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THE EFFECT OF GENDER ON POST-CONCUSSION SYMPTOM RATINGS BY PENNSYLVANIA STATE UNIVERSITY ATHLETES

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Abstract

Mild traumatic brain injury (mTBI), also known as concussion, has become an increasingly popular area of interest for academics and health professionals, as well as the general public, which may, in part, be due to many highly publicized cases of concussion in professional and collegiate athletes. Recent research by Hunt et al. (2010) suggests that there may be anywhere from 1.6 to 3.8 million sports-related concussions each year in the United States. Research on sports-related concussion has emphasized the importance of baseline and post-concussion neuropsychological testing in both the monitoring and treatment of mTBI. Self-reporting of symptoms by concussed athletes is another significant factor that must be considered. The aim of the present study is to examine whether males and females report a different number or type of symptoms both at baseline and post-concussion. Previous research on the topic has been mixed. Two studies (Covassin et al., 2006; Martinez et al., 2010) found that females report a higher mean symptom score at baseline. A follow-up study by Covassin et al. (2007) found that males reported a greater mean symptom score than females following a concussion. A second study by Broshek et al. (2005), reported the opposite, with females endorsing a greater mean symptom score than males. The present study examines the symptom score reports for 623 Pennsylvania State University Athletes who completed a baseline examination, as well as the symptom scores for 69 of those same individuals who also completed a post-concussion examination. It was found that females reported a greater mean number of symptoms at baseline, and this is mostly due to greater reporting of emotion-related symptoms. However, no main effect of sex was found post-concussion. The implications and limitations of these findings are discussed.

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Introduction

Mild traumatic brain injury (mTBI), or more commonly known as concussion, has become an increasingly popular area of interest for academics and health professionals, as well as the general public. This may be partially due to many highly publicized cases recently discussed in the media of the long-term consequences of concussion in professional and collegiate athletes. As greater knowledge and understanding of mTBI has developed over the past few decades, its definition has changed, and public understanding of concussions may continue to differ from scientific understanding.

In 2008, the 3rd International Conference on Concussion in Sport was held in Zurich. During this meeting, concussion was unanimously agreed to be defined as "a complex pathophysiological process affecting the brain, induced by traumatic biomechanical forces" (McCrory et al., 2009). More specifically, a mTBI is caused by a direct blow to any part of the body (but particularly the head, face, and neck) that results in an "'impulsive' force transmitted to the head," but may or may not cause loss of consciousness (McCrory et al., 2009). The sudden acceleration and deceleration of the blow causes movement of the brain within the skull and movement of brain tissue against itself (Moser, et al, 2007). A concussion often results in the rapid onset of impairments in neurological functioning, which are typically transient but can vary in intensity and duration depending on the grade (ranging from either mild, moderate, or severe) of the concussion (McCrory et al., 2009). This definition of concussion has generally been accepted within the scientific community and will be used for the purpose of this study.

Unlike more severe forms of traumatic brain injury, clinical symptoms and impairments associated with concussion generally reflect a functional disturbance in the

brain, rather than a structural one (McCrory et al., 2009). Levels of axonal stretching are low, and generally result in only short-lived changes in neurophysiology (Moser et al, 2007). According to research done by Giza and Hovda (2004), the primary mechanisms by which neurological impairments occur include "ionic shifts, abnormal energy metabolism, diminished cerebral blood flow, and impaired neurotransmission." For the majority of affected cells, however, these effects appear to reversible.

Following a mTBI, a concussed individual is likely to experience any of several cognitive, somatic, and affective symptoms. Some of the most common symptoms include "headache, dizziness, confusion, nausea, memory difficulties, 'mental fogginess,' fatigue, balance problems, attention and concentration difficulties, sleep disturbances, and 'nervousness'" (Moser et al., 2007). Other possible symptoms include vomiting, tinnitus, impairments in vision, balance problems, and personality or behavior changes. Post-concussion symptoms follow a nonlinear recovery pattern and have no defined period of time within which they will be relieved (Hunt et al. 2010). Generally, however, most individuals suffering from a concussion will be free of symptoms within a month of their injury (Moser et al., 2007).

