



## **BSc in Psychology**

# Post-Concussion-Like Symptoms in a Healthy Sample: Demographic Factors and the Use of Self-Report Measurement

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Foreword and Acknowledgements

Submitted in partial fulfillment of the requirements of the BSc Psychology degree, Reykjavik University, this thesis is presented in the style of an article for submission to a peer-reviewed journal.

## Abstract-English

Post-concussion symptoms are considered to be non-specific because they have been reported in many different settings and by individuals who have not been diagnosed with a concussion. The main purpose of the study was to investigate the prevalence of post-concussion symptoms in a non-clinical sample, as well as to look at how education, age, gender, residency and self-reported sleep quality related to self-reported post-concussion symptoms. The gender distribution in the research was equal with 49.5% ( $n = 150$ ) of participants identifying themselves as male and 49.5% ( $n = 150$ ) identifying themselves as female. Participants' age ranged from 18 to 68 years old. The mean age was 30.05 ( $SD = 11.83$ ). Specific endorsement rates of post-concussion symptoms at a mild level ranged from 6.8% to 40.2% and from 1.7% to 25.2% for more severe levels of symptom endorsement. Females reported more post-concussion symptoms than males. Those who rated their sleep quality as less than optimal reported more post-concussion symptoms. Results from the linear regression model demonstrated that gender and sleep quality had a significant correlation with the self-report of post-concussion symptoms.

*Keywords:* post-concussion-like symptoms, gender, education, age, self-report

## Abstract-Icelandic

Eftir-heilahristings einkenni eru sögð vera ósértæk vegna þess að einstaklingar sem ekki hafa fengið heilahristing hafa greint frá einkennum. Markmið eftirfarandi rannsóknar var að skoða algengi eftir-heilahristings einkenna hjá heilbrigðu fólki ásamt því að skoða áhrif menntunar, aldurs, kyns, búsetu og svefngæða á eftir-heilahristings einkenni. Þátttakendur rannsóknarinnar voru 49,5% ( $n = 150$ ) karlar og 49,5% ( $n = 150$ ) konur. Því var um jafnt kynjahlutfall að ræða. Þátttakendur voru á aldrinum 18 til 68 ára en meðalaldurinn var 30,05 ( $SD = 11,83$ ). Helstu niðurstöður eftirfarandi rannsóknar voru þær að þátttakendur greindu frá vægum eftir-heilahristings einkennum á bilinu 6,8% til 40,2% og miðlungs til alvarlegum eftir-heilahristings einkennum á bilinu 1,7% til 25,2%. Konur greindu frá fleiri eftir-heilahristings einkennum en karlar. Því verr sem einstaklingar mátu svefn sinn, því fleiri eftir-heilahristings einkenni höfðu þeir. Niðurstöður aðhvarfsgreiningarlíkansins voru þær að bæði kyn og svefngæði höfðu marktæk áhrif á eftir-heilahristings einkenni þátttakenda.

*Lykilorð:* eftir-heilahristings einkenni, kyn, menntun, aldur, sjálfsmat

Post-Concussion-Like Symptoms in a Healthy Sample:  
Demographic Factors and the Use of Self-Report Measurement

**Post-concussion syndrome**

Post-concussion syndrome (PCS) is described as a cluster of symptoms that can occur following a concussion (Ryan & Warden, 2003). Post-concussion symptoms can be physical, cognitive, emotional and behavioural. The main symptoms are headaches, dizziness, memory difficulties, concentration problems, sensitivity to both light and noise, sleep disturbances, fatigue, depression, and anxiety (Chan, 2001).

Post-concussion symptoms are quite frequent among individuals suffering from a concussion (Barlow et al., 2010; Bernstein, 1999; Piland et al, 2003). These symptoms usually appear immediately following an injury and usually disappear quickly, with symptoms predominantly gone within three to six months (Iverson & Lange, 2003). Not all individuals suffering from a concussion recover within the first three months (Dikmen, Machamer, Winn, & Temkin, 1995). Some people continue to experience distressing post-concussion symptoms three months post injury, with a minority even experiencing symptoms years after the injury (Hartlage, Durant-Wilson, & Patch, 2001). The prevalence of persistent post-concussion symptoms (>3 months after a concussion) (Bigler, 2008) has been reported differently across studies with the prevalence rate ranging from 7-8% (Binder, Rohling, & Larrabee, 1997) up to 33% (Rimel et al., 1981).

**The diagnosis of post-concussion syndrome**

The International Classification of Diseases (ICD-10) (World Health Organization, 1992) and the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV) (Frances, 1994), are the leading diagnostic criteria for PCS (Dean, O'Neill, & Sterr, 2012).

