Chronotypes and Insomnia in Iceland

How does chronotype affect insomnia, as well as anxiety, depression and SAD for people in Iceland?

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We hereby declare this thesis to be the project of our own work and the project of our own investigation.

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I hereby confirm that this final thesis fulfils according to my own judgment the requirements for a B.A. degree in the Faculty of Psychology.

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Abstract

**Background**
Chronotype is what is used to describe how an individual’s rhythm in the circadian system coordinates their biological clock in relation to cognitive, behavioral and physiological processes which surge accordingly later or earlier in the day. The Morningness-Eveningness Questionnaire (MEQ) identifies individuals as either morning types or evening types. Former studies have shown a significant 3-hour difference between core rhythm peaks in morning and evening types. Icelandic people go to bed later than people in other European countries and it is hypothesized that a wrong time-zone is responsible. This means that chronotypes in Icelandic people are usually later considering geographical location and that they experience more social jetlag compared to other countries. Numerous studies have connected chronotype to depression or depressive episodes in other psychological disorders. Insomnia is one of the most frequently diagnosed psychological health problems and it has a strong association with other psychiatric disorders, especially depression and anxiety. It has been suggested that some treatments for sleep disturbances could even prevent the development of depression. There is a correlation between being an evening type, experiencing seasonal affective disorder (SAD) and having sleep problems and many studies have shown differences between morning types and evening types when it comes to duration and quality of sleep. Evenings types are more sensitive to social jetlag and it has been suggested that being an evening type is a risk factor for the development of affective disorder for those who suffer from insomnia. The results of previous research intrigued us, and for that reason, we wanted to assess the connection between chronotypes and insomnia, anxiety, depression and SAD. Our research question is: How does chronotype affect insomnia, as well as anxiety, depression and SAD for people in Iceland? Our main hypothesis is: There is an association between chronotype and insomnia.

**Methods**
The sample of this study consists of 261 participants. After excluding missing data, people not living in Iceland and those who do not have Icelandic as their native language, 249 participants were included in our final analysis. The questionnaires submitted to the participants were SPAQ, MEQ-IS, MIQ-RS-IS, BIS-IS, PHQ-9 and DASS. Our independent variable was chronotype and our dependent variables were insomnia, anxiety, depression and seasonal affective disorder (SAD). We also used gender and age as an independent variable to see if there was any difference in relation to chronotypes. For our statistical evaluation, we used descriptive statistics, non-parametric ANOVA, chi-square test and binomial logistic regression model with the R-function gml().

**Results**
We found a significant difference between chronotypes where evening types had higher score on insomnia (p<.001), depression (p<.001), anxiety (p<.001) and SAD (p=.036). A significant difference was between age groups when it came to chronotypes (p<.001). We found no significant difference when it came to gender in relation to all the dependent variables.

**Conclusion**
Further research is required in order to fully understand how a wrong time-zone affects chronotypes, like in Iceland. We suggest that the population of Iceland should be compared to those living in a correct time-zone to see how that contributes to the prevalence of insomnia, depression, anxiety and SAD.

Keywords: Iceland, chronotype, insomnia, depression, anxiety, seasonal affective disorder (SAD)
Útdráttur

Bakgrunnur

Dægurgerðir er hugtak sem lýsir sólahringstakti einstaklings og hvernig lífræðileg klukka hans samstíllir hugræna, hegðunar og lífeðlisfræðilega ferla sem rísa í samræmi við fyrrípart eða seinnípart dagssins. Morningness-Eveningness Questionnaire (MEQ) er spurningalisti sem mælir það hvort einstaklingur eru morguntípur eða kvöldtípur. Fyrri rannsóknir hafa sýnt að það er marktækur klukkstunda munur á húpunktum dægursveifla milli morgun- og kvöldtípurnar. Íslendingar fara að jafnaði morgun típur eða kvöld típur sem rísa í samræmi við fyrri eða seinní dagdags.

Morningness-Eveningness Questionnaire (MEQ) er spurningalisti sem mælir það hvort einstaklingur eru morguntýpur eða kvöldtípur. Fyrri rannsóknir hafa sýnt að það er marktækur klukkastunda munur á húpunkum dægursveifla milli morgun- og kvöldtípurnar. Íslendingar fara að jafnaði morgun típur eða kvöld típur sem rísa í samræmi við fyrri eða seinní dagdags.

Tilgátur okkar úrtak innihélt 261 þátttakanda. Eftir að hafa keiði út brettfallsgildi, þátttakandur sem búu ekki á Íslandi og það hafa ekki íslensku sem móðurtungumál, voru 249 þátttakandur innanálir í rannsókninni. Spurningalistarnir sem við lögðum fyrir þátttakandurna voru SPAQ, MEQ-IS, MIQ-RS-IS, BIS-IS, PHQ-9 og DASS. Óháða breytingar okkar var dægurgerð og háðu breyturnar okkar voru svefnleysi, þúglyndi og skammdegisþunglyndi (SAD). Við skoðuðum einnig breyturnar kyn og aldur sem óháðar breytingar, til þess að sjá hvort það væri munur þar þegar kemur að þátttakandi. Fyrir tölfraeúrvinslu gagnanna notuðum við östikaða dreifigreiningu (ANOVA), kí-kvaðratpróf, og tvíkosta aðhvarfsgreiningu með R-aðgerðinni gml().