Mild traumatic brain injuries are an all too common occurrence in sports. Studies by the Center for Disease Control and Prevention from only a few years ago estimated that there were approximately 300,000 sports-related concussions each year (Covassin, 2006). More recent research, however, has suggested that this is a gross-underestimate of the actual number of cases that are occurring. This may be due to several factors including inconsistent definitions of mTBI, a desire by athletes to continue sport participation (and therefore underreport symptoms or not report them at all), and a lack of

knowledge among coaches, trainers, and physicians (Echemendia et al., 2001; Rosenbaum & Arnett, 2010). According to an article by Hunt et al. (2010), there may actually be anywhere from 1.6 to 3.8 million sports-related concussions each year in the United States.

Neuropsychological evaluations of concussion are an integral part of the field of sports medicine. Early research by Gronwall and Wrightson (1974) demonstrated the value of neuropsychological techniques in measuring concussion-related impairments, and noted concussion-related deficits in such cognitive areas as attention and concentration (Echemendia et al., 2001). In addition, their work gave early implications that the effects of concussion can be cumulative and, in some cases, lead to long-term deficits. Barth et al. (1989) continued this research in sports-related mTBI and found that deficits in visuomotor abilities, reaction time, information processing, and memory are also a common result of concussion (Echemendia et al., 2001).

In 1989, Barth et al. completed the first study to systematically evaluate the effects of concussion on football players. Included in this program was the groundbreaking idea of preseason testing, or "baseline" testing. Athletes were asked to complete a number of tests prior to the beginning of their season, and completed these same tests after sustaining a concussion. Barth et al. found detectable levels of cognitive and information processing deficits within 24 hours of the injury. For the majority of athletes, follow-up test indicated that they were restored to baseline functioning within 5 to 10 days post-injury.

Over the next few decades, continued research on sports-related concussion has emphasized the importance of baseline and post-concussion neuropsychological testing in

both the monitoring and treatment of mTBI. As a result, many sports medicine professionals in both professional, collegiate, and high school athletics have adopted such programs (Moser et al., 2007). Preseason evaluations of cognitive performance have been recognized as an important point of reference for deficits after an athlete has experienced a concussion, thereby allowing clinicians to track recovery. Without baseline data, it can be difficult to ascertain what portion of post-concussion test performance is due to effects of the injury versus individual fluctuations. Neuropsychological evaluations, in conjunction with clinical observations, have also become an indispensable tool in making return-to-play decisions for concussed athletes. The current understanding is that athletes should not begin participating again until their scores have reached levels either equal to, or better, than at baseline and when symptoms have been relieved (Covassin et al., 2006). If athletes return to play prematurely, they are at risk of sustaining a second injury before they fully recover, resulting in a possibly fatal increase in pressure in the brain called Second Impact Syndrome (Rosenbaum et al., 2006).

In addition to post-concussion test performance, self-reporting of symptoms by concussed athletes is another significant factor that must be considered in the treatment of mTBI. After experiencing a concussion, the majority of individuals will experience symptoms, although they can vary considerably in type, severity, and duration. According to a study by Bohnen et al. (1992), individuals who experienced a concussion and reported a significant number of post-concussion symptoms performed worse over time than did individuals with a concussion and minimal symptoms (Echemendia et al., 2001). For this reason, it is essential that coaches and clinicians assess the number and

severity of symptoms reported by a concussed athlete. Fortunately, a number of simple scales and checklists have been devised for this purpose, including the Post Concussion Symptom Scale, the Graded Symptom Checklist, the Head Injury Scale, and the ImPACT Total Symptom Score (Hunt et al., 2010). Self-report symptom measures should be used in conjunction with other neuropsychological assessments, however, as some athletes may be motivated to underreport symptoms in an effort to return-to-play quickly (Bailey, Echemendia, & Arnett, 2006; Rosenbaum & Arnett, 2010).

