTP, 2015).

In reality, many Missouri teens seem to be putting their health at risk by engaging in risky sexual behaviors (MO HRBS, 2013). Even when teens used contraceptives, they reported not using them consistently or effectively according to Scott, Wildsmith, Welti, Schelar and Steward-Strength (2011). A suggested method to combat these issues would be to make sure the topics of human sexuality, Human Immunodeficiency Virus (HIV) prevention, pregnancy prevention and Sexually Transmitted Disease (STD) prevention remain part of the health education curricula in secondary schools. However, the Missouri School Health Profile (2015) reported the opposite to have occurred. Between 2008 and 2014, the percentage of Missouri secondary schools who have prepared and implemented lessons on the topics of human sexuality, Human Immunodeficiency Virus (HIV) prevention, pregnancy prevention, and Sexually Transmitted Disease (STD) prevention has significantly declined (11.5 %, 6.6%, 6.7% and 6.2%,
respectively; MO DESE, 2014).

One potential reason for this decrease could be due to the statically significant downward trend in professional development received by Missouri teachers in the content areas of sexual health (Table 3). For example, the percentage of Missouri teachers who received training in HIV prevention in 2014 was 16.8% and that was a statistically significant change from the 35.6% who received training in 2008. The decreased percentage of teachers receiving training in sexual health topics in the state of Missouri could be a factor in why fewer Missouri teachers have reported teaching the sexual health topics and why Missouri adolescents report continued participation in health risk behaviors despite the long-term health consequences (MO HRBS, 2013).

Health Education Professional Development

One criterion noted for the delivery of a successful health education curriculum by the World Health Organization (2013) was having it taught by a trained health professional. Health educators are charged with helping to reduce the negative impact of major health problems such as heart disease, cancer, mental illness, and obesity. In the state of Missouri, secondary health teachers face elevated pressures due to: Missouri’s obesity rate (ranked 8th; Trust of America’s Health & Robert Wood Johnson Foundation, 2013); suicide remains the second leading cause of death for adolescents age 15-24 (Missouri Institute of Mental Health, 2013); and rates of teenage pregnancy remain high (MO HRBS, 2013). Missouri health teachers reported receiving significantly less training than in years past for many of these health issues (MO DESE, 2014).

Missouri health teachers have been asked to do the impossible. Health teachers are charged with educating students in a personal evolving discipline that has 15 content areas where immediate outcomes cannot be measured. With minimal amounts of professional development received, most health teachers struggle with staying current in the science, learning new content, and creating innovative lesson plans. These challenges are even greater for those teachers assigned to teach multiple grades and multiple subjects.

One perplexing finding in the Missouri School Health Profile (2014) was the decreased number of teachers who reported an interest in receiving training and professional development in health content areas. These findings failed to report why teachers desired less training. The financial strain on public education in the state of Missouri might suggest that districts are not funding it and teachers would have to pay out of pocket to attend training or would prefer to use professional development funds to attend different pieces of training. Some Missouri health teachers may not want to sign up for professional development training if they have to give up weekends or remain at school after hours. The lack of interest in professional development may also suggest that the health topics are not being taught by teachers whether it be due to time constraints,
uncomfortable nature of health topics or undue pressures from parents on material that is covered.

With the present state of health for youth in the state of Missouri, decreasing health education would not benefit health outcomes and could likely be detrimental by leading to increased health risk behavior participation. However, the health teachers in Missouri reported receiving less professional development on health topics versus years past. So the question remains as to whether the decrease in training received by lead health teachers in the state of Missouri could have contributed to the downward trend of health topics being taught in Missouri schools (see Table 1). The findings from this analysis suggest a need to continue to track professional development and education received by Missouri secondary health teachers in relationship to health programs taught by teachers and the health education received by secondary students in the state of Missouri.

Table 4
Lead Health Teachers’ Training Experiences

<table>
<thead>
<tr>
<th>Instructional Strategies</th>
<th>Receiving training</th>
<th>Would like training</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teaching students with disabilities</td>
<td>49.7</td>
<td>59.4</td>
</tr>
<tr>
<td>Teaching students with various cultural backgrounds</td>
<td>39.5</td>
<td>43.6</td>
</tr>
<tr>
<td>Teaching students with limited English proficiency</td>
<td>20.3</td>
<td>39.3</td>
</tr>
<tr>
<td>Teaching students of different sexual orientations or gender identities</td>
<td>11.2</td>
<td>42.3</td>
</tr>
<tr>
<td>Encouraging family or community involvement</td>
<td>35.3</td>
<td>60.5</td>
</tr>
<tr>
<td>Using interactive teaching methods</td>
<td>53.0</td>
<td>57.1</td>
</tr>
<tr>
<td>Teaching skills for behavior change</td>
<td>42.7</td>
<td>61.0</td>
</tr>
<tr>
<td>Classroom management techniques</td>
<td>65.7</td>
<td>59.2</td>
</tr>
<tr>
<td>Assessing or evaluating students in health education</td>
<td>27.3</td>
<td>62.5</td>
</tr>
</tbody>
</table>

(MO DESE, 2014)
The connection between health and education provides the integral link for youth and disease prevention. Encouraging and providing educational tools promoting good health is important for children physically as well as cognitively. “Today, we are faced with a host of health problems that require individual action. . . . Bringing about that action requires education” (Allegrante, Sleet, & McGinnis, 2004, p. 371).

The Joint Committee on National Health Education Standards (2007) advises school districts to provide health education instruction to students a minimum of 40 hrs for Pre-K to grade 2 and 80 hrs for grades 3 to 12 each academic year. The World Health Organization’s research review on school health education programs reported three key findings influencing program quality: health education programs that focused on skill development and communicated knowledge and attitudes were more likely to positively impact student’s health behaviors; healthy skill development has the most potential when tied to a specific health behavior and/or decision; and participatory experiences and actively involving students in skill development are more effective than passive health education endeavors (WHO, 2003).

The reported declines in professional development opportunities and instructional practices of the Missouri school health educators is concerning. From 2008 to 2014, significant declines in health topics taught in Missouri schools was reported for emotional and mental health, sexual health, nutrition and diet behaviors, and physical activity and fitness. All of these topics and behaviors are specific areas of concern for our Missouri students so the decline in instructional engagement may pose a negative impact on Missouri’s state of health. Health education teachers who received training also declined significantly from 2008 to 2014 for topics in sexual health, nutrition and diet behaviors, physical activity and fitness. Without current and effective training, the dissemination of quality education is limited. The suggestion that Missouri health education teachers have not been teaching specific health topics due to a lack of training is concerning. Without specific health education training, many Missouri health education teachers may not have the time to learn the content and develop innovative strategies and formative assessments to accompany health education lessons.

Appropriate tools and time need to be dedicated to properly train our health educators so Missouri students can learn to choose healthy lifestyles, reduce risk-taking behaviors, prevent diseases, and develop life skills. The significant declines in the curricular emphasis of health education in our Missouri schools, as described in the Missouri School Health Profiles (2014), is a concern we cannot afford to ignore. Investing in education that can improve health risks of our Missouri youth is a cost-effective approach to ensuring a healthy Missouri.
References


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An Examination of How Traditional and Non-traditional Students Differ in Perceived Stress and How They Manage Stress

Don Austin and Blake Lockmiller

Introduction: Previous research about college stress has focused on traditional students. Yet, there is a need to examine nontraditional students’ stressors. While studies have examined the stress levels of traditional and nontraditional students in how they perceive and manage stress, there is still a lack of research exploring the stress levels of these two student cohorts. Purpose: The purpose of the study was to compare a sample of traditional age and non-traditional age students to determine whether there were differences in stress between these student populations. Methods: Participants were 39 college students (20 traditional - Mean age =18.9 yrs, SD=.9; and 19 non-traditional - Mean age =32.2 yrs, SD=5.9) enrolled as full-time students. All participants completed a survey packet including the Perceived Stress Scale (PSS) and an original survey developed for this study examining students’ perceived stress and coping strategies used to manage stress. Results: An independent t-test examining the two groups on overall PSS score was significant (t=3.24, p<.05), indicating traditional students perceived stress to a greater extent than non-traditional students. An examination of stress management strategies indicated that the most popular strategy for traditional students was listening to music whereas the most popular strategy for non-traditional students was exercise. Conclusion: Perceived stress was different depending on the age cohort (traditional vs. nontraditional) of the students. Implications: If we look at more ways to help reduce stress for students no matter what their age, we could help students to become less worried with school and better able to enjoy the experience of college instead of stressing over it.

