The Role of Physical Activity and Unhealthy Diet on ADHD Symptoms and Emotional Well-Being in Adolescents Diagnosed with ADHD

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Foreword

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

Studies have indicated that healthier dietary pattern and physical activity can improve mental health in the general population. However, limited amount of researches have examined these non-pharmacological interventions on ADHD symptoms and emotional well-being among adolescents diagnosed with ADHD. The aim of this study was to examine this relationship among 13-16 years old adolescents diagnosed with ADHD. The data used in this study came from the 2014 annual population-based, *Youth in Iceland*, survey. ADHD symptoms were assessed using 18-items self-reported questionnaire of statements related to ADHD symptoms. Emotional well-being was assessed using 10 depression items and four anxiety items from the SCL-90. Results revealed that male had more ADHD symptoms than female. Students low on unhealthy diets showed fewer ADHD symptoms than those high on unhealthy diet. There was no difference on ADHD symptoms after level of physical activity. Students low on unhealthy diet showed more positive emotional well-being than those high on unhealthy diet. Students high on physical activity showed more positive emotional well-being than those who engaged in low or moderated physical activity. Female showed more negative symptoms of emotional well-being than males.

Keywords: ADHD, physical activity, depression, anxiety, unhealthy diet

Útdráttur

Rannsóknir hafa sýnt fram á að heilsusamlegt mataræði og hreyfing getur bætt andlega heilsu hjá almenningi. Hinsvegar hafa rannsóknir verið takmarkaðar varðandi tengsl á ADHD einkennum og tilfinningalegri líðan meðal unglinga sem greinast með ADHD. Markmið þessarar rannsóknar var að kanna þetta samband meðal unglinga, á aldrinum 13-16 ára, sem greindir voru með ADHD. Í rannsókninni voru notuð gögn úr *Ungt fólk* 2014. ADHD einkenni voru metin með 18 atriða spurningalista. Andleg vellíðan var metin með 10 atriða spurningalista varðandi þunglyndi og fjögurra atriða spurnigalista varðandi kvíða þar sem notast var við SCL-90. Niðurstöður leiddu í ljós að karlar höfðu fleiri ADHD einkenni en konur. Þeir nemendur sem borðuðu minna af óhollu fæði sýndu færri ADHD einkenni en þeir nemendur sem borðuðu mikið af óhollum mat. Það var enginn munur á ADHD einkennum eftir því hve mikla líkamlega áreynslu þeir stunduðu. Þeir nemendur sem borðuðu minna af óhollu fæði sýndu einnig betri líðan en þeir sem voru á óhollu mataræði. Nemendur sem stunduðu mikla líkamlega áreynslu sýndu betri líðan en þeir sem stunduðu litla eða miðlungs líkamlega áreynslu. Konur sýndu almennt meiri einkenni um tilfinningalega vanlíðan en karlar.

Lykilhugtök: ADHD, vellíðan, líkamleg áreynsla, matarræði, kvíði, þunglyndi

The Role of Physical Activity and Unhealthy Diet on ADHD Symptoms and Emotional Well-Being in Adolescents Diagnosed with ADHD

Attention deficit hyperactivity disorder (ADHD) is among the most common neurobehavioral disorder of childhood, characterized by symptoms of inattention, impulsivity and hyperactivity (Biederman, Mick, & Faraone, 2000). The worldwide prevalence is approximately 5% among children and adolescents and in school children younger than 18 years, it is in the range of 1-20% (Polanczyk, de Lima, Horta, Biederman, & Rohde, 2007). More males than females are being diagnosed with ADHD (Schlack, Hölling, Kurth, & Huss, 2006). Medication is often used as a first line of treatment for diminish the majority of ADHD symptoms in children and adolescents diagnosed with ADHD (Halperin & Healey, 2011). However, not all patients response properly well to the pharmacological treatment (Wigal, 2009). It might be explained by the extreme emphasis on reduced symptoms and less focus on the emotional well-being, which could lead to non-beneficial patient treatment. ADHD individuals are at higher risk of having comorbidity with psychiatry disorders. It is therefore very important to focus on other mental aspects too as well as symptoms (Klassen, Miller, & Fine, 2004; Tai & Chiu, 2009).