Niðurstöður

Það var marktækur munur á milli dægurgerða í tengslum við svefnleysi (p<.001), þúglyndi (p<.001), kviða (p<.001) og skammdegisþunglyndi (p=.036). Það var marktækur munur þegar kom að aldri og dægurgerðum (p<.001). Þegar við skoðuðum kyn í tengslum við háðu breyturnar okkar, reyndist enginn marktækur munur vera þar á milli.

Ályktun

Fleiri rannsóknir eru nauðsynlegar til þess að skilja áhrif þess að vera í röngu tímabelti á dægurgerðir, líkt og á Íslandi. Við mælum með samanburði á íslensku úrtaki við úrtak sem byr í röttum tímabelti til að sjá að þess að svefnleysi, þúglyndi, kviða og skammdegisþunglyndi.

Lykilhugtök: Íslendur, dægurgerð, svefnleysi, þúglyndi, kviða, skammdegisþunglyndi (SAD)
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Introduction

There have been many studies that show how chronotypes affect sleep and the quality of sleep (Li et al., 2018; Shimura et al., 2018; Roenneberg, T., Wirz-Justice, A. & Merrow, M., 2003). Chronotypes explain at what time a day the individuals is at their optimal performance and are often divided into morning types and evening types (Aschoff, 1965). Researchers have also indicated that evening types are more likely to suffer from insomnia and other psychological problems than morning types (Hidalgo et al., 2009). This information gives us the idea that chronotypes influence psychological disorders.

Depression and insomnia have often been linked together, but poor sleep has also been linked directly to mental problems such as anxiety disorders and major depressive disorder (Buckhalt, El-Sheikh, Keller & Kelly, 2009). Insomnia is a Latin word that means “no sleep” and it is a disorder that involves the chronic inability to fall asleep or remain asleep. Not getting enough sleep and not feeling rested can have an impact on the quality of everyday life and affect our everyday activities (American Psychiatric Association, 2013). Insomnia is sometimes a symptom of other conditions (American Psychiatric Association, 2013) but it is often misdiagnosed as a consequence of other illnesses. According to Winkelman (2015), half of those individuals who were diagnosed with major depressive disorder and insomnia, had insomnia predate the onset of the mood disorder. Insomnia can have many consequences, but fatigue, sleepiness and cognitive impairment are most common (Johnston, 2005).

Seasonal affective disorder (SAD) is one subtype of major depressive disorder that appears each year at the same time for a certain amount of time but is nonexistent throughout other time periods of the year. The symptoms usually consist of craving for carbohydrates, hypersomnia and overeating (Rosenthal et al., 1984). The disorder only affects 3,8% of the population of Iceland according to a study by Magnusson (2000). The percentage is rather low compared to other countries of the same latitude, especially when considering the fact that Iceland has the highest usage of antidepressants in OECD countries which include 34 countries around the world (OECD, 2019b).

Anxiety is one of the most common mental disorders. There are about 30-40% of individuals in Western societies that will develop some sort of anxiety at one point in their lives (Davey, pg. 147, 2015). Globally, there were about 3.6% suffering from anxiety disorders in 2015. The largest number came from the Americas, where approximately 7,7% females suffered
from anxiety disorders (WHO, 2017). Anxiety disorders are also commonly comorbid with other psychological disorders because it has a wide variety of symptoms. Anxiety has both mental and physical symptoms. The first symptoms of anxiety are visible, such as trembling, dry mouth, muscle tension and excess sweating (Davey, pg. 146, 2015).

**Chronotypes**


Chronotype is not a frequently used term but it has increasingly been getting more attention in the northern countries, especially in Iceland. Chronotype is what is used to describe how an individual’s rhythm in the circadian system coordinates their biological clock in relation to cognitive, behavioral and physiological processes which surge accordingly later or earlier in the day (Roenneberg, 2015; Aschoff, 1965). Aschoff explained in 1965 that there had been numerous studies that show how all those functions have a high and a low during the 24-hour day and always follow a certain rhythm that he describes to be every living system’s physiological clock. The circadian rhythm of an organism matches external factors called Zeitgebers, where light and temperature play the biggest roles. “Experiments with many species in several laboratories gave rise to the following "circadian" rule: With increasing intensities of illumination, the circadian period is shortened in diurnal (light-active) animals and lengthened in nocturnal (dark-active) animals“ (Aschoff, 1965).

Ever since Aschoff published his study, there have been even more studies that demonstrate the rhythm of each process and how these rhythms are connected to various mechanisms of living things. Lack, Bailey, Lovato and Wright (2009) were curious about these rhythms and did a study where they measured core temperature and melatonin circadian rhythms. They also measured both subjective and objective sleepiness. Their results indicated that there is up to 3-hour difference between core rhythm peaks in morning and evening types. This explains each type’s ability to initiate sleep, but compared to the social clock, the evening types will initiate sleep on up to 3-hour delay. Roenneberg, Kumar and Merrow (2007) suggested that the human clock is entrained by the sun, more than the social clock. They hypothesized that individuals who live in larger cities have later chronotypes due to less exposure to natural light, decreasing the intensity of that Zeitgeber. Resident location has therefore been linked to chronotypes, as morning types often live in rural areas while evening types inhabit urban areas (Roenneberg et al., 2007; Carvalho, Hidalgo & Levandovski, 2014).
Chronotypes and Iceland

According to article 1 Act no. 6/1968, Icelandic time is in the Greenwich Mean Time (GMT), but now there is a bill being promoted that will change the time in Iceland (Pingskjal nr. 421/2014-2015) because current local time is not according to Iceland’s geographical location. Therefore, the external clock does not match the biological clock. We should, in fact, have GMT-1 and the areas furthest west should even be in GMT-2 as displayed in Figure 1. If this bill is accepted, there will be a 64-day increase where there are bright mornings (bright 9 am), which is more than a 2-month period.