According to McCauley et al. (2008), it can be difficult to determine which method should be used when diagnosing PCS. For example, ICD-10 divides 16 symptoms into six

categories while DSM-IV divides 13 symptoms into eight categories. The biggest difference between these criteria lies in how the symptoms are divided into groups. The following symptoms; headache, dizziness and fatigue, all belong to the same category in ICD-10, but not in DSM-IV, which lists these particular symptoms in three different categories. As a result, individuals reporting these symptoms are diagnosed with PCS if DSM-IV criteria is used, but not if ICD-10 is used (Dean et al., 2012).

PCS was not included in the 5th edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-V). PCS was replaced by “Major and Mild Neurocognitive Disorder Due to Traumatic Brain Injury” (American Psychiatric Association, 2013). Moreover, the DSM-V diagnostic criteria do not include individuals who have been diagnosed with PCS based on either DSM-IV or ICD-10 (American Psychiatric Association, 2013). Therefore, DSM-IV might be more useful than DSM-V for evaluating patients with PCS.

Problems with obtaining a sufficient control group (Dikmen, Machamer, & Temkin, 2001) and the chance of a selection bias (McCullagh & Feinstein, 2003) have also contributed to the difficulties in diagnosing PCS. Obtaining a sufficient control group is meant to minimize differences between the experimental group and the control group so that any differences between the groups can be attributed to the injury, rather than chance (Dikmen et al., 2001). Selection bias, on the other hand, refers to a statistical error that can occur when a proper randomization of individuals is not achieved, resulting in experimental groups that do not reflect the variability in the true population (Heckman, 1979).

### **The use of self-report in measuring post-concussion symptoms**

Numerous questionnaires have been developed for the self-reporting of post-concussion symptoms (Potter, Leigh, Wade, & Fleminger, 2006). The questionnaires examine whether symptoms are present or absent (Lees-Haley & Brown, 1993), whether symptoms change within an individual with regard to severity, frequency, or duration (King,

Crawford, Wenden, Moss, & Wade, 1995) and finally, how symptoms affect the individual (Gunstad & Suhr, 2001).

The use of self-reported symptoms as a measure of an individual's state of well-being following a concussion, has a long history (Oddy, Humphrey, & Uttley, 1978). Throughout the years, many different concussion symptom scales have been developed (McLeod & Leach, 2012). Sport Concussion Assessment Tool (SCAT) is a standardized tool, used by physicians and medical officers to evaluate sports-related concussion (McCrorry et al., 2017). SCAT consists of several different aspects, including post-concussion symptom score (PCSS), which is an example of a self-reported symptom scale that has been widely used in the past to assess concussions (Covassin, Elbin, Harris, Parker, & Kontos, 2012). The symptom scale has also been found to be useful in evaluating both symptom presence and severity (Guskiewicz, et al., 2013). In a study conducted by Hänninen et al. (2016), the average severity score (0-132) obtained by an individual was 2.3 ( $SD = 5.2$ ).

Factors, other than concussion, can influence the reliability of self-reported post-concussion symptoms. For instance, being aware that the symptoms are related to a concussion (Van Kampen, Lovell, Pardini, Collins, & Fu, 2006), as well as honesty and willingness of an individual to provide correct information, can impact the diagnosis of PCS (Broglia & Puetz, 2008). Certain psychological factors (Greiffenstein & Baker, 2001), as well as how individuals express their well-being, can also have an impact on the severity of reported post-concussion symptoms (Nolin, Villemure, & Heroux, 2006).

Although self-reporting of symptoms has been frequently used in evaluating post-concussion symptoms, it has been criticized as being unreliable, mostly because the measurement is based on subjective reporting (Kaut, DePompei, Kerr, & Congeni, 2003). For example, athletes might not report symptoms in order to hasten their recovery. Also, open-ended questions might give a different result of symptom reporting among individuals than

checklist methods (Edmed & Sullivan, 2012). Participants reported higher number of symptoms ( $M = 9.1$ ) when they responded to a checklist method versus when they were in an interview ( $M = 3.3$ ) (Iverson, Brooks, Ashton, & Lange, 2010).

### **Non-specificity of post-concussion symptoms**

Post-concussion symptoms are non-specific and are reported in many different settings and by individuals who have not been diagnosed with a concussion (Asken, Snyder, Smith, Zaremski, & Bauer, 2017; Dean et al., 2012; Gunstad & Suhr, 2002; Lees-Haley & Brown, 1993). In fact, 82% of individuals suffering from chronic pain report post-concussion symptoms (Smith-Seemiller, Fow, Kant, & Franzen, 2003) and 43% of individuals with non-brain injury also report post-concussion symptoms (Meares et al., 2008). In a study conducted by Iverson and Lange (2003), post-concussion symptoms were frequent in a healthy group of university students with 61.2% of the participants showing poor concentration and 62.1% having sleep disturbances which are two of the classic post-concussion symptoms. These findings are in accordance with a study conducted by Wang, Chan and Deng (2006), which also stated that post-concussion symptoms are found in individuals that have not been diagnosed with a concussion.