Stress is a factor that college students face every day. In fact, stress is a serious health factor that can be harmful to overall health. There are two major types of academic stressors that college students often experience: eustress and distress. Eustress is considered good stress, has a positive outcome on the student, and makes them feel good. However, distress,
which is considered negative, can damage one’s health. When students go to college, “it is a milestone making students adjust to academic challenges, levels of independence, separation from family and new role expectations, making this transition a source of stress” (Kreig, 2013, p. 635). Misra and Castillo (2004) identified four types of reactions due to stressors from physical stress to psychological perceptions of stress which include physiological, behavioral, emotional, and cognitive. These reactions are due to the students’ perception of academic stressors, and are based on extensive knowledge and having time to acquire it. According to Misra and Castillo (2004), some common sources of academic stressors include frustrations, pressures, conflicts, changes, and self-imposed factors. Ragsdale, Beehr, Grebner and Han (2011) identified two different types of stressors that college students face: quantitative workload (the amount of workload that is placed on the student at a given time) and role ambiguity or uncertainty about expectations on how to fulfill the required tasks asked of the students.

When examining stress among college students, there have been studies done to compare two different types of college students, nontraditional and traditional students. Nontraditional college students are often defined as at least 25 yrs of age or older (Bell, 2003), while traditional students are considered 24 yrs of age or younger. Dill and Henley (1998) found differences between how traditional and nontraditional students perceive stress. Traditional students have shown greater stress from social and peer events, like going to parties, and as well as belonging to organizations, when compared to nontraditional students. Eppler, Carsen-Plentl and Harju (2000) studied differences between traditional and nontraditional students by examining three categories: attributions of negative events (receiving a poor grade); nature of intelligence (the view the student had about their own intelligence); and optimism achievement goal orientation (that they will do good on a given item, test, or class). Specifically, they found that nontraditional students had a higher GPA compared to traditional students. Yet, neither group differed on negative events impacting their academics. They did, however, see a difference in the students’ failure attribution category that helped define academic success when dealing with stress. According to Eppler et al (2000), when a student had a high score in the failure attribution category, they would experience greater stress, but if they had a low score in the failure attribution category, they were better equipped to not have stress in those areas. Differences in these age groups indicate that nontraditional students appeared more resilient to academic learned helplessness when compared to traditional students.

When examining stress in college students across different age groups, one must consider actual stress and perceived stress. Research indicates that traditional-age college students may perceive stress differently than older students. Specifically, younger students (i.e. freshmen) appear most susceptible to stressors because they are transitioning away from home and taking their first steps toward independence. Dyson & Renk (2006)
also noted that attending college for new students can be a very stressful experience. Specifically, they examined six stressors influencing freshman. These stressors were family life, college change, problem focused, emotion focused, avoidant coping, and depression. According to Dyson and Renk (2006), the highest levels of stress that freshman perceive are family, adjusting to college change, and depression. Other research on academic stress has found that negative academic stress increases throughout the semester as a result of cumulative academic demands (Galatzer-Levy & Bonanno, 2013).

Academic stress does not necessarily dissipate after the first year of college. As students progress through college, stress might not show up as dramatically throughout the rest of college but it will definitely show up at crucial times. For example, Kuhn, Kranz, Koo, Cossio and Lund (2005) examined full time students enrolled in a physician assistant program and examined stress via sleeping patterns, dietary habits, and relationships. Out of the 27 students they surveyed, 70% experienced negative changes in eating and sleeping patterns, and 40% experienced negative changes in their relationships, indicating that academic stress could influence students’ health patterns. Such research confirming the relationship between academic stress and health parameters has also been confirmed by other research (e.g. Mahmoud, Staten, Hall & Lennie, 2012; Pedersen, 2012).

Research also indicates that nontraditional students may experience stress differently than younger college students. Bell (2003) examined how nontraditional students experienced stress and its effect by examining six categories of stressors (i.e., worth of the class, test/class anxiety, interpretation of anxiety, self-concept, fear of asking for help, and fear of the teacher) that students could experience in college that might raise their level of stress. Nontraditional students scored extremely high on test/class anxiety compared to other students within the class. Also, nontraditional students had a much lower score on test/class anxiety when compared to traditional students. This finding contradicts Eppler et al’s (2000) findings that nontraditional students had higher GPA’s concerning grades and studies. Bell (2003) went on to conclude that “teachers need to be aware of differences between the students, and should help make an effort to lessen anxiety that students are facing” (2003, p. 161).

While studies have examined the stress levels of traditional and nontraditional students, there is still a lack of research directly comparing the stress levels of these two cohorts. It is important to understand potential differences between traditional and nontraditional students in their (a) perception of and (b) management of stress because enhanced knowledge of these variables may produce effective stress intervention strategies for each individual. Such strategies would help students manage their stress level so it would less likely become a health burden. Therefore, the main purpose of this study was to compare a sample of traditional age and nontraditional age students at a Midwestern, regional university to determine
whether there were differences in perceived stress and stress management strategies between traditional and nontraditional students.

The central research question was: Do traditional and nontraditional students differ in their stress levels and how they manage stress? It was hypothesized that traditional and nontraditional students would display differences in how they perceive and manage their stress. Specifically, it was hypothesized that nontraditional students would show greater perceived stress yet more ability to manage their stress than traditional students.

Methods

Participants
Thirty-nine college students were surveyed, including 20 traditional age students (age 24 or younger) and 19 non-traditional students (age 25 +). This study was approved by the campus IRB for the protection of human subjects prior to data collection. The participants were drawn from a convenience sample from various classes across campus and all volunteers were administered a survey packet which included a consent form, and surveys asking questions regarding perceptions of personal stress and how students manage their stress.

Instrumentation
The first instrument used was a survey created specifically for the purpose of this study to measure how college students managed their stressors as well as the coping methods that they use. This survey contained 23 questions and two open-ended items. When calculating the result from this survey, a lower overall score represented lower perceived stress, while a higher score represented higher perceived stress.

Perceived Stress Scale. The second instrument used in the data collection process was the Perceived Stress Scale (PSS; Cohen, Karmarck, & Mermelstein, 1983). The Perceived Stress Scale is a 14-item, five-point Likert scale that measures the participant’s perception of stress within the last month. The PSS demonstrates adequate validity and reliability and is correlated with stress life-event scores, depressive symptomatology, and social anxiety. From the scale, a higher summary score represents a higher overall perception of personal stress.

Procedures
Upon approval from the campus institutional review board, permission was obtained from various instructors to visit their courses and administer surveys to students. Students were asked to carefully read the front page of the questionnaire which contained the consent form and asked to sign it to be able to participate in the study. Once students read and signed the consent form, they were instructed to carefully read each question that was presented to them within the survey and answer honestly to their
best knowledge by writing/circling their answer based on a five and four point Likert scale. All surveys were administered by the researchers and took less than ten minutes to complete.