![Figure 1: World map of GMT time zones (Europe Time Zone Map, 2019)](image)

If the local time is too early compared to geographical time, the biological clock is not getting the information it needs from the sunrise in order to wake up the body and coordinate all bodily functions (Duffy & Czeisler, 2009). It would be like waking up in the middle of the night, except there is no going back to sleep. The decision was made in 1968 that the local time in Iceland would be in Greenwich Mean Time and it was primarily based on financial and business reasons. Recent studies have revealed numerous negative health consequences of being in the wrong time-zone (Giuntella & Mazzonna, 2019; Luyster, Strollo, Zee & Walsh, 2012; Harrison, 2013), but when the local time is an hour too early, sunrise is an hour too late which leads to dark mornings, but brighter evenings.
Lack of sleep can have severe consequences and studies indicate that Icelandic people don’t get enough sleep in general. Þorleifsdóttir (2019) did a study in the population of Iceland about chronotypes and social jetlag. Her results indicated that the chronotype in Icelandic people is usually later considering geographical location and that they experience more social jetlag compared to other countries, but social jetlag is the conflict between biological and social time (Wittmann, Dinich, Merrow & Roenneberg, 2006). This results in less sleep during weekdays. More studies have shown that people in Iceland go to sleep later than people in other European countries and there are hypotheses about how a wrong time-zone is responsible for this. Hagenauer and Lee (2012) found out that late time-zone results in later chronotype, especially among young adult. People in Iceland go to sleep later than people in other countries, but wake up at the same time to go to school/work and therefore, don’t get the same amount of sleep and as a result experience social jetlag (Þorleifsdóttir, 2019). The majority of Icelandic adolescents do not get their 8-10 hours of sleep every night, but on average sleep for about 6-7 hours per night. When compared to adolescents in Europe, they are sleeping fewer hours during the week (Rognvaldsdottir et al., 2017; Thorleifsdottir, Bjornsson, Benediktsdottir, Gislason & Kristbjarnarson, 2002). Icelandic adolescents go to bed around 00:22 which is later than their European peers, and a late biological clock in Icelandic adolescents could be the reason why. Social jetlag was present for Icelandic adolescents as there was a difference between sleep duration during school days and during weekends as they went to sleep later during weekends and woke up later (Rognvaldsdottir et al., 2017).

**Depression, SAD and Anxiety**

“Depression (major depressive disorder) is a common and serious medical illness that negatively affects how you feel, the way you think and how you act“ (Parekh, 2017).

Depression is one of the most known and widespread psychological disorder in the world. With the prevalence of 2 weeks or longer, up to 16,6% will experience depression at some point in their life, but 6,7% of all adults are diagnosed annually (Parekh, 2017). Its main characteristics are the appearance of sadness, irritation and an empty mood in the company of cognitive and somatic changes that consequentially affects an individual’s functionality (American Psychological Association, 2013). The National Institute of Mental Health (2017) did a survey in the United States of America on the prevalence of major depressive episodes among adults from 18 years and older and their results state that about 7% of adults in the U.S. have suffered at least one major depressive episode and that it is most common among
young adults aged 18-25 years old. Additionally, did a higher number of females report depressive episodes, or 8.7%, while only 5.3% males reported experiencing those episodes.

Seasonal affective disorder (SAD) is “…a condition of regularly occurring depression in winter with a remission the following spring or summer…” (Davey, pg. 201, 2015). This condition is common in countries of high longitude during the winter months due to the lack of sunlight. It causes depression and sleep disturbances in many individuals during the winter months (Magnusson & Stefansson, 1993). Even though it most commonly affects individuals during the winter months, some cases have reported experiencing SAD over the summer months with receding symptoms in the winter (Wehr, Sack & Rosenthal, 1987). DSM-V defines SAD’s main symptoms as depressed mood, hypersomnia, overeating, lack of energy, weight gain and craving for carbohydrates. It is hypothesized that SAD develops in individuals because of increased secretion of the hormone melatonin (Davey, pg. 201, 2015), but there are no studies that show significant difference regarding the secretion of melatonin to be solely responsible for SAD or that it can be used to treat or prevent SAD (Wehr, Jacobsen & Sack, 1986).

Anxiety often follows depression, but the main symptom of anxiety disorders includes excessive fear and other behavioral disturbances. When an individual experiences anxiety, the brain releases chemicals to the body that lets the system know there is imminent danger and the individual must either fight or flight. These reactions of false danger are often accompanied by various physical disruptions such as muscle tension and avoidance behavior. When anxiety progresses, its symptoms include rapid or irregular heartbeat, nightmares, constant need to use the bathroom, diarrhea, chronic fatigue, sleeping difficulties and sometimes sexual problems (American Psychology Association, 2013). Davey (pg. 146-157, 2015) explains how mental symptoms can be somewhat severe and often include intrusive thoughts and a fear of something awful happening. This is often associated with uncontrollable flashbacks of past events. Those who experience these thoughts and anxiety find it difficult to stop the negative thoughts and this happens because of the development of cognitive biases that develop alongside the anxiety.