Gender Differences in Symptom Ratings

The effect of gender on concussion outcomes has been a relatively new topic within the realm of sports-related traumatic brain injury research. One study conducted on this topic found that, simply in terms of susceptibility, female collegiate athletes had a 9.5% likelihood of sustaining a concussion during a game, whereas males only had a 6.4% likelihood (Covassin et al., 2007). This analysis also found that concussions were most likely to occur among female soccer players. Once males and females sustain a concussion, however, it is also possible that they could experience a different number or severity of symptoms and vary in recovery patterns. The various neurochemical and anatomical differences between the male and female brains would lend support to this possibility of different effects in the two sexes. In fact, Weiss et al. (2003) found that females perform better on perceptual motor speed and verbal memory tests than do males. Conversely, males perform better on visuospatial tasks than do females. In addition, a meta-analysis conducted in 2000 found that concussed women fared worse on 85% of variables measured when compared to concussed men (Farace et al., 2000).

Measured variables were primarily somatic symptoms including "poor memory, dizziness, fatigue, irritability in response to light and noise, impaired concentration, headache, anxiety, and depression, with men faring worse only on auditory symptoms" (Covassin et al., 2007). These researchers noted that this analysis may be limited by the current lack of research on this topic and that a prospective study of sex differences in outcome is clearly warranted.

Throughout the medical field, women have been found to report a greater number of somatic and psychological symptoms than men for a variety of conditions (Kroenke et al., 1998). However, within the realm of traumatic brain injury research, very few studies have examined the possibility of differences in symptom reporting due to concussion. Athletes in general may minimize their symptoms in order to remain in play, but there has been evidence that male athletes in particular may feel increased pressure from coaches and/or teammates to play while concussed (Covassin et al., 2007).

One such series of studies was done by Covassin et al. (2006 & 2007), who completed analyses of sex differences in symptom rating by collegiate athletes both as baseline, as well as post-concussion. For both studies, Covassin examined male and female athletes' ratings of symptoms using the ImPACT Total Symptom Score, which requires participants to rate how much they are currently experiencing 22 common concussion-related symptoms. Subsequent analyses showed a significant effect of sex on the number of symptoms reported by individuals at baseline (Covassin et al., 2006). More specifically, females reported higher mean symptom scores on such symptoms as headache, fatigue, sleep difficulty, irritability, sadness, nervousness, feeling more emotional, feeling slowed down, difficulty concentrating, and total symptom scores.

Although endorsement of symptoms was generally mild in nature (i.e. a rating of 1 or 2 on a scale of 6), differences in symptom reporting between the sexes was still found to be significant.

Covassin's baseline findings were replicated in a more recent study (Martinez et al., 2010). In this study, nearly 600 athletes from the Pennsylvania State University completed a baseline neuropsychological evaluation. Of particular interest in this battery was the Post-Concussion Symptom Scale (PCSS), which requires participants to rate the degree to which they are experiencing a variety of physical, emotional, and cognitive symptoms, much like the symptom scale included in the ImPACT. In addition, each athlete completed the NEO Personality Inventory. Female athletes in this sample reported a significantly greater mean number of symptoms on the PCSS than did male athletes. Martinez et al. also looked at the role of Neuroticism (as measured from the NEO) in this gender difference and found that it was a mediating factor. This finding has been replicated in other studies, including one by Williams et al. (2000), which found that gender and neuroticism have significant direct effects on physical symptom reports. These lines of evidence suggest that differing levels of neuroticism between males and females may account for part of the sex difference in symptom reporting among athletes, and possibly, within the general population as well.