Personality traits are known to influence the way individuals respond to an injury (Garden, Sullivan, & Lange, 2010). Individuals might become more irritable, anxious, restless or depressed following an injury (Rush, Malec, Brown, & Moessner, 2006) and therefore their reactions may look like post-concussion symptoms simply because of their overlapping symptoms. Hence, personality traits, such as depression, might be an important factor in understanding post-concussion symptoms following a concussion (Iverson, Zasler, & Lange, 2007).

One study tested the limits of the specificity of post-concussion symptoms using self-report questionnaire, simply by determining if individuals in a healthy sample would be

diagnosed as having PCS based on how they responded to the questionnaire (Garden & Sullivan, 2010). The results of Garden and Sullivan (2010) indicated that post-concussion symptoms are not specific to concussions, but could be due to, or influenced by, factors such as depression. Participants with mild to severe levels of depression had more serious post-concussion symptoms than the remaining participants in the study (Garden & Sullivan, 2010). Trahan, Ross and Trahan (2001) also examined the relationship between post-concussion symptoms and depression. Their results indicated that individuals who suffer from clinical depression are more likely to score higher on a post-concussion symptoms questionnaire than healthy people.

### **The relationship between different factors and post-concussion symptoms**

Demographic factors such as gender, education, and age, can influence the development of post-concussion symptoms (Santa Maria, Pinkston, Miller, & Gouvier, 2001). Females appear to be more likely than males to develop post-concussion symptoms (Bazarian & Atabaki, 2001; Dean et al., 2012). However, it is important to note that the outcome may vary as a result of the criteria used in diagnosing the post-concussion symptoms (McCauley, 2005). Post-concussion symptoms can also be greater in individuals with lower educational levels (Luis, Vanderploeg, & Curtiss, 2003). The abovementioned study by Dean et al. (2012) declaring that females are at a greater risk of developing post-concussion symptoms than males, may have underestimated the severity of post-concussion symptoms due to numerous participants being highly educated. Concerning age, Jinguji et al. (2012) reported that younger females (13-15 years old) exhibited fewer post-concussion symptoms than those who were older (16-19 years old). In addition, older individuals (>40) have been found to be more susceptible to developing persistent post-concussion symptoms (King, 2014).

Furthermore, research has shown that a concussion can have an impact on self-reported sleep, both quantity and quality (Orff, Ayalon, & Drummond, 2009). Post-concussion symptoms and sleep appear to be bidirectional, with concussion affecting sleep quantity and quality and insufficient sleep increasing post-concussion symptoms (Qin, 2017). Symptoms associated with poor sleep quality are similar to those often reported by individuals suffering from PCS. These include depression and anxiety symptoms, concentration difficulties, fatigue or low energy, and nervousness (Morin & Charles, 1989; Mystakidou et al., 2009). In a study conducted by Sufrinko et al. (2015), individuals who already had sleep-related difficulties prior to their injury, reported more post-concussion symptoms such as headache, dizziness, nausea and fatigue. Similar findings were reported in a study where participants were divided into three groups based on information concerning their self-reported sleep time, before their injury (<7 h, 7-9 h, and  $\geq$  9 h) (McClure, Zuckerman, Kutscher, Gregory, & Solomon, 2014; Mihalik et al., 2013). Individuals who slept less than 7 hours reported more post-concussion symptoms than those who slept more than 7 hours (McClure et al., 2014).

### **Current study**

This study focused on the symptoms that can occur following a concussion, but that are also often reported by individuals without brain injury. The aim of the research was to investigate the prevalence of post-concussion symptoms in a non-clinical sample, as well as to look at how education, age, gender, residency and self-reported sleep quality related to self-reported post-concussion symptoms. Based on the abovementioned literature, the following hypotheses were tested:

1. Post-concussion symptoms are frequent among healthy individuals.
2. Those who rate their sleep quality as less than optimal, report more post-concussion symptoms than others.

## Method

### Participants

A total of 303 individuals completed the survey. The gender distribution for the participants was equal with 49.5% ( $n = 150$ ) of participants identifying themselves as male and 49.5% ( $n = 150$ ) identifying themselves as female. Only 1% ( $n = 3$ ) of participants answered “other” when asked about their gender identification. Participants’ age ranged from 18 to 68 years, with a mean age of 30.05 ( $SD = 11.83$ ). The oldest male participant was 66 years old and the oldest female was 68 years old. The majority of individuals who took part in the research were from the capital area of Iceland, or 84.1% ( $n = 253$ ) of participants. Regarding participants’ education level, 48.5% ( $n = 144$ ) had completed matriculation examination. For further information, see Table 1.