Depression, SAD and Anxiety in Iceland

When it comes to Iceland, there is a surprisingly low number of people that reportedly have SAD. In a cross-sectional study by Magnusson (2000), he compared the distribution of SAD in number of countries, but only about 4% of the Icelandic population suffered from SAD. Compared to countries of similar latitudes, that number is surprisingly low. Alaska and
Siberia, which are at 55-64°N, report 6.6%-16.2% prevalence of SAD, Finland, at 60°N, reports 7.1% prevalence of SAD and Norway at 58-70°N reports 5.8% in males and 12.9% prevalence in females (Magnusson, 2000). These numbers are interesting since 12% of the Icelandic nation was reported using antidepressants in the year 2013 (Jóhannsson, Einarsson, Guðmundsson & Bárðarson, 2014).

The Organization for Economic Cooperation and Development (2015) examined pharmaceutical consumption in OECD countries and reported Iceland being the greatest user of antidepressants, followed by Australia, Portugal and Canada. A significant difference was between countries, where Iceland had twice the average consumption of antidepressants compared to other OECD countries. As presented in Figure 2, the usage of antidepressants only increases as the years go by, but daily dosage has climbed from about 117 in 2013 to more than 140 in 2017 (OECD, 2019a).

![Figure 2. Daily dosage of antidepressants in Iceland (OECD, 2015; 2019a)](image)

Sigfusdottir, Asgeirsdottir, Sigurdsson and Gudjonsson (2008) investigated the trends in anxiety among adolescents in Iceland in the years 1997-2006, where they used four time-points to give the participants questionnaires in order to assess their anxiety. Over the time period, their anxiety increased significantly parallel to appointments made with social workers, psychologists and psychiatrists. According to Daníelsdóttir, Eiríksdóttir and Bjarnadóttir (2017) who wrote for the Directorate of Health in Iceland, the numbers of people suffering from anxiety are increasing tremendously. Roughly 42% male and 31% female reported experiencing anxiety in 2017 compared to only 15% male and 19% female in 2007.
It is not only that there are more people who encounter episodes of anxiety, but there are more individuals who are seeking help for their problems related to anxiety. The cause might be more knowledge among people on the matter and the realization that anxiety is a problem no one should have to live with.

**Chronotype, Depression, SAD and Anxiety**

A study by Giannotti, Cortesi, Sebastiani and Ottaviano (2002) showed how teenagers that score as evening types have more emotional problems, do worse in school and often use more tobacco, alcohol and drugs than those who are morning types. Other researches confirm that evening types suffer rather from depression (Gaspar-Barba et al., 2009). Hasler et al. (2012) looked further into the connection between chronotypes, depression and insomnia. They concluded that chronotypes have significant effects on depression under controlled condition. This implies that depression was not only present because of the insomnia, but also because of what chronotype the individual identifies as.

Numerous studies have connected chronotype to depression or depressive episodes in other psychological disorders (Ryu, Joo, Choi & Suh, 2018; Alvaro, Roberts & Harris, 2014; Kanagarajan et al., 2018; Kripke, Elliott, Welsh & Youngstedt, 2015), but few have related chronotypes to the prevalence of anxiety. Sandman et al. (2016), found a correlation between being an evening type and experiencing SAD and having sleep problems in Finland. Evening types have also reported severe detectable depression symptoms on the BDI when compared to other groups (Ong, Huang, Kuo & Manber, 2007). Most of those studies, however, have not found significant relations between chronotype and anxiety, but some have presumed that chronotypes affect anxiety, because chronotypes affect depression and depression affects anxiety. Alvaro et al. (2014) tried to relate chronotypes to separation anxiety and generalized anxiety disorder, while also examining how chronotype relates to depression, insomnia, panic disorder and OCD. Their study displayed no direct connection between chronotypes and anxiety, only through depression or insomnia, but the study was not done in a controlled environment.

**Insomnia**

“Inomnia is the term applied collectively to complaints involving the chronic inability to obtain adequate sleep“ (WHO, 1993).
Insomnia is one of the most frequently diagnosed psychological health problem (Harvey, 2001). Roughly one-third of adults experience dissatisfaction with sleep on a weekly basis but for most people, it does not affect daytime functioning or cause distress. In other cases, prolonged sleeplessness does negatively affect people and for those it would be appropriate to diagnose insomnia (Winkelman, 2015). Insomnia can be defined as different types of inability to obtain sleep. The World Health Organization (1993) explains that the three main complaints are: “sleep onset insomnia (difficulty in falling asleep), frequent nocturnal awakening (interrupted sleep characterized by frequent awakenings) and early morning awakening (waking up early in the morning and not being able to fall back asleep)”. The usual criteria for each of these types of insomnia, according to WHO (1993), is defined as; taking longer than 30 minutes to fall asleep, waking up during the night for more than 30 minutes and obtaining less than 6,5 hours of sleep during the night. Daytime fatigue must also be present for diagnostic, for a person who does not suffer from the lack of sleep during the day should not be considered to suffer from insomnia (World Health Organization, 1993).

Ohayon (2002) explains that insomnia is more common than we would assume. About a third of the general population has the symptoms of at least one of the criteria defined by the DSM-IV and when daytime consequences of insomnia are taken into an account, the frequency is somewhere between 9% and 15%. According to the DSM-IV classification, 6% of the general population were diagnosed with insomnia (Ohayon, 2002). The National Center on Sleep Disorders Research at the National Institutes of Health states that about 30-40% of adults report symptoms of insomnia within a given year and around 10-15% report chronic insomnia (American Psychiatric Association, 2013).