With gender differences in baseline symptom reporting having been demonstrated, it became clear that the next step is to evaluate whether this bias still exists post-concussion. Covassin et al. completed a follow-up study to examine whether sex differences in symptom reporting also appear post-concussion. Analyses of symptom scores revealed that, as opposed to at baseline, male athletes reported sadness and

vomiting with higher frequency and intensity than did female athletes. No other between-group differences in symptom reporting were found post-concussion (Covassin et al., 2007). While her findings are very interesting, they are not without limitations. Most importantly, Covassin and colleagues' sample consisted of only 79 individuals, making reliability and generalizability a possible issue. In addition, she used a version of the ImPact that asks participants to report symptoms that they are currently experiencing, while other versions of the ImPact ask what symptoms athletes have experienced during the last 24 hours. Replication of these findings by several other research groups is needed before more definitive answers can be sought.

As shown earlier, results by Covassin et al. (2007) conflict with previous findings about sex differences in post-concussion symptom rating. A number of studies have found that females report symptoms with a greater likelihood then men following a head injury and that female gender is a significant predictor of symptoms one-month post-concussion (Brooks, 2004). In addition, in an article from 2005, Broshek et al. reported that high school and collegiate female athletes endorsed a greater number of symptoms post-concussion than did their male counterparts. Even when comparing female athletes (who, as a group, primarily did not wear helmets) to the subset of male athletes also without helmets, females continued to report a significantly higher mean number of symptoms. Broshek and colleagues' findings may differ from Covassin's for a number of reasons. Firstly, Broshek et al. included athletes from a wider age group (i.e. both high school and college-aged, rather than just college-aged athletes). The mean age was 18.72 years, with males significantly older than females in this study (19.2 compared to 17.5 years). In addition, Broshek's participants were disproportionately male (71.8%), while

Covassin et al. had nearly equal number of males and females. Lastly, Broshek's sample size was somewhat larger, with a total of 131 total participants. With such conflicting findings and a limited amount of research that has been done on the topic thus far, it is clear that more research on the interaction between gender and post-concussion symptom reporting is warranted. With these considerations in mind, the present study was designed to explore this issue further in a larger sample where athletes were examined both at baseline and post concussion. What follows are a few predictions based upon prior research.

Predictions

Hypothesis 1*: At baseline, female athletes will report a higher total symptom score than male athletes.*

Both Covassin et al. (2006) and Martinez et al. (2010) found that female collegiate athletes report a significantly higher total symptom score compared to male collegiate athletes. In addition, women in the general population tend to report a greater number of somatic and psychological symptoms than males do. This evidence suggests that, within this sample of collegiate athletes, it is likely that females will report a higher total symptom score than males.

Hypothesis 2*: After sustaining a concussion, female athletes will report a higher total symptom score than male athletes. Two competing explanations of this prediction will be explored:*

> ***Hypothesis 2A****: Female athletes will also exhibit a greater increase in reported symptoms post-concussion than males relative to baseline. If this hypothesis is confirmed, it will be mediated by higher neuroticism in female athletes.*
>
> As shown by Martinez et al. (2010) and Williams et al. (2000), higher levels of neuroticism (which are generally seen in women) are highly correlated with greater symptom reporting.
>
> *OR…*
>
> ***Hypothesis 2B****: Female athletes will report a higher total symptom score than males post-concussion, <u>but</u> will not exhibit a significant increase compared to baseline. Though not tested directly, one interpretation of such a finding would*

be that it is due to relative minimization of symptoms by female athletes' desire to return to play.

As Bailey et al. (2006) cited, underreporting of symptoms can be a serious impediment to accurate diagnosis and treatment of concussion. Female athletes may be driven by a desire to return to play after a mTBI, and therefore, not exhibit a significant increase in total symptom score from baseline to post-concussion.

Method

Participants

623 Pennsylvania State University student athletes who completed a baseline neuropsychological examination through the Penn State Sports Concussion program served as participants for this study. Of those 623 athletes, 69 also completed a post-concussion evaluation. Participant characteristics are outlined in Table 1 and 2 of Appendix A.