Data Analysis

Data analyses were performed using SPSS (Version 20.0) for Windows. Descriptive statistics were computed to examine overall and group stress and perceived stress scores. In order to examine the hypothesis of whether traditional and non-traditional students differed in their perceived stress, separate independent t-tests were used to examine differences in summed scores of the original instrument and overall PSS score. An additional independent t-test was performed to determine if the two groups were different on their stress management techniques. An alpha level of $p<.05$ was adopted for all analyses.

Results

The final sample of 39 participants consisted of 20 traditional students and 19 nontraditional students. Participants were classified into these two groups based on their age, as defined by Bell (2003). The mean age of the traditional student group was 18.9 yrs (SD=.9), while the nontraditional student group mean was 32.2 yrs (SD=5.9). In terms of gender, there were 18 males and 21 female participants, while the year in school breakdown was 17 freshmen, 13 sophomores, four juniors, and five seniors. Two separate independent t-tests were conducted to determine if there was a significant difference between traditional and nontraditional students in how they perceived and managed their stressors based on our survey as well as the PSS sum score. Results of the first independent t-test comparing the age groups on the original scale developed for this study were not significant, $t(37)=.534, p>.05$, (traditional group $M=46.55$, $SD=6.57$, non-traditional group $M=45.52$, $SD=6.57$) A second independent t-test was performed comparing PSS scores between the two groups, and this independent t-test was significant ($t(37)=3.24, p<.05$), indicating that traditional age students ($M=38.35$, $SD=5.4$) had significantly greater perceived stress compared to non-traditional students ($M=22.57$, $SD=5.7$).

Additional independent t-tests performed on individual items from the original survey created for this study demonstrated statistically significant differences on five separate items: “I never get frustrated with school” ($t(37)=2.697, p<.05$), “I feel pressured from friends and family to succeed in college” ($t(37)=2.404, p<.05$), “I frequently use supplements to stay alert” ($t(37)=-2.702, p<.05$), “I find it hard to fit in socially” ($t(37)=-2.051, p<.05$), and “On average how much time within in a given day do you use for reducing stress” ($t(37)=2.364, p<.05$). Finally, using content analysis, open-ended responses for the last survey item (asking students the different ways they coped with stressors), participants’ written responses were analyzed and grouped into common higher order
themes. The results indicated the most common stress coping themes were: (1) listening to music, (2) exercising, (3) reading, (4) meditating, (5) confiding in someone, and (6) and “other” category. Specifically, the most popular stress management technique for traditional students was listening to music \(n=15\), whereas the most popular choice of coping with stress among nontraditional students was exercise \(n=11\).

**Discussion**

The purpose of this study was to compare traditional age with nontraditional age students and determine whether or not differences existed in their perceptions, or their management of stress. The results revealed a significance difference between traditional and nontraditional students on their perceived stress according to the Perceived Stress Scale (PSS). However, the hypothesis that non-traditional students had higher overall stress compared to traditional students was not supported. When examining individual items from the original survey on perceptions of stress that were statistically significant, some interesting differences between traditional and nontraditional students emerged. First, traditional students showed a higher frustration level with school when compared to nontraditional students. This may have been due to the fact the younger college students had not yet learned “life skills” to deal with many of their stressors compared to older, non-traditional students. Traditional students were found to have a higher stress level with more time to cope with stressors when compared to nontraditional students. Lastly, traditional aged students also received more pressure from family and friends to succeed in college than compared to the non-traditional students. When looking at the non-traditional students, they had a higher score on frequently used supplements and they also used them more often to stay alert as well as finding it hard to fit in socially when compared to the traditional aged college student group. Since traditional and nontraditional students differed on rates of supplements use to counter stress, future research may wish to examine these habits in more detail, as there may be concern over misusing supplements as a dysfunctional coping method. Both age groups demonstrated similar patterns of dealing with stress in that both groups reported that listening to music and exercising were effective means to deal with stress.

Stress is a factor in life that can cause damage one’s health and well-being, if not properly handled. When stress is not handled properly and quickly in one’s life, signs and symptoms of distress will start to appear. Examples of distress can include depression, anxiety, lack of sleep, and bad eating habits. However, healthy stress coping methods can defend against the negative impact of stress. Li and Lindsey (2013) indicated several effective stress management areas for college students including health responsibility, stress management, physical activity, nutrition, spiritual growth, and interpersonal relationships. Specifically, Li and
Lindsey (2013) indicated that 60% of students engaged in physical activity for stress reduction, and over 50% utilized social support from meaningful relationships to reduce stress. Such close scrutiny of college students (from both traditional and non-traditional cohorts) is necessary to gain greater insights into stress indices and management techniques of college students.

Several limitations should be noted in the study. First, the sample was small (N=39) and was a convenience sample, so generalizability is limited. The second limitation was the ability of finding nontraditional students to participate in the study, compared to traditional students. With the ability to find more non-traditional students, the generalizability of the study would have been further enhanced. Thus, future research should be done to further examine non-traditional students in how they perceive stress and manage that stress and see if any other factors could present themselves that was not already presented in this study. The third limitation was that the method was cross-sectional and not longitudinal, in that by assessing perceived stress over an entire academic year, a more comprehensive view of both perceived academic stress and stress management techniques will be obtained. Therefore, future research should be longitudinal in nature, examining traditional versus nontraditional students’ entire college education experience, to get a better understanding on how stress affects both groups over time.

In conclusion, perceived stress among college students tends to appear to be different depending on the age group of the students. Future research should examine exactly where in their life a student may perceive stressors differently and why it happens. Researchers should also look at more ways to reduce stress for students no matter what their age so they can be less worried about school and better able to enjoy the experience instead of stressing over it. Mis-managed stress during college is likely to result in negative health habits and stress-related problems after college. Potential strategies like physical activity, stress management, nutrition, spiritual growth, and interpersonal relationships (Li & Lindsey, 2013), may help both age groups with their stress in their college years. Finally, future research should examine whether implementing stress management strategies at an earlier age would help reduce stress for students upon entering their college experience.

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DON AUSTIN is a 2015 graduate of Missouri Western State University. He is currently a first year Master’s student in the exercise science program at the University of Central Missouri.
There is a need for nutrition programs designed for high school students to address national concerns of low fruit and vegetable consumption, excessive empty calorie intake, and excessive sugar-sweetened beverage consumption. The aim of this study was to examine the effectiveness of a short term, four-lesson theory-based nutrition education program designed for high school students to address empty calories from snacking and beverages. A pre-post questionnaire was used to identify knowledge, attitude, behavioral intent, and behavior changes. Results indicated no significant change in total knowledge, attitude, behavioral intent, or behavior scores from pre to post intervention (p > .05). Analysis among individual questions, specifically behavior questions, showed slight increases in the number of students who answered correctly post intervention. Additional research is needed in this population to identify if a more intense long-term education curriculum would promote improved results in the adolescent population.

**Key words:** adolescence, Social-Cognitive Theory, diet, nutrition, obesity, school-based

Obesity among school-aged children is a nationwide concern. Children and adolescents are not meeting the recommended amount of fruits and vegetables with some studies showing that 40-61% of children are consuming less than 1 fruit or vegetable per day (Cullen et al., 2003; Gonzalez, Jones, & Frongillo, 2009). An analysis of the National Health and Nutrition Examination Survey, a national cross-sectional survey that col-
lects health information data on children ages 2-18 years old, reports that adolescents consume nearly 40% of total energy intake from empty calorie foods with a high proportion of calories coming from solid fat and added sugars. Among children 14-18 years old, soda and grain desserts such as cookies, cakes, and pastries made up the largest percentage of empty calories (Reedy & Krebs-Smith, 2010). A high percentage of empty calories in the food choices of children and adolescents is a contributor to the lack of fruits and vegetables in their diet (Reedy & Krebs-Smith, 2010). These food habits coupled with physical activity behaviors contribute to the high prevalence of overweight and obese children and adolescents.