Table 1

*Information concerning age, education and residency of participants across gender*

Variables	Males	Females	Other
Mean age	30.14 ( $SD = 11.47$ )	30.03 ( $SD = 12.26$ )	26 ( $SD = 8.49$ )
Education			
Elementary school	7.1%	6.7%	0.3%
High school	21.9%	26.6%	-
Vocational school	3.4%	2.7%	-
Bachelor degree	9.4%	5.7%	0.3%
Masters degree	7.7%	7.1%	-
Doctorate	-	1%	-
Residency			
From Reykjavík	42.2%	41.2%	0.7%
Outside Reykjavík	7.6%	8.3%	-

## Measures

SCAT-5 is a standardized assessment tool that assesses sports-related concussions among athletes aged 13 years and older (McCrory et al., 2017). SCAT consists of many different features, including PCSS which is a post-concussion symptom scale designed to assess the symptoms that can occur following a concussion (Lovell et al., 2006). Regarding SCAT's symptom diagnosis, participants are asked to review a list that contains 22 common post-concussion symptoms (Mittenberg et al., 1992). This type of checklist allows participants to self-report their current symptoms (with a maximum of 22) along with severity ratings for each endorsed symptom (with a maximum of 132) using a seven-point Likert scale rating (McCrory et al., 2017). Each symptom is rated from 0 (non-existent) to 6 (severe). According to Lovell et al. (2006), PCSS is a highly reliable measure with an internal consistency between 0.86 and 0.94. The following study used the Icelandic version of SCAT's 3 symptom evaluation component (Jónbjörnsson & Tómasson, 2016).

The question concerning participants' sleep was asked on a five-point Likert scale. Participants had to describe how well they slept on average (1 = Strongly disagree, 2 = Slightly disagree, 3 = Neither agree nor disagree, 4 = Slightly agree, 5 = Strongly agree).

## Procedure

The survey was carried out over a two-month period, from early February until the end of March 2018. Participants in the study were recruited via advertisements that were posted on Facebook and Twitter. Snowball sampling was used for collection of participants.

Prior to data collection the investigator filled out a form regarding the purpose of the study and submitted it to The Icelandic Data Protection Authority (DPA). Before participants could answer the questionnaire, they were told that only those who had never been diagnosed with a concussion or a disease in the central nervous system, were eligible to take part in the research. Therefore, participants in the study should all have been healthy community

volunteers. Participation was restricted to healthy individuals because the aim of the study was to determine the self-reported rates of post-concussion symptoms in a healthy population with no concussion history.

After the participants had answered the questionnaire they were sincerely thanked for their contribution to the research. Participants did not receive any kind of monetary incentives or other kinds of benefits for their participation in the research.

### **Design and data analysis**

Descriptive statistics were calculated to give information about the prevalence of post-concussion symptoms in a healthy sample using the Icelandic translation of the symptom evaluation component of the SCAT-3 (Jónbjörnsson & Tómasson, 2016).

All of the 22 post-concussion symptoms were computed into one variable. Additionally, the original Likert scale rating of the 22 post-concussion symptoms (0 = Non-existent, 1 = Mild, 2 = Mild, 3 = Moderate, 4 = Moderate, 5 = Severe, 6 = Severe) (McCrorry et al., 2017) was recoded into a different variable. Values 1 and 2 were combined and given the value 1 (mild), values 3 and 4 were combined and given the value 2 (moderate) and values 5 and 6 were combined and given the value 3 (severe). The value for non-existent symptoms remained the same. Thus, the maximum score of participants' severity ratings in this research was 66 instead of 132.

Linear regression was conducted to examine how different factors contributed to the self-reported post-concussion symptoms. The following variables; education, age, gender, residency and sleep quality, were all included in the regression model.

Bivariate correlation was also conducted to show the correlation between the post-concussion symptoms, education, age, gender and residency with how participants' rated their sleep on average.

The statistical analyses were performed with the International Business Machines (IBM), Statistical Package for the Social Sciences (SPSS, version 24) (IBM, 2016). For all analyses, criterion level of significance was set at  $p < .05$ .

## Results

### Prevalence of post-concussion symptoms

The frequency and percentages of the 22 post-concussion symptoms of the SCAT-3 reported at a mild level and higher, are presented in Table 2.