Measurements

Post-Concussion Symptom Scale, PCSS (Lovell, Iverson, Collins, Podell, Johnston, & Pardini, 2006)

The PCSS asks participants to rate the degree to which they are currently experiencing 21 common somatic, affective, and cognitive post-concussion symptoms. Symptoms are rated on a scale of 0 to 6, where 0 is none and 6 is severe.

ImPact Total Symptom Score, ITSS (Lovell, Collins, Podell, Powell, & Maroon, 2000)

Much like the PCSS, the ITSS is a self-report measure of subjective symptoms. The ITSS asks participants to assess the degree to which they are currently experiencing 22 somatic, affective, and cognitive symptoms on a scale from 1 to 6, where 1 is minor and 6 is severe. Participants are also given the option to check a box if they are not currently experiencing the symptom.

NEO Personality Inventory Short-Form (Costa & McCrae, 1989)

The NEO Personality Inventory Short-Form is an abbreviated version of the original NEO and is used to assess personality characteristics. Participants are asked to rate the degree with which they agree or disagree with 60 statements using a scale from 1 to 5, where 1 is strongly disagree, 3 is neutral, and 5 is strongly agree. The NEO can be used to assess the Big Five personality traits – openness to experience, conscientiousness, extraversion, agreeableness, and neuroticism. The Neuroticism subscale of the NEO will be used only if Hypothesis 2 is supported (i.e. in the case that females report a greater

mean number of symptoms than males post-concussion) in order to assess whether Hypothesis 2A, 2B, or neither apply.

Procedure

Measurements of interest were included in a larger neuropsychological battery that participants were asked to complete both at baseline, as well as post-concussion. The battery took approximately 2 hours to complete and was administered by an undergraduate or graduate student working under the supervision of a clinical neuropsychologist. Four alternative forms of the tests in the battery were used to insure that practice effects would be minimized. Participants in the study always received a different form post-concussion than at baseline. The same post-concussion symptoms scales (PCSS and ITSS) were used at both time points. Athletes who completed both a baseline and post-concussion examination between September 2003 and March 2011 were included in this analysis.

Results

Responses to the Post-Concussion Symptom Scale were available for 468 males and 155 females at baseline, and of those athletes, PCSS data were available for 54 males and 15 females post-concussion. A between-subjects multivariate analysis of variance (MANOVA) from the Statistical Package for the Social Sciences (SPSS) version 19.0, was used to analyze mean gender differences in symptom rating at baseline. As shown in Table 4, females reported a total mean of 7.29 symptoms and males reported a mean of 5.56 symptoms (Multivariate $F(21, 601) = 2.50$, $p < .001$). Univariate tests were completed to explore sex differences in the ratings of the individual items of the PCSS. Of the 21 items, five were found to be statistically significant: headache ($F(1,621) = 5.99$, $p < .02$), feeling more emotional than usual ($F(1,621) = 21.30$, $p < .001$), irritability ($F(1,621) = 5.16$, $p < .05$), sadness ($F(1,621) = 16.64$, $p < .001$), and feeling nervous or anxious ($F(1,621) = 8.42$, $p < .01$). Each of these five symptoms was rated higher by females than males.

A 2 x 2 ANOVA was also performed using the PCSS data collected post-concussion. This analysis showed that, within the smaller sample of 69 individuals who had both baseline and post-concussion PCSS data, males reported a mean of 7.65 symptoms post-concussion, and females reported a mean of 8.57, and this difference was not statistically significant ($F(1, 67) = .08$, $p > .78$). Additionally, there was no Time x Sex interaction ($F(1, 67) = .11$, $p > .70$). Lastly, there was no main effect of time ($p = .96$), as participants (who completed both a baseline and post-concussion evaluation) reported an average of 8.17 symptoms at baseline and 8.04 post-concussion ($F(1,67) = .00$). Univariate tests were completed to explore sex differences in the ratings of the

individual items of the PCSS post-concussion. Of the 21 items, only sleeping more than usual ($F(1,67) = 4.99$, $p < .05$) was found to be significant post-concussion. Again, female athletes rated this symptom more highly than male athletes.