Public health nutritionists’ combat obesity by implementing theory based nutrition education programs into existing early childhood and middle schools curricula. The Institute of Medicine report states that schools should be the primary target to prevent child and adolescent obesity (Institute of Medicine, 2012). Among many behavior change theories, the Social Cognitive Theory is one of the most used theoretical bases for obesity prevention programs as they rely heavily on increasing self-efficacy, social-support, and self-regulation to positively change health behaviors (Anderson, Winett, & Wojcik, 2007; Anderson-Bill, Winett, & Wojcik, 2011; Powers, Struempler, Guarino, & Parmer, 2005).

Statewide efforts such as The Coordinated Approach To Child Health (CATCH) program and Planet Health program have utilized theory based intervention programs to promote healthier eating habits, increase physical activity, and address the issue of body image in middle school students. The CATCH study improved nutrition knowledge and increased physical activity among middle school students (Springer et al., 2013). The Planet Health program resulted in reducing weight and potential risk factors for chronic disease, and promoting overall health among middle school students (Katz, 2009).

Although national efforts have addressed the nutrition and health concerns of the younger student population, little data has documented the efforts of addressing adolescents in the high school setting. Existing nutrition programs choose to target children in elementary and middle school with the intention that children will apply nutrition knowledge gained from these programs into adolescent and adult behavior (Haynos & O’Donohue, 2012; Powers et al., 2005). Research supports the need for nutrition programs directed towards high school students to address national trends of low fruit and vegetable consumption, high proportion of total calories coming from empty calories, and excessive sugar-sweetened beverage consumption (Centers for Disease Control and Prevention, 2011; Springer et al., 2013).

The purpose of this study was to examine the effectiveness of a short-term nutrition education curriculum targeting healthy snacking and beverage options implemented into a high schools physical education class.

**Method**

**Study Design**

This is a pre-post assessment study that evaluated knowledge, attitude, behavioral intent and behavior changes after a short-term nutrition educa-
tion curriculum to high school students in a physical education class. The same questionnaire (see Appendix) was administered to participants prior to beginning the first lesson in the curriculum and after the fourth lesson of the curriculum.

Total time from the administration of the questionnaire pre curriculum to the administration of the questionnaire post curriculum was approximately five weeks. Although a consortium of nutrition education survey tools was referenced (Research and Evaluation Unit-California Department of Public Health, 2010-2011), the questionnaire was specifically developed by the creators of the curriculum for this nutrition education program based off of the Social Cognitive Theory constructs of self-efficacy, self-regulation, and expectation outcomes. A panel of registered dietitians determined construct validity. Reliability was determined in a population of 24 students that matched age and demographics of study participants.

The nutrition curriculum was designed using the Social Cognitive Theory to specifically target the topic of healthy snacks and beverages. There were four, one-hour lessons that included a nutrition education portion, a physical activity to reinforce new concepts, and activities aimed to help support Social Cognitive Theory concepts of self-efficacy, self-regulation, and expectation outcomes. These concepts were chosen as research has documented positive results with similar strategies (Rustad & Smith, 2013; Springer et al., 2013; Waters et al., 2014). Two registered dietitians delivered the first lesson plan in the classroom to demonstrate lesson delivery. The physical education teacher then delivered the remaining three lessons. Table 1 highlights the nutrition education curriculum in more detail.

**Participant Information**

All data was collected from a high school in the Midwest region of the United States. Specifically, the program targeted students enrolled in a required physical education class. The high school was in a low-income inner city location. Student’s grade level ranged from 9-12 grade. The student population was 98% African American with an 86% attendance rate. Approximately 87% of the school qualifies for free or reduced priced lunch compared to the state average of 50%. The four-year graduation rate is 42% compared to the state average of 86% (Missouri Department of Elementary and Secondary Education, 2014).

**Measures and Procedures**

Students completed a three section, multiple-choice questionnaire that examined knowledge, attitudes, behavioral intent, and behavior concerning healthy snacks and beverages. Questionnaires were administered prior to the first lesson in the curriculum and following the final lesson of the four-lesson curriculum. Inclusion criteria included enrollment in the selected physical education class, completion of the nutrition education curriculum, and completion of the pre or post questionnaire.

**Knowledge** was assessed from questions on knowledge of fat, fiber, and sugar content of various food/beverage items. Appropriate snacking times, appropriate amounts of fruit juice consumption, and label reading ability were also assessed.
<table>
<thead>
<tr>
<th>Lesson</th>
<th>Theme</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>One: <em>What to snack on, What beverages should I choose?</em></td>
<td>Educated on what makes a snack or beverage an optimal choice: 1. nutrient density 2. high in vitamins and minerals 3. low in added sugar, fat 4. high in fiber</td>
<td>Kickball game that reviewed the benefits of over 150 snack and beverage items.</td>
</tr>
<tr>
<td>Two: <em>Portion sizes and energy balance</em></td>
<td>Educated on importance of energy balance. Portion sizes of snacks may be different for each individual. Appropriate amount of sugar sweetened beverages.</td>
<td>Matching physical activity to burn off a certain amount of calories coming from a snack or beverage.</td>
</tr>
<tr>
<td>Three: <em>When to snack and choose certain beverages</em></td>
<td>Discussed personalizing snacks to individual schedule and energy needs. Highlighted appropriate times for sports drinks.</td>
<td>Basketball game mirroring different snacking times throughout the day.</td>
</tr>
<tr>
<td>Four: <em>Comprehensive</em></td>
<td>Reviewed what constitutes a healthy snack and beverage. Stressed the importance of: 1. nutrient density 2. heart healthy, low sodium 3. low added sugar beverages</td>
<td>Stationed physical activities (push-ups, mountain climbers, wall sits, etc.) and active quiz reviewing importance concepts from lessons 1-3.</td>
</tr>
</tbody>
</table>
Attitude and self-efficacy was assessed using five questions that measured the student’s self-perceived ability to choose healthy items compared to less healthy food options, their opinion on drinking water throughout the day, and their motivation for choosing snacks.

Behavior was assessed by measuring current behaviors of the students such as preference of snack items, preference of beverages, and frequency of fruit drink and milk consumption.

Individual questions included in the knowledge, attitude, and behavior sections of the questionnaire were coded for analysis using the same method. Possible responses were coded so that the most ideal answer received a high point value and the least ideal received the lowest point value (value depended on total number of responses). The total score for each variable was determined by dividing the sum of each section by the total number points possible.

Behavioral intent was assessed by asking students when they had the choice, how often did they choose what they ate because of how much fat it contained. This question was then reframed three times for sugar, fiber, and overall health. Possible responses were rated on a 4 point scale ranging from 1 = never to 4= always. A score of 4 indicated the most ideal or correct answer. Behavioral intent was assessed by scoring individual questions and then calculating the sum of the questions. The higher the sum the more healthy the behavioral intent.

Data Analysis

Statistical analyses were conducted with SAS software (SAS Institute Inc., Version 9 for Windows, Raleigh, NC, 2014) with statistical significance set at a \( p \) value of < .05. Independent samples t-test was used to identify differences between pre-only group and pre-post group and between the post-only and pre-post group on total knowledge, behavior, and behavioral intent scores. Knowledge, attitude, and behavior questions were analyzed using McNemar’s test for paired categorical data. Change in total knowledge, attitude, behavior, and behavioral intent variables from pre to post intervention were measured using paired \( t \)-test in the pre-post group only.