Sleep maintenance insomnia is most common among those who report insomnia. The second most common is difficulty falling asleep and last is the early morning awakening (American Psychiatric Association, 2013). Prevalence of insomnia increases with age. Difficulty falling asleep is more common among young people with insomnia while older people with insomnia report more in general frequent nocturnal awakening and early morning awakening (American Psychiatric Association, 2013). Even though Winkelman (2015) reports that the elderly were more likely to report symptoms of insomnia, the diagnoses are not recurrent in the elderly. This can be explained by sleeplessness on daytime functioning which seems to be less dramatic for the elderly than for younger people. If we look at the difference between men
and women, women report more sleep problems than men (American Psychiatric Association, 2013).

Those who work shifts and those who have disabilities are at more risk of suffering from insomnia. Psychiatric disorders are often associated with insomnia (roughly 50%) and among these, mood and anxiety disorders are most common (Winkelman, 2015). According to Buckholt et al. (2009), sleep disturbances are known to cause various mental problems and poor sleep has been directly linked to anxiety disorder and major depressive disorder. There are few medical illnesses that can be associated with insomnia: shortness of breath, pain and gastrointestinal disturbance (Winkelman, 2015). Not only does this affect adults, but research has also shown that when children do not get enough sleep, it affects their cognitive abilities and learning abilities. Simultaneously, these children can experience behaviour problems, disturbed mood and dysregulated emotions (Buckhalt et al., 2009).

Common consequences of insomnia are fatigue, sleepiness, cognitive impairment (Johnston, 2005) and deficits in cognitive processes that are related to impaired alertness like working memory and attention switching (Winkelman, 2015). Even those who do not suffer from insomnia, but have experienced some sort of sleeplessness, can experience the increased difference in cognitive processing, attention and reaction time (Johnston, 2005). Fatal injuries are associated with chronic insomnia along with increased risk of workplace injuries and perceived quality of life and health (Winkelman, 2015). Symptoms of insomnia have been associated with being a risk factor for suicide attempts and death from suicide, independent of depression (Winkelman, 2015).

There is a strong association between insomnia and depression, anxiety and other psychiatric disorders across the life cycle as most individuals with insomnia also suffer from another psychiatric or medical disorders. It has often been a debate of whether insomnia is a disorder of its own or simply a symptom of other illnesses. Insomnia can be a symptom of another condition, for example, jetlag and shift work, but it is often misdiagnosed as a consequence of stress and worry (American Psychiatric Association, 2013).

**Insomnia, Anxiety and Depression**

Insomnia has a strong association with other psychiatric disorders, especially depression and anxiety (American Psychiatric Association, 2013). In a study by Ford and Kamerow (1989) participants were questioned about sleep difficulties and other psychiatric disorders at baseline and again one year later. There was a higher risk of developing major depression for
those who suffered from insomnia than for those who did not suffer from insomnia. 40% of those suffering from insomnia also suffered from another psychiatric disorder, while only 16% of those not suffering from insomnia suffered from another psychiatric disorder, major depression and anxiety being most often comorbid with insomnia. Ford and Kamerow (1989) suggested that there was a direct relationship between insomnia and depression and that treatment for sleep disturbances could even prevent the development of depression.

Johnson, Roth and Breslau (2006) examined insomnia and other comorbid disorders, trying to find the indication for the association. Their study deduced that in the case of insomnia and depression, insomnia preceded depression in 69% of their cases. Anxiety however, appeared before insomnia in 73% of their cases. Some longitudinal studies indicate that insomnia is a risk factor when it comes to developing major depression, anxiety disorders and suicide. It is necessary to keep in mind that no longitudinal or retrospectively based studies have estimated incidences where insomnia is developed from other mental disorders (Johnson et al., 2006). In a study by Ohayon and Roth (2003), when it came to anxiety, insomnia and anxiety symptoms appeared at the same time in 38% of the sample and insomnia appeared following anxiety in 34% of the sample. Regarding mood disorders, symptoms appeared following insomnia in 40% of the sample and at the same time in 22% of the sample.

There seems to be a strong connection between insomnia, depression and anxiety. According to the studies mentioned before, insomnia is thought to be a consequence and a reason for other disorders. Insomnia symptoms have often been misdiagnosed as a consequence of other disorders, as a secondary disorder rather than a primary disorder which could lead to insufficient treatment (Harvey, 2001).

**Insomnia and Chronotypes**

There are many studies that have shown differences between morning types and evening types when it comes to duration and quality of sleep. In a study by Giannotti et al. (2002) the aim was to see the relationship between chronotypes, sleep patterns and daily behaviour in adolescents and their results showed that evening types experienced greater sleep-related problems such as difficulty falling asleep, daytime sleepiness and worse sleep quality. Evening types also had more irregular sleep/wake schedules, as there was a difference when it came to weekdays and weekends. Evening types slept significantly less than morning types on weeknights, but they slept significantly more than morning types on weekends. This could possibly point out that evening types are more sensitive to social jetlag; their circadian rhythm does not suit their social demands to wake up early (Wittmann et al., 2006). Irregular sleep
pattern is more common among evening types and it has shown that regulating sleep pattern can improve sleep and daytime sleepiness. This could be an important point when it comes to evening type insomnia patients (Ong et al., 2007).

Interestingly, evening types report worse sleep quality even though they also report longer total sleep time (Hasler et al., 2012; Monk et al., 2011; Ong et al., 2007). Sleep onset is longer among evening types and that could point out that trying to fall asleep too early according to their circadian phase is perhaps a reason for their insomnia (Hasler et al., 2012). A study that examined bedtime regularity in retired seniors indicated that regular bedtimes and rise time is associated with better sleep quality, as well as being a morning type (Monk et al., 2011).