Similar analyses were performed for the ImPact Total Symptom Score. Responses to the ITSS were available for 457 males and 153 females at baseline, and of those athletes, ITSS data was available for 47 males and 15 females post-concussion. A single-factor ANOVA was again used to analyze gender differences in symptom rating at baseline. As seen in Table 7, females reported a total mean of 7.58 symptoms and males reported a mean of 5.45 symptoms ($F(1,608) = 6.14$, $p < .05$). Individual items of the ITSS were not available for analysis at the time of this study. A 2 x 2 ANOVA was again performed using the ITSS data collected post-concussion, and revealed that females reported a mean total of 10.73 and males reported a mean of 9.56 ($F(1,60) = .11$, $p > .74$). Again, sex was not found to be significant post-concussion, and there was no Time x Sex interaction ($F(1,60) = .07$, $p = .80$). Lastly, participants (who completed both a baseline and post-concussion evaluation) reported an average of 8.80 symptoms at baseline, and 11.50 symptoms post-concussion. However, no main effect of time was found ($F(1,60) = .82$, $p = .37$).

Discussion

The purpose of the present study was to examine whether sex differences in symptom ratings exist for Pennsylvania State University athletes, both at baseline and post-concussion. Previous research on this topic has revealed mixed results, so the present analysis is warranted. To address this issue, mean symptom scores were calculated for males and females at both time points.

The first hypothesis, that females would report more symptoms than males at baseline, was supported. Analysis of responses to both the Post-Concussion Symptom Scale (PCSS) and the ImPact Total Symptom Score (ITSS) revealed that female athletes reported significantly higher mean symptom scores at baseline than male athletes. This finding is a replication of two earlier studies by Covassin et al. (2006) and Martinez et al. (2010). Interestingly, a post-hoc analysis of the PCSS revealed that, of the 21 individual symptoms, the only items that were significantly different between the sexes were headache, feeling more emotional than usual, irritability, sadness, and feeling nervous or anxious (all of which females reported more frequently). In other words, female athletes more frequently reported emotion-related symptoms than their male counterparts. This could be due, in part, to the higher levels of neuroticism that females report (Martinez et al., 2010).

The second hypothesis, that females will report a higher mean symptom score than males post-concussion, had two competing explanations. The first was that female athletes would exhibit a greater increase in reported symptoms post-concussion than males relative to baseline, and this difference would likely be mediated by higher neuroticism in female athletes (Hypothesis 2A). The second explanation was that female

athletes would report a higher total symptom score than males post-concussion, but would not exhibit a significant increase compared to baseline. Although not directly testable given the nature of our data, one interpretation to such a finding would be that it is due to relative minimization of symptoms by female athletes' desire to return to play (Hypothesis 2B). However, after conducting an analysis of the PCSS and ITSS data for athletes post-concussion, neither of these hypotheses was supported. Males and females did not report a significantly different number of symptoms post-concussion. This finding was inconsistent with other previous studies completed on this topic (Broshek et al., 2005; Covassin et al., 2007). However, female athletes did report that they were sleeping more than usual post-concussion compared to their male counterparts. Still, this finding was most likely due to chance, as it was the only statistically significant finding out of 21 comparisons.

In addition, participants (regardless of sex) did not report a significantly different number of symptoms from baseline to post-concussion. This finding is particularly important because athletes are generally expected to report more symptoms after experiencing a head injury. This finding could be due to several factors. Firstly, athletes may underreport symptoms post-concussion because of a desire to return-to-play or because of pressure from coaches or teammates. Another possibility is that athletes may be reporting different types of symptoms from baseline to post-concussion. For example, they may report symptoms that are unique to concussion more frequently post-concussion (e.g. mental fogginess) than at baseline.