Results

After completion of the curriculum, 60 students had a matched pre-post questionnaire. This left 44 students with only a completed pre questionnaire and 42 students with a post only questionnaire. Analyses were performed for the group of 60 students with a matched pre-post questionnaire. A majority of the students were in grade 9 (56%), with a small percentage of the respondents in grade 10 (9%). The remaining students were upperclassmen (16%) or did not have an identified grade level (19%). Slightly over half (53%) of the students were female with the remaining students male (47%).

Independent samples \( t \)-test confirmed that there was no statistically significant difference between the pre-only and the pre-post group and between the post-only and the pre-post group concerning knowledge, attitude, behavior, or behavior change (\( p > 0.05 \)). Therefore the remaining re-
### Table 2
Statistics On Number Answering Correctly, Pre-Post Group

<table>
<thead>
<tr>
<th>Knowledge Construct</th>
<th>Pre</th>
<th>Post</th>
<th>n</th>
<th>p&lt;sup&gt;a,b&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q1. Which food item has more fat?</td>
<td>47 (78.3%)</td>
<td>51 (85.5%)</td>
<td>60</td>
<td>0.25</td>
</tr>
<tr>
<td>Q2. Which food item has more fiber?</td>
<td>35 (59.3%)</td>
<td>36 (61.0%)</td>
<td>59</td>
<td>0.82</td>
</tr>
<tr>
<td>Q3. Which food item has more sugar?</td>
<td>55 (93.2%)</td>
<td>47 (79.7%)</td>
<td>59</td>
<td>0.01</td>
</tr>
<tr>
<td>Q4. Snacking times are different for every person depending in his/her schedule.</td>
<td>52 (93.2%)</td>
<td>46 (76.7%)</td>
<td>60</td>
<td>0.18</td>
</tr>
<tr>
<td>Q5. What is the highest amount of 100$ fruit juice I should drink in one day?</td>
<td>10 (16.7%)</td>
<td>17 (28.3%)</td>
<td>60</td>
<td>0.09</td>
</tr>
<tr>
<td>Q6. What is the healthier snack option based on the nutrition label below?</td>
<td>32 (55.2%)</td>
<td>33 (56.9%)</td>
<td>58</td>
<td>0.84</td>
</tr>
<tr>
<td>Total knowledge score (mean ± standard deviation)</td>
<td>.65 ± .19</td>
<td>.64 ± .19</td>
<td></td>
<td>0.79</td>
</tr>
</tbody>
</table>

### Attitude/Self-Efficacy Construct

| Q1. I can choose foods that would make a healthy snack.   | 33 (55.0%) | 33 (55.0%) | 60  | 1.00           |
| Q2. I can choose my favorite fruit instead of my favorite cookie. | 41 (68.3%) | 35 (58.3%) | 60  | 0.16           |
| Q3. I can choose my favorite fruit or vegetable instead of chips. | 25 (41.7%) | 29 (48.3%) | 60  | 0.41           |
| Q4. I like drinking water throughout the day.            | 44 (73.3%) | 42 (70.0%) | 60  | 0.59           |
| Q5. I choose the snack that I eat because they protect me from disease. | 26 (44.1%) | 28 (47.7%) | 59  | 0.69           |
| Total attitude/self-efficacy score (mean ± standard deviation) | .56 ± .26 | .56 ± .27 |  | 0.86           |

### Behavior Content

| Q1. Which snack would you pick to eat?                   | 20 (33.9%) | 25 (42.4%) | 59  | 0.28           |
| Q2. Which snack would you pick to eat?                  | 27 (46.6%) | 32 (55.2%) | 58  | 0.20           |
| Q3. Which beverage would you pick to drink?             | 35 (61.4%) | 35 (61.4%) | 57  | 1.00           |
| Q4. Yesterday, how many times did you drink fruit drinks (such as fruit punch or Kool-Aid), sports drinks, or soda? | 18 (30.0%) | 22 (36.7%) | 60  | 0.32           |
| Q5. Yesterday, how many times did you drink mild (Skim, 1%, 2%, or flavored milk)? | 6 (10.0%) | 5 (8.3%) | 60  | 0.71           |
| Total behavior score (mean ± standard deviation)        | .36 ± .22 | .40 ± .23 |  | 0.09           |

### Behavioral Intent Score

| Q6. When you can choose, how often do you choose what you eat because of how much fat it has? | 10 (16.7%) | 8 (13.3%) | 60  |
| Q7. When you can choose, how often do you choose what you eat because of how much sugar it has? | 9 (15.0%) | 12 (20.0%) | 60  |
Q8. When you can choose, how often do you choose what you eat because of how much fiber it has?

<table>
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<th></th>
<th>10 (16.7%)</th>
<th>8 (13.3%)</th>
<th>60</th>
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</table>

Q9. When you can choose, how often do you choose what you eat because you think it is good for your overall health?

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<th></th>
<th>16 (26.7%)</th>
<th>12 (20.0%)</th>
<th>60</th>
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</thead>
</table>

Total behavioral intent score (mean ± standard deviation)

|          | .47 ± .27  | 47 ± .26  | 0.97 |

**Results** focus on the pre-post group.

The paired *t*-test for total knowledge score in the pre-post group exhibited a mean score of .65 (± .19) prior to intervention compared to the post intervention mean score .64 (± .19). Total knowledge score, found in Table 2, did not statistically increase. McNemar’s test indicated one question, “Which food item has more sugar”, showed a statistically significant change in knowledge from pre to post intervention, (*p*=0.01) Fewer students (80%) answered the question correctly post intervention compared to 93% of students at pre intervention (Table 2). The remaining five knowledge questions did not show statistical change from pre to post intervention.

The remaining constructs of attitude/self-efficacy, behavioral intent, and behavior produced little change from pre to post intervention. Paired *t*-test examining total scores as well as McNemar’s test for individual questions indicated no statistical change from pre to post intervention. Frequency and mean scores with corresponding *p*-values are provided in Table 2.

**Discussion**

This article summarizes the results of a short-term nutrition education curriculum and the changes in knowledge, attitude, behavioral intent and behavior concerning healthy snacks and beverages. The findings further contribute to the mixed results found in nutrition and physical education programs (Haynos & O’Donohue, 2012; Heitmann, Koplan, & Lissner, 2009; Waters et al., 2014).

It is important to note that there was no significant difference between pre-only and pre-post group scores and between post-only and pre-post group scores concerning knowledge, attitude, behavioral intent, and behavior. Although the paired pre-post data was only available for roughly 41% of the students in the physical education class, the results are not biased towards students with a paired pre-post questionnaire.

Regarding total knowledge gained from this nutrition curriculum, total mean scores were relatively the same prior to intervention compared to
post intervention. Results indicate that students answered almost 4 of the 6 questions correctly which shows that students entered the curriculum knowledgeable about nutrients (fiber, sugar, and fat) in snacks and beverages and appropriate snacking times. This may have created a ceiling effect with little improvement available post intervention.

Reasons for a lack of significant increase from pre to post intervention may also include the length of the nutrition education. The entire curriculum lasted approximately 4 weeks and only provided 6 hours of nutrition exposure with less than a third of that time devoted for education alone. Research supports that the intensity of the intervention may lead to greater results (Haynos & O’Donohue, 2012). A smaller study did find positive results with an intense short-term education that provided only three educational sessions over a three week time period. This program that found positive results put heavy emphasis on clear instructions and provided an opportunity for participants to practice taught concepts through cooking and meal planning (Rustad & Smith, 2013). Research is needed to compare the difference in knowledge changes based on the intensity and time frame of nutrition education curricula.