Evening types worry more about the consequences of insomnia than other chronotypes and this suggests that they are possibly more susceptible to the effects of sleep loss. Dysfunctional cognitions and poor sleep habits are common for people who suffer from insomnia, but those problems are more noticeable in evening types than morning types (Ong et al., 2007).

Hasler et al. (2012) suggested that being an evening type is a risk factor for the development of affective disorder for those who suffer from insomnia and that this is under-recognized. Depression among evening types that also suffer from insomnia is statistically significant, even after controlling for total sleep time, which indicates that depression is not necessary only due to severe insomnia.

Motivation and Research Question

While it is worth replicating these findings, it is of further interest to investigate the interaction between chronotype and insomnia, anxiety, depression and SAD for the population of Iceland as the seasonal variation is rather extreme in Iceland. We did not come across recent researches that compare anxiety or insomnia in Iceland to other nations, so we do not know if it is a bigger or a smaller problem in Iceland, but the latest research that examined prevalence of SAD in Iceland was done by Magnusson (2000) where he presented results indicating that the proportion of people suffering from SAD in Iceland is lower than in other countries with similar seasons. There was, on the other hand, another research that examined depression among elderly people and there was a big difference between countries, where Iceland had the lowest score on the depression scale (Copeland et al., 2004). This offers unique conditions to study the relation between chronotypes, insomnia, depression, anxiety and SAD. We wanted to examine if there was the same chronotype effect on those
psychological disturbances here in Iceland. Therefore, our research question is: How does chronotype affect insomnia, as well as anxiety, depression and SAD for people in Iceland? Our main hypothesis is that there is an association between chronotype and insomnia. In order to answer our research question, we asked participants about their age and sex, if they had experienced insomnia, SAD, depression or anxiety and tried to find out what their chronotype is.

Methods

Ethics
This study was approved by the Icelandic Science Ethics committee at the University of Akureyri.

Participants and Recruitment
The sample of this study consist of 261 participants. The aim was to have the proportions of participants evenly distributed for each gender in each age-group: 18-30 years old, 30-60 years old and 60 years and older.

Questionnaires and Translation Procedure
The questionnaires that we submitted to the participants were the Seasonal Pattern Assessment Questionnaire (SPAQ), Morningness-Eveningness Questionnaire (MEQ-IS), Movement Imagery Questionnaire – Revised (MIQ-RS-IS), Bergen Insomnia Scale (BIS-IS), Patient Health Questionnaire (PHQ-9) and Depression, Anxiety, Stress Scale (DASS). The MEQ, MIQ-RS and BIS questionnaires were translated from English to Icelandic by the authors among 6 other bachelor students: Dagrún Björk Sigurðardóttir, Giedré Grigaraviciuté, Halldóra Þordís Skúladóttir, Inga Lóa Karvelsdóttir, Jóhanna Ingvarsdóttir and Katla Sigurðardóttir under the supervision of Yvonne Höller.

Statistics
Our research question is: How does chronotype affect insomnia, as well as anxiety, depression and SAD for people in Iceland? Our main hypothesis is:

$H_1$: There is an association between chronotype and insomnia.

$H_1$: $CT_{Morning} \neq CT_{Evening}$

$H_0$: There is no association between chronotype and insomnia.

$H_0$: $CT_{Morning} = CT_{Evening}$
We also had few secondary hypotheses, that there is an association between chronotype and anxiety, depression and SAD.

Our independent variable is *chronotype* and we used the Morningness-Eveningness Questionnaire (MEQ). It is a nominal, 5-points variable: definitely morning type, moderately morning type, neither type, moderately evening type and definitely evening type. But we merged definitely morning type and moderately morning type together in one variable: morning type. We also did this for evening types as moderately evening type and definitely evening type became one variable: evening type. In the end, chronotype was a 3-point variable: morning type, neither and evening type.

Our dependent variable is *insomnia* and we used Bergen Insomnia Scale (BIS). It has six questions and 8 options for each question. It is an ordinal variable, where scores range from 0-42.

We also examined 3 other dependent variables: *anxiety, depression* and *SAD* in relation to the independent variable chronotype. For the variables anxiety and depression, we used the Depression, Anxiety, Stress Scale (DASS) and they are ordinal variables. Our forth dependent variable is seasonal affective disorder (SAD) and we used the Seasonal Pattern Assessment Questionnaire (SPAQ) to measure it. It is an ordinal variable with several scales, one that measures Global Seasonality Score (GSS). According to Magnusson (1996) the scores are split in three groups, SAD, Subclinical SAD (S-SAD) and no SAD and it is therefore, defined as a nominal variable. The classification for SAD is GSS >10 where seasonal changes are at least a moderate problem and where participants feel worst during winter months. For S-SAD it is GSS>10 and seasonal change is a no or only a mild problem where participants feel worst during the winter months. S-SAD can also be classified as a GSS 9-10 where seasonal change is at least a mild problem where participants feel worst during the winter months. We merged S-SAD and SAD together in one group and named it SAD.

We also used *gender* and *age* as an independent variable to see the distribution of chronotype, insomnia, anxiety and depression within gender and age. We merged age in three age groups: 18-30 years old, 30-59 years old and 60 years and older.