Table 2

*Percentage of the post-concussion symptoms endorsed at a specific rate*

Post-concussion symptoms	Mild (%)	Post-concussion symptoms	Moderate-to-Severe (%)
Headache	21.1	Headache	11.4
“Pressure in head”	18.7	“Pressure in head”	8.1
Neck pain	21.2	Neck pain	9.2
Nausea and/or vomiting	6.8	Nausea and/or vomiting	2.0
Dizziness	12.7	Dizziness	3.4
Blurred vision	14.3	Blurred vision	5.1
Balance problems	7.2	Balance problems	3.1
Sensitivity to light	15	Sensitivity to light	5.4
Sensitivity to noise	19.3	Sensitivity to noise	6.5
Feeling slowed down	12.5	Feeling slowed down	3.7
Feeling like “in a fog”	6.8	Feeling like “in a fog”	2.3
“Don’t feel right”	18.2	“Don’t feel right”	7.8
Difficulty concentrating*	30.4	Difficulty concentrating*	14.2
Difficulty remembering	22.3	Difficulty remembering	10.2
Fatigue or low energy*	40.2	Fatigue or low energy*	25.2
Confusion	7.1	Confusion	1.7
Drowsiness*	37.7	Drowsiness*	21.2
More emotional	22.3	More emotional	11.2
Irritability*	30.4	Irritability*	12.5
Sadness	24.6	Sadness	9.2
Nervous or anxious*	33.1	Nervous or anxious*	22.9
Trouble falling asleep*	25.4	Trouble falling asleep*	16.9

*Note.* \*Cumulative percentage over 40%.

The rate at which mild post-concussion symptoms were endorsed ranged from 6.8% to 40.2% with participants most frequently reporting of concentration difficulties (30.4%), fatigue or

low energy (40.2%), drowsiness (37.7%), irritability (30.4%) and being nervous or anxious (33.1%). Moreover, severe endorsement rates of post-concussion symptoms reported ranged from 1.7% to 25.2%. The most common symptom participants reported at this level was fatigue or low energy (25.2%), followed by being nervous or anxious (22.9%) and drowsy (21.2%).

Females reported more post-concussion symptoms than males. As seen in Figure 1, females self-reported greater instances for every post-concussion symptom than did their male counterparts. The biggest difference between genders was that females tended to be “more emotional”. Even though it appears in Figure 1 that females reported more post-concussion symptoms than males, only 12 of the 22 symptoms were significant.

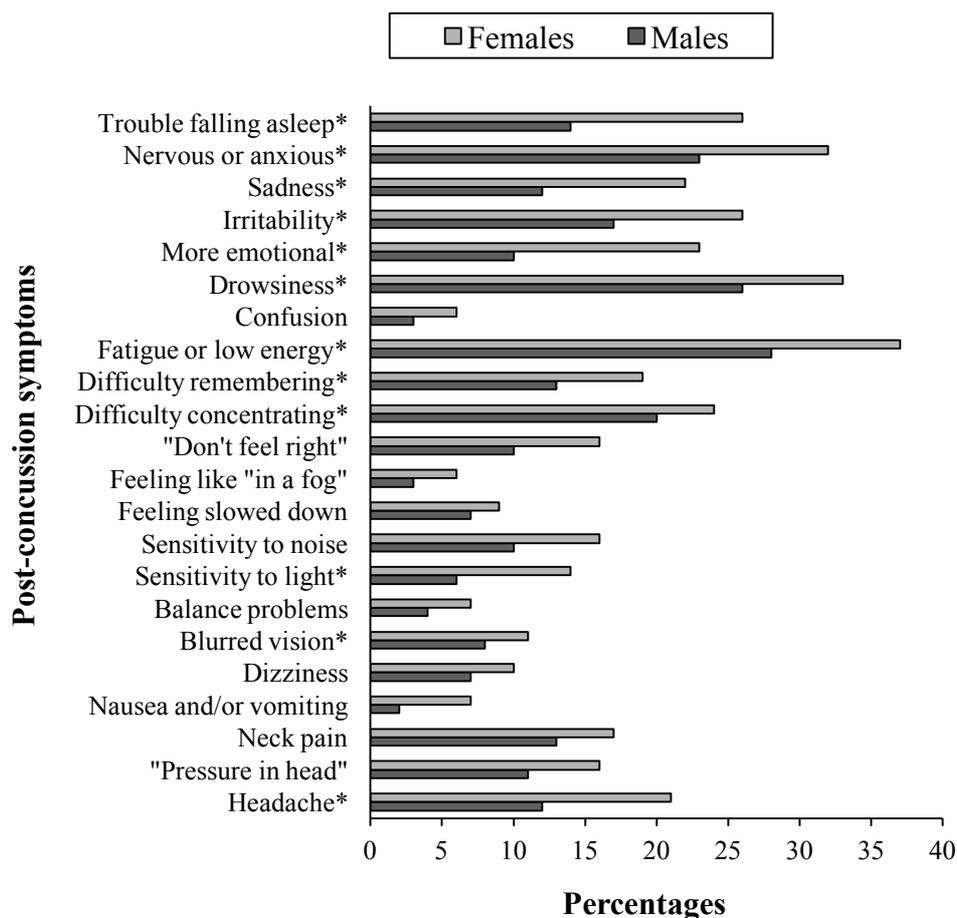


Figure 1. Frequency of reported symptoms across gender. Statistical significance: \* $p < .05$ .