There was a statistically significant decrease in the number of students who answered correctly for the question concerning sugar content. The question gave students two possible choices to choose from, milk and orange juice. Students may have assumed that both options were healthy choices and therefore had difficulty choosing the higher sugar content item. This curriculum lacked explanations of natural sugar versus added sugar among snacks and beverages and specific recommendations for appropriate amounts of specific sugar sweetened beverages that are popular with this age group. Also, activities in the additional lessons did not utilize other aspects of the Social Cognitive Theory such as self-regulation and expected outcomes to further reinforce the concept of added sugar versus natural sugar content of snacks and beverages.

Self-efficacy was one of the targeted components of the curriculum based off the Social Cognitive Theory. Although non-significant, the question “I can choose my favorite fruit or vegetable instead of chips” showed an increase in self-efficacy from 41.67% to 48.33%, which may be attributed to the curriculum emphasizing the importance of 5 servings of fruits and vegetables per day. The remaining questions targeting self-efficacy and perceived ability to choose healthy snacks showed little change post intervention. This further highlights the need for environmental reform within the school setting. School curriculums must consider additional messages sent by the school environment such as food availability, and food fundraisers of candy and unhealthy snack items, if they want students to apply lessons learned and have the confidence to make healthier decisions.

More promising results of this nutrition curriculum were the increase in number of students who answered behavior questions correctly post intervention. The increase indicated that post intervention more students choose trail mix or apple slices over less desirable snack choices compared to their pre intervention preference. There was also an increase in the number of students who drank fruit juices or fruit drinks zero times that day. These changes were not significant but timing of post question-
naire administration may not have provided sufficient time for students to implement behavior change. The short term education program that found favorable behavioral changes by providing a three week education curriculum allotted participants one week to implement behavior changes (Rustad & Smith, 2013). The small increase among participants in choosing healthy options as snacks and consuming fruit drink zero times per day may have further increased if students were given additional time to implement these concepts.

Behavioral intent to choose healthier foods did increase from pre intervention (15%) to post intervention (20%) based on the sugar content of the snack item or beverage. These frequencies indicate an overall low percentage concerning sugar knowledge as well as intent to make healthful decisions based on sugar content. Students may have gained an understanding of the importance of sugar content, but as shown with the decrease in knowledge of sugar content, the curriculum needs to provide more emphasis on the concepts of natural sources of sugar, added sugar, and concrete recommendations for sugar consumption.

A limitation of this study and the nutrition education curriculum was that there was no assurance that students who had a matched pre-post questionnaire attended and received education from all four lessons. The impact of this nutrition curriculum is based upon data collected from a newly constructed questionnaire designed specifically for this program. Although the questionnaire was validated in a similar population, it may not have accurately captured the constructs of knowledge, attitude, behavioral intent, and behavior among study participants. Behavior questions targeting sugar sweetened beverages and milk consumption were self-reported responses. Two behavior questions asked participants to recall how many times they consumed a beverage the previous day. It is difficult to conclude behavior change based on self-reported recall of one day.

Conclusion

As a result of the findings in this short-term study, further research should examine the effectiveness of nutritional professionals working in conjunction with physical education professionals either in curriculum development or nutrition content delivery. As the governing body of registered dietitians indicates, no other profession is as prepared to address the pediatric obesity epidemic than registered dietitians (Hoelscher, Kirk, Ritchie, & Cunningham-Sabo, 2013) In addition to utilizing registered dietitians, research is needed to examine what individual components of a nutrition education curriculum, whether it is the intensity, the length, or the theory-based curriculum, produce the greatest health behavior change in the adolescent population.
References


Gonzalez, W., Jones, S. J., & Frongillo, E. A. (2009). Restricting snacks in U.S. elementary schools is associated with higher frequency of fruit and vegetable consumption. *Journal of Nutrition, 139*(1), 142-144. doi: 10.3945/jn.108.099531


Reedy, J., & Krebs-Smith, S. M. (2010). Dietary sources of energy, solid
Appendix

Questionnaire

I am interested in learning more about what you know about snacks and beverages. There are no right or wrong answers so answer honestly. Please circle one answer for every question.

Section A

1. Which food item has more fat?
   A. Pretzels
   B. Potator Chips
2. Which food item has more fiber?
   A. Orange
   B. Vanilla yogurt
3. Which beverage has more sugar?
   A. Orange Juice
   B. Milk
4. Snacking times are different for every person depending on his or her schedule.
   A. True
   B. False
5. What is the highest amount of 100% fruit juice I should drink in one day?
   A. 0 ounces
   B. 4-6 ounces (less than a cup)
C. 6-8 ounces (about a cup)
D. 8-10 ounces (a little more than a cup)
E. 10-12 ounces (a cup and a half)

6. What is the healthier snack option based on the nutrition label below CIRCLE either A or B.

A

B

<table>
<thead>
<tr>
<th><strong>Nutrition Facts</strong></th>
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<tbody>
<tr>
<td><strong>Serving Size</strong></td>
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<tr>
<td>1.0 oz</td>
</tr>
<tr>
<td><strong>Amount Per Serving</strong></td>
</tr>
<tr>
<td><strong>Calories</strong> 155 Calories from Fat 96 % Daily Value *</td>
</tr>
<tr>
<td><strong>Total Fat</strong> 11g 16%</td>
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<tr>
<td>Saturated Fat 3g 16%</td>
</tr>
<tr>
<td>Polyunsaturated Fat 3g 16%</td>
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<tr>
<td>Monounsaturated Fat 3g 16%</td>
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<tr>
<td><strong>Cholesterol</strong> 0mg 0%</td>
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<tr>
<td><strong>Sodium</strong> 149mg 6%</td>
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<tr>
<td><strong>Total Carbohydrate</strong> 14g 5%</td>
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<td>Dietary Fiber 1g 5%</td>
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<tr>
<td>Sugars 1g</td>
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<td><strong>Protein</strong> 2g</td>
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<tr>
<th><strong>Nutrition Facts</strong></th>
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<tbody>
<tr>
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<tr>
<td><strong>Servings Per Container</strong> 8</td>
</tr>
<tr>
<td><strong>Amount Per Serving</strong></td>
</tr>
<tr>
<td><strong>Calories</strong> 260 Calories from Fat 60 % Daily Value *</td>
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<tr>
<td><strong>Total Fat</strong> 7g 11%</td>
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<tr>
<td>Saturated Fat 0.5g 3%</td>
</tr>
<tr>
<td>Trans Fat 0g</td>
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<tr>
<td><strong>Cholesterol</strong> 0mg 0%</td>
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<tr>
<td><strong>Sodium</strong> 350mg 15%</td>
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<tr>
<td><strong>Total Carbohydrate</strong> 46g 15%</td>
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<tr>
<td>Dietary Fiber 4g 15%</td>
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<tr>
<td>Sugars 21g</td>
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<tr>
<td><strong>Protein</strong> 7g</td>
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Vitamin A: 2% Vitamin C: 4%

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<tr>
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<td>290g</td>
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<th><strong>Sugar</strong></th>
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<tr>
<th><strong>Protein</strong></th>
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<td>7g</td>
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This section asks questions about how sure you are about being able to eat some of the foods below and how you feel about snacks and beverages. Please circle one answer for every question.

**Section B**

1. I can choose foods that would make a healthy snack.
   A. Not sure
   B. A little sure
   C. Very sure

2. I can choose my favorite fruit instead of my favorite cookie.
   A. I know I can
   B. I think I can
   C. I am not sure I can
   D. I do not think I can

3. I can choose my favorite fruit or vegetable instead of chips.
   A. I know I can
   B. I think I can
   C. I am not sure I can
D. I do not think I can
4. I like drinking water throughout the day.
   A. Agree
   B. Disagree
5. I choose the snacks that I eat because they protect me from disease.
   A. Agree
   B. Disagree

This section asks questions about how many times you drink certain beverages and what food items you would choose for a snack if you had the choice. Please circle one answer for every question.