Numerous studies have reported that non-pharmacological interventions like healthy diet and physical activity can improve mental health among individuals in diverse population (Jacka et al., 2010; Nanri et al., 2010; Sánchez-Villegas et al., 2012; Oddy et al., 2009; Carek, Laibstain, & Carek, 2011; Warburton, Nicol, & Bredin, 2006). However, limited amount of researches have examined these non-pharmacological interventions, with the goal of enhancing both, ADHD symptoms and emotional well-being in individual diagnosed with ADHD.

The role of dietary patterns on ADHD symptoms

Recent cross-sectional studies have shown association between overall dietary

patterns and ADHD symptoms (Azadbakht & Esmaillzadeh, 2012; Howard et al., 2011; Woo et al., 2014; Park et al., 2012; van Egmond-Fröhlich, Weghuber, & Zwaan, 2012; Liu et al., 2014). Diets high in processed food and sugary products has been associated with greater risk of ADHD symptoms among children and adolescents with ADHD diagnosis (Azadbakht et al., 2012; Howard et al., 2011; Park et al., 2012; van Egmond-Fröhlich et al., 2012; Liu et al., 2014). Studies have been inconsistent on the association between Western dietary pattern and healthy dietary pattern to the prevalence of ADHD symptoms among children and adolescents with ADHD. Some of these studies have shown to combine both variable of, healthy and unhealthy diet together, which might have caused these mixed effect (Azadbakt et al., 2012; Woo et al., 2012). Although, it should be noted that the unhealthy dietary patterns, in the aforementioned studies, are specified differently such as “fast food”, “sweet dietary” and “Western diet”. They all contain the same high intake of saturated fat, salt and refined sugar. Nevertheless, these cross-sectional researches showed evidence that certain dietary patterns can be beneficial for ADHD symptoms, the causal relationship cannot be pointed out.

The role of physical activity on ADHD symptoms

Several recent studies have examined the effects of frequent aerobic physical activity in ADHD symptoms among children and adolescents diagnosed with ADHD. Indicating that moderate to vigorous aerobic physical activity, three to six times per week, can alleviate the behavioral symptoms in ADHD children and adolescents, compare to those engaging in low or non-physical activity (Verret, Guay, Berthiaume, Gardiner, & Béliveau, 2012; Smith et al., 2013; Pontifex, Saliba, Raine, Picchietti, & Hillman, 2013; Kang, Choi, Kang, & Han, 2011; Ahmed & Mohamed, 2011; Abramovitch, Goldzweig & Schweiger, 2013; Khalife et al., 2014). Other studies have suggested that physical activity, low to moderate intensity physical activity, such as yoga and walking can be beneficial to children and adolescents diagnosed

with ADHD (Haffner et al., 2006; Taylor, & Kuo, 2009; Jensen & Kenny, 2004). Although, fewer studies have reported findings that comply with this relationship. Interesting is that some of the studies, mentioned earlier, concluded that physical activity appears to have a powerful impact on executive function where learning and behavior process are located (Smith et al., 2013; Pontifex et al., 2013; Kang et al., 2011). These findings should be examined with caution since most of the studies were controlled studies with a short follow-up that more often included children rather than adolescents. Therefore, more studies are required to determine the relationship between physical activity and ADHD symptoms in adolescents with ADHD.

The roles of dietary patterns and physical activity on emotional well-being

Scientific findings have reported connection between unhealthy foods and high prevalence in mental disorders, such as depression and anxiety, among varied populations (Jacka et al., 2010; Sánchez-Villegas et al., 2012). Healthier dietary habits have also shown to reduce risk of mental disorders (Jacka et al., 2010; Nanri et al., 2010; Sánchez-Villegas et al., 2012). However, the affected is yet to be studied on emotional well-being among individual diagnosed ADHD.