The total number of symptoms participants reported (maximum of 22) varied between individuals, with 69 participants (24.7%) endorsing 10 or more symptoms. Concerning post-concussion symptoms endorsed at a specific rate, 152 participants (57.6%) reported four or fewer mild symptoms meanwhile 75 participants (28.4%) endorsed three or more moderate-to-severe symptoms. Only 13 participants (5%) reported 10 or more moderate-to-severe symptoms.

The severity ratings for each endorsed symptom (with a maximum of 66) was also examined. The highest score obtained by an individual was 51, where as the lowest score of 0 was obtained by 30 participants (11.4%). In addition, it is worth noting that 177 participants (67%) scored 10 or lower.

**The relationship between the post-concussion symptoms and sleep quality**

Figure 2 shows the distribution of how participants rated their sleep across gender. Of the participants, 22.59% ( $n = 68$ ) either strongly disagreed or slightly disagreed with the statement: "I sleep well on average." Participants that strongly agreed with the statement were in total 42.19% ( $n = 127$ ) of the sample. According to Kolmogorov-Smirnov, the variance for sleep was not normal  $D(301) = .249, p < .001$ .

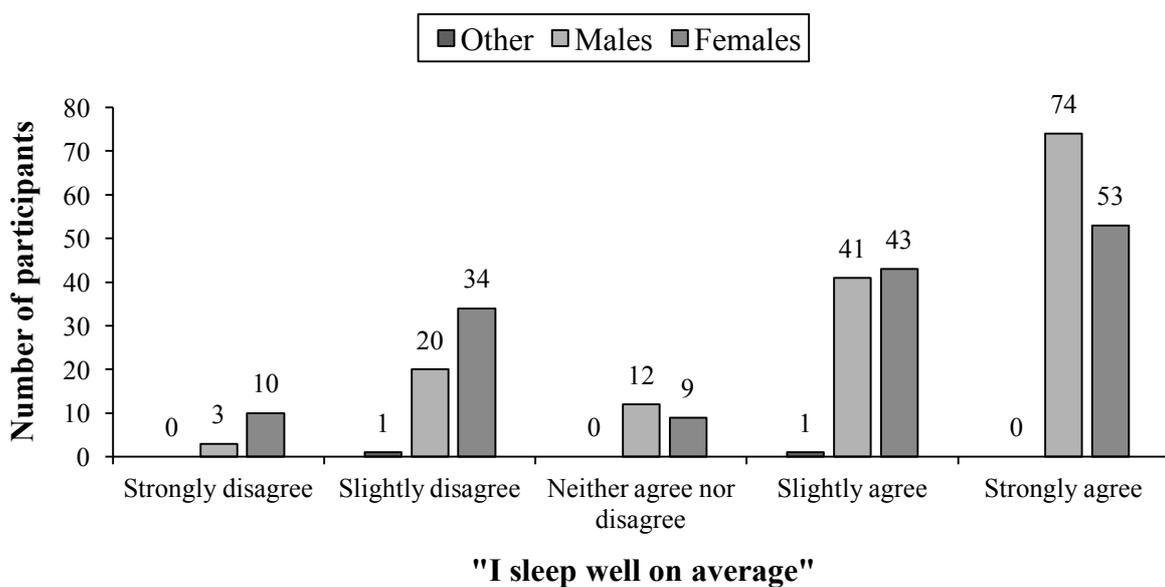


Figure 2. The distribution of how participants rated their sleep.

Pearson correlation coefficient was examined for descriptive purposes. Table 3 demonstrates the correlation between the post-concussion symptoms, education, age, gender and residency with the sleep quality of participants.

Table 3

*The correlation between the post-concussion symptoms, education, age, gender and residency with sleep*

Variables	Sleep quality
Post-concussion symptoms	
Headache	-.255**
"Pressure in head"	-.162**
Neck pain	-.209**
Nausea and/or vomiting	-.083
Dizziness	-.194**
Blurred vision	-.212**
Balance problems	-.124*
Sensitivity to light	-.154**
Sensitivity to noise	-.236**
Feeling slowed down	-.279**
Feeling like "in a fog"	-.236**
"Don't feel right"	-.232**
Difficulty concentrating	-.365**
Difficulty remembering	-.374**
Fatigue or low energy	-.387**
Confusion	-.201**
Drowsiness	-.417**
More emotional	-.263**
Irritability	-.324**
Sadness	-.406**
Nervous or anxious	-.321**
Trouble falling asleep	-.514**
Education	.008
Age	-.064
Gender	-.159**
Residency	.035

*Note.* Statistical significance: \* $p < .05$  \*\* $p < .001$ .