For our statistical evaluation, we used descriptive statistics and non-parametric ANOVA to measure the relationship between chronotype and insomnia, anxiety and depression. We used chi-square test to see if chronotypes differ in relation to age. We ran non-parametric ANOVA
to see if there was an age difference in relation to insomnia, anxiety and depression. We fitted a binomial logistic regression model with the R-function glm() to see if there was a significant effect of chronotype on SAD. We used a Bonferroni correction to reduce the changes of type I error, that lowered the significant level to $p<0.007$.

Results

Sample
In this study, we recruited N=261 participants. All participants were asked to complete forms about chronotype, insomnia, SAD, depression and anxiety. After excluding missing data, people not living in Iceland and those whose native language is not Icelandic, N=249 participants were included in our final analysis. There were 146 female participants and 103 male participants. The age in our sample ranged from 18 to 92 years and the mean age was 45.2 years. In the youngest age group were 35.7% of our sample (n=89), in the middle age group was 31.7% of our sample (n=79) and the oldest age group was 32.5% of our sample (n=81).

Descriptive Statistics
In our sample, 28.5% (n=71) of participants identify as morning type, 56.2% (n=140) as neutral and 15.3% (n=38) as evening type.

We used Bergen Insomnia Scale (BIS) to measure insomnia. The range of the score was from 0-40, the mean score was 13.17 and the standard deviation 8.66.
We used SPAQ to measure SAD and 84.7% (n=211) of the participants did not suffer from SAD, but 15.3% (n=38) did.

![Seasonal Affective Disorder](image1)

**Figure 4.** The proportion of participants suffering from SAD or not.

**Analysis**

There was not a significant difference when it came to gender as an independent variable and chronotype, anxiety, depression, insomnia or SAD. We ran a non-parametric ANOVA for chronotype and insomnia and there was a significant difference between chronotypes in relation to insomnia ($F=(2,185)=17.248$, $p<.001$).

![Insomnia distribution](image2)

**Figure 5.** ANOVA for chronotype and insomnia.
We ran a non-parametric ANOVA for chronotype and depression and there was a significant difference between chronotypes when it came to depression ($F=(2,185)=17.142, <.001$).

![Depression distribution](image)

**Figure 6. ANOVA for chronotype and depression.**

We ran a non-parametric ANOVA for chronotype and anxiety and there was a significant difference between chronotypes in relation to anxiety ($F=(2,185)=8.096, p<.001$). But it is necessary to keep in mind that this correlation is possibly due to the fact that chronotype and insomnia correlate and anxiety and insomnia correlate.

![Anxiety distribution](image)

**Figure 7. ANOVA for chronotype and anxiety.**
We ran chi-square test to see if there was any connection between chronotype and age and our results showed a significant difference ($X^2_{(4)}=63.662$, $p<.001$). There was a big difference among age groups, as older people tend to be morning types and young people evening types.

As there was a difference between chronotypes in relation to insomnia, anxiety and depression where all of those disturbances were less common among morning types, and chronotype and age seemed to have a relationship where older people were rather morning types, we wanted to see if there was a relationship between age and insomnia, anxiety and depression. We used a non-parametric ANOVA to see if there was any difference. There was an age difference for insomnia ($F_{(2,245)}=13.994$, $p<.001$), anxiety ($F_{(2,245)}=10.712$, $p<.001$) and depression ($F_{(2,245)}=25.987$, $p<.001$) where older people suffered less from all of those disturbances.

To see if there was any correlation between chronotype and SAD we ran a logistical regression (see Table 1) and according to those results, the difference was significant when it came to evening types. Age effect was non-existent when we controlled for chronotype, which indicated that the main influence on SAD was chronotype.

Figure 8. The proportion of chronotypes according to age.
Table 1

*Logistics Regression*

|                      | Estimate | Std. Error | z-value | Pr(>|z|) |
|----------------------|----------|------------|---------|----------|
| (Intercept)          | -1.64085 | 0.78201    | -2.098  | 0.0359*  |
| MEQ: neutral vs. morning | 0.66962  | 0.54863    | 1.221   | 0.2223   |
| MEQ: evening vs. morning | 1.372    | 0.65433    | 2.097   | 0.036*   |
| Age                  | -0.01204 | 0.01119    | -1.076  | 0.2819   |
| Gender: Male vs. Female | -0.64654 | 0.39311    | -1.645  | 0.1      |

Deviance Residuals:

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Null deviance: 212.75 on 248 degrees of freedom

Residual deviance 199.57 on 244 degrees of freedom

Signif. codes 0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
Discussion

Related Work

The aim of this study was to assess the relationship between chronotype among people in Iceland and insomnia as well as anxiety, depression and SAD. Our hypothesis holds according to our study, as there is an association between chronotype and insomnia as well as anxiety, depression and SAD in our sample that was gathered in the Icelandic population.

Previous studies have shown a connection between chronotypes and other psychological disturbances (Carvalho, Hidalgo & Levandovski, 2014; Kanagarajan et al., 2018; Müller & Haag, 2017; Taylor & Hasler, 2018). The study Sandman et al. (2016) did in Finland resembles ours in a way they both study the connection between chronotypes, SAD and insomnia. The data they received was from the National FINRISK 2012 study. They analyzed data from 4905 individuals from January through early April at 60°–65° northern latitude. These individuals completed SPAQ and MEQ and answered questions regarding average hours of sleep, use of antidepressant and/or hypnotics and whether the individual had experienced nightmares or insomnia in the last 30 days. They concluded that individuals who met the criteria for SAD had occurrence of nightmares and insomnia and the majority did not have a diagnosis for depression. They also concluded that evening types were at a higher risk of having problems related to seasons.