Physical activity has been more strongly associated with improvement in this subject, wherein a rapidly growing literature suggest that physical activity has beneficial impact in numerous areas (Carek et al., 2011; Warburton et al., 2006). Researches have shown that ADHD children and adolescents who engaged in moderated to high physical activity displayed fewer mental health problems, than those who engaged in low physical activity (Abramovitch et al., 2013; Verret et al., 2012; Kiluk, Weden, & Culotta, 2008; Gawrilow, Stadler, Langguth, Naumann, & Boeck, 2016). Other studies have reported that females in general health population have more negative symptoms of well-being than males (Oquendo et al., 2013). However, studies have reported that males with ADHD are more likely than

females to show negative feelings of emotional well-being (Biederman et al., 2009; Klassen et al., 2004). More researches need to analyze further if the physical activity and healthier diet have more positive effect on emotional well-being in children with ADHD. Although a child may not show any positive improvements regarding ADHD symptoms, it may well show greater improvements in emotional well-being that might have indirectly positive impact on his or her life.

The aim of this study is to examine the impact on ADHD symptoms and emotional well-being from three groups, physical activity, unhealthy diet and gender in adolescents diagnosed with ADHD. Based on the above literature it was hypothesized that 1) Males students with ADHD will report more ADHD symptoms than females, 2) Students diagnosed with ADHD who had consumed low of unhealthy foods will report less ADHD symptoms compared to students high on unhealthy foods, 3) Students diagnosed with ADHD that engage in high intensity physical activity will report less ADHD symptoms than students engaging in low or moderated intensity physical activity, 4) Students diagnosed with ADHD who consumed low of unhealthy foods will report more positive emotional well-being compared to students high on unhealthy foods, 5) Students diagnosed with ADHD that engage in high intensity physical activity will report more positive emotional well-being than students engaging in low or moderate intensity physical activity, 6) Females students with ADHD will have more negative emotional-wellbeing than males.

Method

Participants

The data used in this study came from the 2014 annual population-based, *Youth in Iceland*, survey conducted by the Icelandic Center for Social Research and Analysis (ICSRA). Participants in the survey were 13 to 16 years old (8^{th}, 9^{th} and 10^{th} grade) in all elementary schools in Iceland. The total obtained responses of the population were 11,013 individuals. The overall response rate nationwide was 86.3% (Kristjánsson, Pálsdóttir,

Þórisdóttir, Sigfúsdóttir, Sigfússon, & Guðmundsdóttir, 2014). Sample size was randomly procured of the population. Valid questionnaires were obtained from 1362 participants diagnosed with ADHD, about 60% were boys and 40% girls. Participants did not receive any payment for taking part in the study and all of them agreed to passive consent.

Design and Data analysis

The study design was a 2 x 3 x 2 independent factorial design. The dependent variables were two, ADHD symptoms and emotional well-being and there were three independent variables, unhealthy diet (UD), physical activity (PA) and gender.

Factorial ANOVA (FANOVA) with three categorical variables was used for testing of the hypotheses. The mean effects and interaction on ADHD symptoms was examined after three categorical variables, UD, PA and gender. The same test was conducted with the dependent variable, emotional well-being.

The assumptions of the FANOVA were tested in appropriate ways but not all of the underlying assumptions were met. The *Shapiro-Wilk normality* test was used to examine the assumption of normality for dependent variables**.** Both symptoms of ADHD*,* D (1145) = .96, $p < .001$, and emotional well-being, D (1145) = .93, $p < .001$, were not normally distributed according to the *Shapiro-Wilk* normality test. This effect indicates that the assumption of the normality had been violated. The *Levene´s* test was used to assess the assumption of the homogeneity of variance. According to the *Levene´s* test the variance was unequal for emotional well-being across PA, gender and UD in participants, F (11, 1076) = 5.294, $p <$ .001. It was presumed that the assumption of the homogeneity of variance had failed to comply.

Instruments and Measures

ADHD symptoms. The dependent variable, *ADHD symptoms* were measured using the Barkley Current Symptom Scale (BCSS) which corresponds with DSM-IV criteria for

ADHD symptoms. It should be noted that the ADHD symptoms scale is self-reported scale and therefore only capable of screening for ADHD symptoms. The instrument consisted of an 18-items questionnaire, nine items relating to inattention and nine items to hyperactivity/impulsiveness (Appendix A). Each item was scored on a 4-point ordinal rating scale of frequency of symptoms in previous six months (0 = *never or rarely,* 1 = *sometimes,* 2 = *often and* 3 = *very often*) (Guðjónsson, Sigurðsson, Eyjólfsdóttir, Smári, & Young, 2009). The Icelandic form of this questionnaire was used in the study that has been developed from year to year by ICSRA (Kristjánsson et al., 2014). The eighteen questions related to ADHD symptoms were added together in one continuous variable to make a single dependent variable. The range of the total score was between 0-54 and from 0-27 in each subscale. Higher score on the ADHD rating scale indicates more symptoms. Reliability test was run for the 18 questions ADHD symptoms scale and the Cronbach´s alpha was .92, resulting in a good internal consistency on ADHD symptoms.