All of the post-concussion symptoms, except nausea and/or vomiting, were significantly correlated with sleep quality reported by participants. Additionally, gender was significantly correlated with sleep quality meanwhile education, age and residency were not found to be significantly correlated with sleep quality. The strongest correlation was between drowsiness

and sleep quality ( $r = -.417$ ) and the weakest correlation was between education and sleep quality ( $r = .008$ ).

### **The effects of education, age, gender, residency and sleep quality on post-concussion symptoms reported by participants**

Linear regression analysis was used to show how different factors such as education, age, gender, residency and sleep contributed to the self-report of post-concussion symptoms among participants. As displayed in Table 4, model 1, gender and sleep were the only factors significantly related to the self-reported post-concussion symptoms.

Table 4

*Linear regression model predicting self-reported post-concussion symptoms*

Predictor	Model 1 $\beta$
Education	.052
Age	-.123
Gender	.192**
Residency	-.057
Sleep quality	-.439**
Adjusted R <sup>2</sup>	.251

*Note.*  $\beta$  = Beta, standardized coefficient. Statistical significance: \*  $p < .05$  \*\*  $p < .001$ .

Gender had a quite strong positive influence ( $\beta = .192$ ,  $p < .001$ ) on self-reported post-concussion symptoms, meaning that females were more likely to report post-concussion symptoms than males. Additionally, sleep quality had a strong negative influence ( $\beta = -.439$ ,  $p < .001$ ) on self-reported post-concussion symptoms, indicating that those who rated their sleep quality as less than optimal reported more post-concussion symptoms than others.

However, age was marginally significant ( $\beta = -.123$ ,  $p < .075$ ), indicating that younger participants were more likely to report post-concussion symptoms than those who were older.

Model 1 was statistically significant  $F(5, 250) = 18.104$ ,  $p < .001$ , explaining 25.1% ( $R^2 = .251$ ) of participants' variance regarding self-reported post-concussion symptoms.

### Discussion

As previously stated, the present research did not investigate self-reported post-concussion symptoms in individuals who had been diagnosed with a concussion. The main purpose of the current study was to examine the prevalence of self-reported post-concussion symptoms among healthy individuals as well as to investigate if certain demographic characteristics, such as education, age, gender, residency and self-reported sleep quality, would impact the self-report of post-concussion symptoms. The correlation between the post-concussion symptoms, education, age, gender and residency with sleep quality was also examined.

In this research, self-reported post-concussion symptoms were frequent among healthy individuals with participants reporting of both mild and moderate-to-severe symptoms. Therefore, the first hypothesis, which stated that post-concussion symptoms would be frequent in a healthy sample, was met. These abovementioned findings are consistent with other research in this area that also reported high rates of post-concussion symptoms among healthy community volunteers (e.g. Iverson & Lange, 2003; Lees-Haley & Brown, 1993; Meares et al., 2008, Wang, Chan, & Deng, 2006). The most frequently reported post-concussion symptom, regardless of severity, was fatigue or low energy (65.4%), which was consistent with previous studies (Iverson & Lange, 2003). Other frequently reported post-concussion symptoms were drowsiness (58.9%), being nervous or anxious (56%) and having concentration difficulties (44.6%). In addition, Asken and colleagues (2017) reported relatively high rates of fatigue or low energy (22.1%), drowsiness (12%), being nervous or anxious (22.1%) and having concentration difficulties (16.6%). Hence, it can be concluded that there is a high prevalence of self-reported post-concussion symptoms in a healthy population.

One of the aims of the study was also to examine how self-reported sleep quality, gender, age, education and residency related to self-reported post-concussion symptoms. According to the linear regression analysis, education, age and residency were not significantly correlated with the post-concussion symptoms reported by participants. The fact that education did not have an effect on self-reported post-concussion symptoms was surprising given previous results which demonstrated that post-concussion symptoms can be greater in individuals with lower educational levels (Luis, Vanderploeg, & Curtiss, 2003). Age was marginally significant ( $\beta = -.123, p < .075$ ), indicating that younger participants were more likely to report post-concussion symptoms than those who were older. These findings are consistent with past studies (Jinguji et al., 2012; King, 2014). Regarding the effects of residency on self-reported post-concussion symptoms, it proved to be quite difficult to compare studies, only because few researches, if any, had investigated that particular connection.