Limitations & Future Research

There were several limitations to the present study that may serve as points for future research. The greatest limitation of this study was the limited number of participants who had completed both baseline and post-concussion examinations. Although data for 623 athletes was available at baseline, only 69 individuals also had PCSS data available post-concussion and 62 also had ITSS data available post-concussion. Of the participants who had examinations at both time points, only 15 were female, making it less likely that statistical differences between groups would be found. Future studies on this topic would benefit from having a larger post-concussion sample with a greater number of female athletes.

A second limitation of this study was that responses to the individual ITSS items were not available either at baseline or post-concussion at the time of this analysis. Future research may benefit from analyzing the 22 individual items in this measure in order to reveal whether the same types of symptoms (i.e. emotional symptoms) are driving the sex difference in symptom ratings seen with the PCSS at baseline.

Lastly, because athletes in this sample unexpectedly did not report a statistically greater mean number of symptoms from Time 1 (baseline) to Time 2 (post-concussion), future studies would benefit from comparing symptom ratings using a large post-concussion sample, and also considering possible moderator variables.

Conclusions

The present study replicated previous studies which found that female athletes report a greater mean number of symptoms compared to male athletes at baseline. This

sex difference was mainly due to females reporting a greater number of emotion-related symptoms (i.e. feeling more emotional than usual, irritability, and sadness), as well as higher reporting of headache. No overall sex difference was found post-concussion, which is inconsistent with previous research on this topic. However, females did report that they were sleeping more than usual post-concussion compared to males, but this finding was most likely due to chance. Interestingly, the mean number of symptoms reported at baseline was not significantly different than the number reported post-concussion, regardless of sex. Due to the limitations of this study, further research utilizing a larger sample is needed to clarify these issues.

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Appendix A: Tables

Table 1
Data Set Information – General

Measure	N	Mean	Standard Deviation
Age in Years	623 (Baseline)	18.5	0.98
Sex	623 (Baseline)	Males – 468 (75.1%) Females – 155 (24.9%)	
Days between Baseline & Post-Concussion	69 (Post-Concussion)	482.09	435.90

Table 2
Data Set Information – Sex

Measure	Males (N)	Females (N)
Baseline PCSS	468	155
Baseline ITSS	457	153
Post-Concussion PCSS	54	15
Post-Concussion ITSS	47	15

Table 3
Baseline PCSS Data, Comparisons Between Sexes

Measure	F	Significance
Total PCSS	2.504	0.000*
Dizziness	0.067	0.796
Headache	5.986	0.015*
Nausea	0.285	0.594
Vomiting	1.255	0.263
Balance	3.724	0.054
Trouble falling asleep	0.678	0.411
Sleeping more than usual	1.868	0.172
Drowsiness	2.613	0.107
Low energy	0.278	0.598
Sensitivity to light	0.107	0.744
Sensitivity to noise	0.373	0.542
More emotional than usual	21.295	0.000*

Irritability	5.160	0.023*
Sadness	16.635	0.000*
Nervous/Anxious	8.425	0.004
Numbness or Tingling	0.047	0.828
Feeling slowed down	0.002	0.968
Feeling as though "in a fog"	0.777	0.378
Feeling "pressure" in the head	0.287	0.593
Difficulty concentrating	1.415	0.235
Difficulty remembering	0.000	0.995

Note: Significance is denoted by a *.