Section C

1. Which snack would you pick to eat?
   A. Trail mix
   B. Cheetos/Cheese Puffs
2. Which snack would you pick to eat?
   A. Apple Slices
   B. Potato Chips
3. Which beverage would you pick to drink?
   A. 100% Orange Juice
   B. Orange Soda
4. Yesterday, how many times did you drink fruit drinks (such as fruit punch or Kool-Aid), sport drinks, or soda?
   A. 0 times
   B. 1 time
   C. 2 times
   D. 3 times
   E. 4 or more times
5. Yesterday, how many times did you drink milk (Skim, 1%, 2%, or flavored milk)?
   A. 0 times
   B. 1 time
   C. 2 times
   D. 3 times
   E. 4 or more times
6. When you can choose, how often do you choose what you eat because of how much fat it has?
   A. Always
   B. Most of the time
   C. Not Very Often
   D. Never
7. When you can choose, how often do you choose what you eat because of how much sugar it has?
   A. Always
   B. Most of the time
   C. Not Very Often
   D. Never

8. When you can choose, how often do you choose what you eat because of how much fiber it has?
   A. Always
   B. Most of the time
   C. Not Very Often
   D. Never

9. When you can choose, how often do you choose what you eat because you think it is good for your overall health?
   A. Always
   B. Most of the time
   C. Not Very Often
   D. Never

**EMILY C. EDWARDS, AMY R. MOORE, MARJORIE A. SAWICKI,** and **PATRICK V. KELLY** are at St. Louis University.
Abstracts of Student Presentations
2015 MOAHPERD Annual Conference
Lake Ozark, MO - November, 2015

2015 Dr. Patricia McSwegin Research Award Winner

An Examination of Traditional and Non-traditional Students Differences in Perceived Stress and Stress Management
Don Austin and Blake Lockmiller
Faculty Sponsor: Dr. William Russell
Missouri Western State University

Introduction: Previous research on college stress has focused on traditional students, yet there is a need to examine nontraditional students’ stressors as well. While studies have examined the stress levels of traditional and nontraditional students in how they perceive and manage stress, there is still a lack of research exploring the stress levels of these two student cohorts. Purpose: The purpose of the study was to compare a sample of traditional age and non-traditional age students to determine whether there were differences in stress across these groups of student populations. Methods: Participants were 39 college students (20 traditional $M_{age} = 18.85, SD = .93$; 19 non-traditional $M_{age} = 32.15, SD = 5.9$) enrolled as full-time students. All participants completed a survey packet including the Perceived Stress Scale (PSS) and an original survey developed for this study examining students’ perceived stress as well as coping methods used to manage stress. Results: An independent $t$-test examining the two groups on overall PSS score was significant ($t = 3.24, p < .05$), indicating traditional students significantly greater perceived stress than non-traditional students. In addition, results examining stress management strategies indicated that the most popular strategy for traditional students was listening to music whereas the most popular strategy for non-traditional students was exercise. Conclusion: Perceived stress was different depending on the age cohort (traditional vs. nontraditional) of the students. Implications: If we look at more ways of how we can help to reduce stress for students no matter what their age, we could help students to become less worried with school and to be able to enjoy the experience of college instead of stressing over it. Implementing strategies at an early age would likely help reduce potential stressors among college students.

2015 Dr. Patricia McSwegin Research Award Runner-Up

Effects of Simulated Altitude Training on Aerobic Fitness
Kelly D. Barns, Haley F. Grueber, Erik S. Gustafson, Amanda E. Hall,
A method that is used to facilitate improvements in an individual’s aerobic fitness is altitude training. Most increases in aerobic fitness within altitude training are seen at 8,000 to 10,000 feet (Goods et al., 2014). A recent device in altitude training is the Elevation Training Mask 2.0.

**PURPOSE:** The purpose of this study was to examine the extent to which an individual’s aerobic fitness was increased while training with the Elevation Training Mask 2.0 compared to a control group training without a mask. **METHODS:** Nine female participants (mean age = 21 years) ran a VO_{2\text{Max}} test to measure their aerobic fitness baseline. Each participant was randomized into an experimental or control group. Both groups completed the same evidence-based High Intensity Interval Training (HIIT) three days a week for four weeks. The experimental group wore the Elevation Training Mask 2.0 during HIIT, while the control group wore no breathing apparatus. The resistance upon the mask was increased from 3,000 feet to 6,000 feet during week three of training. After four weeks of training, the participants’ aerobic fitness was again assessed using a VO_{2\text{Max}} test. One participant dropped out of the study due to musculoskeletal injury. The data was analyzed with paired t-tests and Cohen’s d effect sizes were computed. **RESULTS:** There was no significant differences across the experimental and control group’s relative change in VO\textsubscript{2\text{max}} scores (t(6)=-0.05, p<0.48) with little to no effect (d=0.03). Within the experimental group from pre to post VO\textsubscript{2\text{max}} there was a moderate positive effect size (d=0.54) but there was no statistical significance (t(8)=-0.86, p<0). **CONCLUSION:** The Elevation Training Mask 2.0 did not significantly increase the individual’s aerobic fitness over the course of four weeks when compared to the control group. However, effect sizes indicated a moderate effect within the experimental group for increases in aerobic fitness. **IMPLICATIONS:** The mask is a promising accessory in facilitating improvements in aerobic fitness among college aged women.
the goal of the study was to develop a success profile for elite cyclists after completing a PST program. A collegiate cycling team formed the treatment group (N=25, \(M_{age} = 21.04, SD = 3.30\)) \((M_{training\ age} = 6.72, SD = 3.98)\) who received a 12-week in-season PST program, and a similar demographic control group \((N=28)\) \((M_{age} = 23.18, SD = 2.54)\) \((M_{training\ age} = 6.36, SD = 2.88)\) received no mental skills training. The 12-week PST program exposed the treatment group to goal setting, arousal control, visualization, motivation, self-talk, positive affirmations, confidence, focus, mindfulness, and flow. Sports psychology instruments using pre- and posttest included the Sports Emotional Reaction Profile (SERP), Athletic Coping Skills Inventory-28 (ASCI-28), Profile of Mood States, and the Athlete Identity Measurement Scale. Participation among elite cyclists in a 12-week long psychological skills in-season training program has shown to positively correlate self-efficacy toward psychological skills and emotional states. Based on USA-Cycling race results and parameters measured in the ASCI-28, a predictive success model was created using a linear regression analysis to filter highly correlative variables using other psychometric instruments \((p<.01)\). High scores in confidence, self-discipline, and tension control on the SERP were highly predictive of success \((p<.001)\). Further research may support the efficacy of using PST intervention programs with other elite and sub-elite populations and sports.

Factors Influencing the Development of Fine Motor Skills in Young Adults
Melinda Hedges, McNair Intern
Faculty Advisor: Dr. H. Scott Strohmeyer
University of Central Missouri

People use fine motor skills to complete tasks involving fine details, such as being able to comb your hair, opening a pop can, or writing. These skills are important for people to have throughout life, because without them it would be very difficult to complete even the simplest of tasks. The goal of this research was to determine what factors influence the development of fine motor skills throughout childhood on a college-aged adult, such as the community size in which participants grew up, the kinds of activities in which subjects participated as children, and the number of hours they spent weekly participating in those activities during childhood. To assess fine motors skills, subjects completed a timed pegboard test, by maneuvering three small pegs at a time into holes on a board, using only one hand to complete the entire task. A multiple regression model was fit to the data using stepwise regression. The best-fit model consisted of only two variables: whether or not they played sports and whether or not they played video games as children. The predictive regression model showed that participants who played video games were predicted to
take a longer amount of time to complete the pegboard test than those who did not play video games; whereas, those who played sports were predicted to take a shorter amount of time to complete the pegboard test than those who did not play sports during childhood. This study serves as an initial inquiry into what possible factors have an influence on fine motor skill development in young adults. Additional studies would be needed to fully understand which factors have the greatest influence on the development of fine motor skills.