A clear difference between morning and evening types was detected in our study, as morning types suffered a great deal less from insomnia, anxiety, depression and SAD. We also found a strong connection between age and chronotypes; younger people tend to fall in the evening type a lot more than older participants and older people tend to fall in the morning type criteria a lot more than younger participants. It seems that the older we are, the more we identify as morning types (Roenneberg et al., 2007; Haraden, Mullin & Hankin, 2019).

The debate that is now going on about changing the time-zone for Iceland needs to consider the wellbeing of the people. Previous researches show that being in the wrong time-zone can affect people mentally in a negative way (Giuntella & Mazzonna, 2019) as the sunlight is a strong indicator of bedtime and wake-up time for humans (Roenneberg & Merrow, 2007) and wrong sleep schedule especially affects young people since it encourages daytime sleeping (Luo, Zhang, Chen, Lu & Pan, 2018).
Limitations
This is the first time the Morning-Eveningness Questionnaire (MEQ), Motion Imagery Questionaire (MIQ) and Bergen Insomnia Scale (BIS) were validated after being translated from English to Icelandic and therefore our study is the first one to use these translated questionnaires. We did not calculate any other psychometric properties and the translation could possibly have affected the results and further validation is necessary. The sample in this study was rather small and with a larger sample, more accurate information could have been gathered. All of the questionnaires were submitted and answered in February, which possibly caused a bias in the results as there is a big difference between seasons in Iceland. Perhaps the results would have been different if the questionnaires were answered at a different time during the year. There could also be a bias because of the culture in Iceland, as Icelandic people celebrate Christmas with great feasts and all individuals, in general, eat a lot more in December. The same thing happens around February – March when there is a midwinter feast called Þorrablót. These cultural events could have some effect on how the participants responded to the questionnaire that has nothing to do with SAD and could have affected the SAD results. Some individuals could also experience more stress around Christmas that has nothing to do with seasonal changes which could also affect our results. This study was a cross-sectional study, and we think that a longitudinal study would be more informative and give us a better idea of how common SAD, depression, insomnia and anxiety really are in Iceland. This all would be interesting to investigate further.

Future Directions
Studies have shown that children are in general morning types, young adults are rather evening types and older adults tend to be morning types. Our results resemble this and it makes us wonder what causes humans to start out as morning types, then turn into evening types in their early teens, then turn back into morning types when they get older. We wonder if this is something we could possibly take control of in Iceland? If the time-zone would change, would there be more morning types among adolescents? Would fewer individuals suffer from insomnia, depression, anxiety and SAD and would the number for these disorders decline for the whole Icelandic population? Would it perhaps be good enough to start the day about an hour later? Could it be possible in the nearest future to train evening types in becoming closer to being a morning type until they are completely a morning type? All of this would be worth investigating further since being a morning type clearly has many good
qualities. It could even be a part in treating and/or preventing psychological disorders related to insomnia, depression, anxiety and SAD.

**Conclusion**

Like we mentioned in this thesis, Iceland is geographically in the wrong time-zone, where the difference is from an hour and up to 2 hours farthest west. The Icelandic population experiences more social jetlag than other nations, most likely due to a wrong time-zone. This especially affects individuals that are evening types, mainly because of their delayed circadian rhythm. The societies rules and regulations depend on everyone to start their day at the same time and this is especially inconvenient for evening types. With the time-zone also being almost 2 hours wrong, these individuals are not only waking up approximately 3 hours before their preferred wake-up time, they are waking up almost 5 hours before their biologically preferred wake-up time.

Morning types had considerable advantages over evening types in relation to insomnia, depression, anxiety and SAD according to our study. Morning types were more common among elderly people and evening types were more common among younger people. Evening types suffered more from insomnia, depression, SAD and anxiety than morning types. Older participants also reported suffering less from insomnia, depression and anxiety. Evening type was the main influence on SAD after controlling for age and gender. There was no significant difference between genders in relation to chronotype, insomnia, anxiety depression or SAD.

In a sample from 2015, Þorleifsdóttir’s (2019) results showed that there were more evening types in Iceland compared to other nations. However, like mention above, the results from Magnusson’s (2000) cross-sectional study about SAD showed that there was a surprisingly low number of people in Iceland that suffered from SAD and our results showed a correlation between SAD and chronotypes, where morning types suffered less from it. In a discrepancy with Þorleifsdóttir’s results, it nevertheless makes us wonder if there is a possibility that the reason for Iceland scoring so low on SAD is that there is a larger number of morning types in Iceland compared to other nations, even though we are in the wrong time-zone? Did Þorleifsdóttir’s results perhaps show more evening types because Iceland is in the wrong time-zone and would it be different if the time-zone would be corrected? Perhaps the rate of SAD and other psychiatric disorders would drop with the changes. This is a subject for a whole other study that could lead to interesting results. What we do know is that younger people in Iceland suffer a great deal more from insomnia, anxiety, depression and SAD, and
they are in general more likely to be evening types than older people, which makes them even more vulnerable to those psychological disorders. Our study and its results open the doors for many questions in relation to chronotypes and it could be interesting to investigate this subject further, as the results could be useful in future treatments of various psychological disturbances.
References

Alvaro, P. K., Roberts, R. M. & Harris, J. K. (2014). The independent relationships between insomnia, depression, subtypes of anxiety, and chronotype during adolescence. *Sleep Medicine, 15*(8), 934-941. doi:10.1016/j.sleep.2014.03.019


Lög um tímareikning á Íslandi nr. 6/1968.


**Figures**