Table 4
Baseline PCSS Data – Responses to Significant Items by Sex

Measure	Mean Response for Males	Mean Response for Females
Total PCSS	5.563	7.292
Headache	0.333	0.529
More emotional than usual	0.254	0.658
Irritability	0.259	0.445
Sadness	0.218	0.516

Table 5
Post-Concussion PCSS Data

Measure	F	Significance
Total PCSS	0.078	0.781
PCSS Time	0.003	0.960
PCSS Time x Sex	0.110	0.741
Dizziness	0.110	0.741
Headache	2.536	0.154
Nausea	0.017	0.897
Vomiting	-	-
Balance	0.027	0.871
Trouble falling asleep	1.644	0.204
Sleeping more than usual	4.988	0.029*
Drowsiness	0.052	0.821
Low energy	0.158	0.693
Sensitivity to light	0.093	0.761
Sensitivity to noise	0.099	0.754
More emotional than usual	0.092	0.763
Irritability	0.063	0.802

Sadness	0.127	0.723
Nervous/Anxious	0.043	0.836
Numbness or Tingling	0.696	0.407
Feeling slowed down	0.682	0.412
Feeling as though "in a fog"	0.995	0.322
Feeling "pressure" in the head	2.515	0.117
Difficulty concentrating	0.017	0.898
Difficulty remembering	0.047	0.829

Note: Significance is denoted by a *.

Table 6
Post-Concussion PCSS Data – Responses to Significant Items by Sex

Measure	Mean Response for Males	Mean Response for Females
Sleeping more than usual	0.280	0.930

Table 7
Baseline ITSS Data

Measure	F	Significance
Total ITSS	6.135	0.014*

-	**Mean Reponse for Males**	**Mean Response for Females**
Total ITSS	5.451	7.582

Note: Significance is denoted by a *.

Table 8
Post-Concussion ITSS Data

Measure	F	Significance
Total ITSS	0.112	0.739
ITSS Time	0.822	0.368
ITSS Time x Sex	0.066	0.798

Appendix B: Academic Vita

Katherine Robinett

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University Address: 10 Vairo Blvd. Apt 219B, State College, PA 16803

Permanent Address: 2296 Roylen Circle State College, PA 16801

Phone Number (Cell): (814) 441-9086

Education

The Pennsylvania State University, University Park, PA

Bachelors of Science in Psychology – Expected Graduation May 2011
Biological & Evolutionary Science Option

Schreyer Honors College with Honors in Psychology

Thesis – The Effect of Gender on Post-Concussion Symptom Ratings by Pennsylvania State University Athletes
Honors Adviser – Peter A. Arnett, Ph.D.
Thesis Adviser – Kenneth N. Levy, Ph.D.

Relevant Experience

Counseling, Consultation, and Psychotherapy Services
Intern
May 2010 – January 2011

- Billed insurance companies for clients' appointments
- Contacted insurance companies regarding unpaid claims or when additional client information is needed
- Deposited clients' payments
- Logged and filed receipts

The Centre County Women's Resource Center
Domestic & Sexual Abuse Counselor/Advocate
August 2009 – Present

- Received 80 hours of training in issues related to domestic violence and sexual assault
- Completed a 5-hour practicum

- Provided counseling and advocacy as an overnight/weekend counselor on a 24-hour hotline for residents of Centre County
- Facilitated Emergency Protection from Abuse Orders (EPFAs) and shelter intakes
- Acted as a member of the Sexual Assault Response Team (SART) at the Mount Nittany Medical Center
- Act as an overnight/weekend counselor in the Center's Shelter

Penn State Sports Concussion Neuropsychology Program
Research Assistant
Fall 2007 – present

- Administer battery of psychological tests to Penn State athletes to assess deficits and aid in back-to-play decisions
- Score and analyze psychological tests
- Direct data entry projects and analyze data using SPSS Statistics
- Assist in the training of new research assistants.
- Assist program director in conducting research.

Work Experience

The Green Bowl
Waitress
June 2006 – December 2010

- Served food and drinks to patrons
- Maintain cleanliness of establishment

Honors

- **Dean's List,** all semesters
- **Evan Pugh Scholar Award**
- **Superior Academic Achievement Award from the College of Liberal Arts,** all semesters
- **Phi Beta Kappa** – Honor Society
- **Psi Chi –** National Honor Society in Psychology