A Comparison of Percent Body Fat in Skinfold and the InBody 770
Nicholas Christie, Justin Hall, Molly Josephs, Christopher Padilla, Martin Rubalacaba
Faculty Advisor: Dr. Jessie N. Stapleton
Missouri Baptist University

Introduction: Body composition has been measured as a tool to assess the health of people by measuring percent body fat. Elevated percent body fat can lead many chronic diseases, such as obesity, diabetes and cardiovascular disease. Purpose: To test the accuracy of the InBody 770 against conventional skinfold testing with respect to percent body fat. It is expected that skinfold and InBody 770 will compare well with one another based off of research between skinfold and DXA (Wattabaoenobiaoon et al, 1998) and InBody and DXA (Rosen et al, 2014). Methods: Participants completed an informed consent form and questionnaire. A single Lange caliper and the InBody factory protocol were used. All skinfold testing was done by a single researcher and recorded by a separate researcher. Results: A two sample T-test assuming unequal variances was run on Excel with $\alpha=0.05$. There was $n=8$ participants (4 men, 4 women), aged 19-24. The results supported the original hypotheses that skinfold and the InBody 770 are not statistically different. The $p$ values recorded were $p=0.57$ for men and $p=0.28$ for women. Conclusion: Skinfold testing and the InBody 770 are not statistically different. The null hypothesis agreed with the resulting $p$ values for men ($p=0.57$) and women, ($p=0.28$). Implications: The InBody 770 records similar results to the conventional skinfold testing.

To Wear or Not to Wear: Do Compression Pants Affect Muscle Recovery?
Gabrielle Rentuma
Faculty Advisory: Dr. Steve Burns
University of Central Missouri

Purpose: Published research is divided on the efficacy of compression pants for recovery post exercise. The purpose of this study was to examine if the use of compression pants affects muscle recovery. Methods: Six recreationally active college-aged people (4 female, 2 male) participated. Subjects performed a Wingate test, 3 sets of 10 vertical jumps, and 60 reps at 60% of their 1RM on a leg-extension machine. Following exercise, subjects
wore either a Nike-brand compression pant (COMP) or loose-fitting shorts (NONCOMP) during the 60-minute recovery phase. Blood markers evaluated during the recovery phase were creatine kinase and lactate. The recovery phase consisted of: creatine kinase blood draws at 0 and 60 minutes; lactate finger pricks at 0, 15, 30, 45, and 60 minutes; and perceived muscle soreness ratings at 30 and 60 minutes. Subjects subjectively rated their muscle soreness on a scale of 1-10. Subjects returned to the lab at 24 and 48 hours post exercise for an additional blood draw and perceived muscle soreness assessment. Subjects completed this protocol a total of two times wearing both conditions. Results: Means, standard deviations, and paired samples t-test were used for statistical analysis. Paired samples t-test for creatine kinase, lactate, and perceived muscle soreness showed there was no significant difference between compression pants and no compression pants (p > 0.05). Conclusion: The current findings suggest wearing compression pants was not any more or less effective for clearance of creatine kinase and lactate than not wearing compression pants. The findings also suggested the use of compression pants was not effective in perceived muscle soreness. Implications: Future researchers should consider many variables when researching compression garments. Variables to consider are duration garment is worn, type of garment, and proper fit of garments.

Effects of Concentric and Eccentric Exercise on Muscle Fatigue
Andrew T. Fernandez & Andrew C. Graham
Faculty Advisor: Not listed
University of Central Missouri, Warrensburg, MO

The majority of published studies show that the concentric phase of an exercise will cause greater fatigue, if performed alone, than the eccentric phase. PURPOSE: The purpose of this study was to determine which phase of a bicep curl induced fatigue more quickly. METHODS: Ten college students, ages 18-24, were recruited to perform the concentric and eccentric phases of a bicep curl, separately, at 50% of their one-repetition max, until fatigued. One-repetition maxes were determined for each phase. A dumbbell in the dominant arm of each subject was used to determine these values. RESULTS: The results showed that participants were able to complete more concentric repetitions before fatigue than eccentric repetitions. The average number of concentric repetitions completed before fatigue was 75.33 ± 44.19. The average number of eccentric repetitions completed before fatigue was 50.11 ± 28.07. A paired t-test revealed significant differences between the means (p<0.05). CONCLUSION: The hypothesis that participants would be able to complete more repetitions eccentrically before fatigue was not supported. As a whole, subjects were able to perform more repetitions concentrically than eccentrically. IMPLICATIONS: This study provides information to health professionals on which phase of an exercise should...
be the main focus if muscle fatigue is the goal. This would pertain to both rehabilitation and bodybuilding routines where a decrease in muscle fatigue is the desired product. If professionals can determine which phase of an exercise induces fatigue quicker, that information can be used to more effectively develop workout routines.

A Study to Assess the Efficacy of a 15-Week Psychological Skills Training Program for Collegiate Wrestlers
James Malechek, CSCS, USAW, MS
Faculty Advisor: Dr. Paul Wright
Lindenwood University

Introduction: One specific gap in the research literature is identifying appropriate and meaningful PST interventions that provide the most congruent fit to specific sports. One such sport that has been under-represented in the research literature is wrestling. One of the goals of this study is to address this oversight. The purpose of this study was to show whether or not mental training techniques can be improved through a self-guided psychological skills training program spread over a competitive season. Traditionally, PST programs are implemented during the off-season or pre-season for athletes (Weinberg et al., 2011). This 15-week study was designed to explore whether wrestling athletes, given access to a self-guided psychological skills training program would implement the techniques on their own. Purpose of Study: The purpose of this study was to assess the efficacy of using a self-guided psychological skills training program to improve wrestler mental skills during a competitive season.

Methodology:
Total of 48 male division II collegiate wrestlers
   27 wrestlers from Lindenwood University
   21 wrestlers from the University of Wisconsin-Parkside
Instruments Used:
   The Athletic Coping Skills Inventory-28

Results: Significant increase was found in athlete’s subscale of confidence and achievement motivation and goal setting and mental preparation. Coach saw significant increase in freedom from worry. Athletic trainer saw significant decrease in coachability, goal setting and mental preparation and cumulative post-test score. Conclusions: With wrestlers having their psychological skills impacted, it is critical that a program is in place in order to help minimize the damage done to these skills during the competition season. This program found specifically that confidence and achievement motivation along with goal setting and mental preparation can be impacted with a short-term in-season PST intervention program.
Guidelines for Contributing Authors

Editors, 2016

Manuscripts, research abstracts and art material are invited from any individual within the profession or from other disciplines or organizations and will be carefully considered for publication. Publication is subject to space availability. In submitting a manuscript for publication, the author should include a statement that it has not been published or accepted for publication elsewhere. Articles and materials are accepted in three categories: editor-reviewed articles, refereed articles, and student articles. Editor-reviewed submissions are evaluated in terms of their contribution to knowledge, practice, theory, scholarly presentation, and relevance to the profession and readership. Revisions may be required.

Manuscripts submitted to the refereed section should be data-based (numerical or text) articles or substantial reviews of research literature. They are sent to three reviewers for a blind review and vote as to acceptability. Publication is contingent on revisions required by the reviewers. Authors should indicate their desire to have their manuscript refereed. Please note that referees hold manuscripts to the highest standards, particularly in regard to research methodology and currentness. The Missouri AHPERD Journal might publish refereed articles that are more practitioner-oriented than national journals or pertinent to Missouri, but articles must be of the highest quality.

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