In this research, females were more likely to report post-concussion symptoms than males. Support for this comes from Lovell and colleagues (2006) who reported a significant difference between males and females regarding post-concussion symptom report rates. Their results showed that females reported more post-concussion symptoms than males. Previous research has also suggested that females appear to be more likely than males to develop post-concussion symptoms (Bazarian & Atabaki, 2001; Dean, O'Neill, & Sterr, 2012; Dischinger et al., 2009; Jinguji et al., 2012).

The second hypothesis, stating that those who rated their sleep quality as less than optimal reported more post-concussion symptoms than others was supported. These results are consistent with a research conducted by Sufrinko and colleagues (2015), which proclaimed that individuals who already had sleep-related difficulties prior to their injury, reported more post-concussion symptoms such as headaches, dizziness, nausea and fatigue.

According to Mystakidou and colleagues (2009), symptoms that are associated with poor sleep quality are similar to the ones known to be related to PCS. Consequently, one possible explanation for sleep quality being the strongest predictor for self-reported post-concussion symptoms might be due to the fact that the symptom cluster for PCS does have substantial overlap with symptoms of poor sleep quality.

There were several limitations to this study. First, the study did not use a sample of concussed individuals. As a result, it cannot be known with certainty if there are other factors that motivate symptom reports among concussed individuals compared to a non-clinical sample. Participants in the present study were mostly from Reykjavik (84.1%) and therefore the generalizability of the current study is limited and may not generalize to the wider population. Furthermore, as the study was based on self-report measurement, more specifically a post-concussion symptom checklist, it could have resulted in more responsiveness in terms of identifying symptoms, i.e. with participants over-reporting symptoms (Iverson et al., 2010). In addition, the researcher had to assume that participants would answer the survey conscientiously as well as with full honesty.

Despite these limitations, this study possesses several strengths. The translated version of the post-concussion symptom component of SCAT-3 used in this study, had an excellent internal consistency (Cronbach's  $\alpha = .92$ ) which is consistent with past research (Lovell et al., 2006). It is also worth noting that the gender distribution in the research was equal. This is also the first study to collect base rate information of post-concussion symptoms in a healthy population using an Icelandic version of the SCAT-3's symptom component.

Regarding future research, it might be sensible to carry out the same study, only with a greater number of participants. However, regarding generalizability, it is also important that participants differ in terms of age, gender, education and residency. It might be interesting to

conduct the same study in different countries and determine if there are any cultural differences that affect the self-report of post-concussion symptoms among healthy people. Furthermore, it may also be appealing to compare the prevalence of post-concussion symptoms in healthy individuals with those who have already been diagnosed with a concussion.

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## Appendix A

### The questionnaire

SCAT heilbrigðir BS ritgerð ÓT 2018

100%

[Exit Survey](#) 

Takk fyrir að opna þennan tengil.

Eftirfarandi spurningalisti er liður í BSc rannsóknarverkefni Ósvalds Jarls Traustasonar við Háskólann í Reykjavík. Spurt er um líkamleg og hugræn einkenni sem geta hrjáð heilbriggt fólk. Spurningalistinn er stuttur og tekur um 5-10 mínútur að svara honum.

Einstaklingar sem hafa fengið heilahristing eða aðra höfuðáverka eða hafa sjúkdóma í miðtaugakerfi (heila) geta ekki tekið þátt.

Engum er skylt að klára listann þótt hann opni hann.

Rannsakendur leggja áherslu á að ekki verður hægt að rekja svör til einstakra þátttakenda og að ekki verður unnið með persónugreinanleg gögn. Rannsóknin hefur verið tilkynnt til Persónuverndar.

Með fyrirfram þökk og von um þátttöku,

Ósvald Jarl Traustason, sálfræðinemi við Háskólann í Reykjavík (osvald15@ru.is)

Ábyrgðarmaður: María Kristín Jónsdóttir, dósent í Sálfræði við Háskólann í Reykjavík

**Hvert er kyn þitt?**

- Karl
- Kona
- Annað
- 

**Hver er aldur þinn? (miðaðu við þann aldur sem þú nærð á árinu 2018)**

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**Hvaða menntun hefurðu lokið?**

- Grunnskólamenntun
- Stúdentspróf
- Önnur framhaldsskólamenntun en stúdentspróf (t.d. iðnnám)
- Háskólapróf (Grunnnám í háskóla, t.d. BS)
- Háskólapróf (framhaldsnám í háskóla, MS eða sambærileg)
- Háskólapróf (Doktorspróf)

**Hvar er búseta þín?**

- Á höfuðborgarsvæðinu
- Utan höfuðborgarsvæðisins
- 

**Ég hef almennt vel**

- Að öllu leyti ósammála
- Að dálitlu leyti ósammála
- Hvorki sammála né ósammála
- Að dálitlu leyti sammála
- Að öllu leyti sammála
-