Emotional well-being. The second dependent variable, *Emotional well-being* was assessed by 14 items which included ten items of depression symptoms and four of anxiety symptoms (Appendix A). Ten depression items were used from the original symptoms distress checklist 90 (SCL-90). The items included thoughts for example of feeling low in energy, feeling sad or blue, feeling hopeless about the future and feeling lonely. The four anxiety items, used from the original SCL-90, included for example, feelings of nervousness and sudden fear for no apparent reason (Gunnlaugsson, Kristjánsson, Einarsdóttir, & Sigfúsdóttir, 2011). Both items of depression and anxiety were rated on a 4-point ordinal scale to indicate severity of symptoms. Participants did answer these statements by referring to feelings, they experience during the week prior, to their participation in the study. The 14 items of both anxiety and depression were combined into one continuous scale that ranged

from 0-42, with lower score meaning greater emotional well-being. The Cronbach´s alpha score was .94 which indicate that these variable had good internal consistency.

Unhealthy diet. The instrument measuring one of the three independent variables, *unhealthy diet* was assessed by using the exploratory factor analysis to examine how many items cluster onto the same component and how much each variable, in the 14-items of dietary, was associated with each aspect (Appendix A). The exploratory factor analysis did indicate three different clusters but the study only used one cluster which included seven variables of poor dietary habits. The variables included poor dietary habits such as candy, potatoes/chips, french fries, hamburgers, pizza, sugar, sugar-free soft drinks and sugary soda drinks. The response format of the food questionnaire was on a 5-point ordinal scale ranging from more than once a day to never. The seven unhealthy items were reversed and combined together in one continuous variable in the range of 0-28, with higher score indicating more consumption of the unhealthy food. The unhealthy diet was divided into two groups. A group low on unhealthy food (LUD) ranging from 0-17 and a group high on unhealthy food (HUD), ranging from 18-28. The Cronbach´s alpha for these seven variables was .87 which is a good internal consistency on unhealthy dietary patterns.

Physical activity. The study used one question that concerned participants, *physical activities* (Appendix A). The answers to questions were on a 6-point ordinal scale. It assessed how often participants related to the statement, from never to almost always *(*0 = *never,* 1 = *once per week,* 2 = *twice per week,* 3 = *three times per week,* 4 = *four to six times per week and* 5 =*once a day).* The response option to physical activity was divided into three groups, those who engaged in low (LPA), moderate (MPA) and high (HPA) physical activity. Values of 0-1 meant low physical activity and were defined as one, values of 2-3 indicated moderated physical activity and were defined as two and high physical activity included values of 4-5 were marked as three.

Gender. The response format of question assessing *gender* of participants was on a nominal scale, male or female (Appendix A).

Procedure

The survey was conducted by ICSRA in February 2014. All aspects of data collection, including participant involvement based on passive parental support, were in compliance with Icelandic law, regarding the protection of human subjects, and approved by the Icelandic Data Protection Authority (Appendix B). Students in 8th to 10th grades, who were present in class during the day of surveying, participated in the study. Teachers managed the survey in all cases and it took place in the classrooms. Participants were asked neither to sign their names nor to write identification numbers on the answers sheets so it would be impossible to trace the answers to them. With each questionnaire followed an unmarked envelope which participants put the questionnaire in, after finishing the survey. The participants were also asked to answer all the questions the best way they could and ask for help if needed (Kristjánsson et al., 2014).

Results

Descriptive statistics

Figure 1 illustrates the distribution of the total scores on the ADHD symptoms scale. The ADHD symptoms scores were on a continuous scale that ranged from 0-54. The lowest possible score was 0 which meant that the participants never or rarely did show any signs of ADHD symptoms.

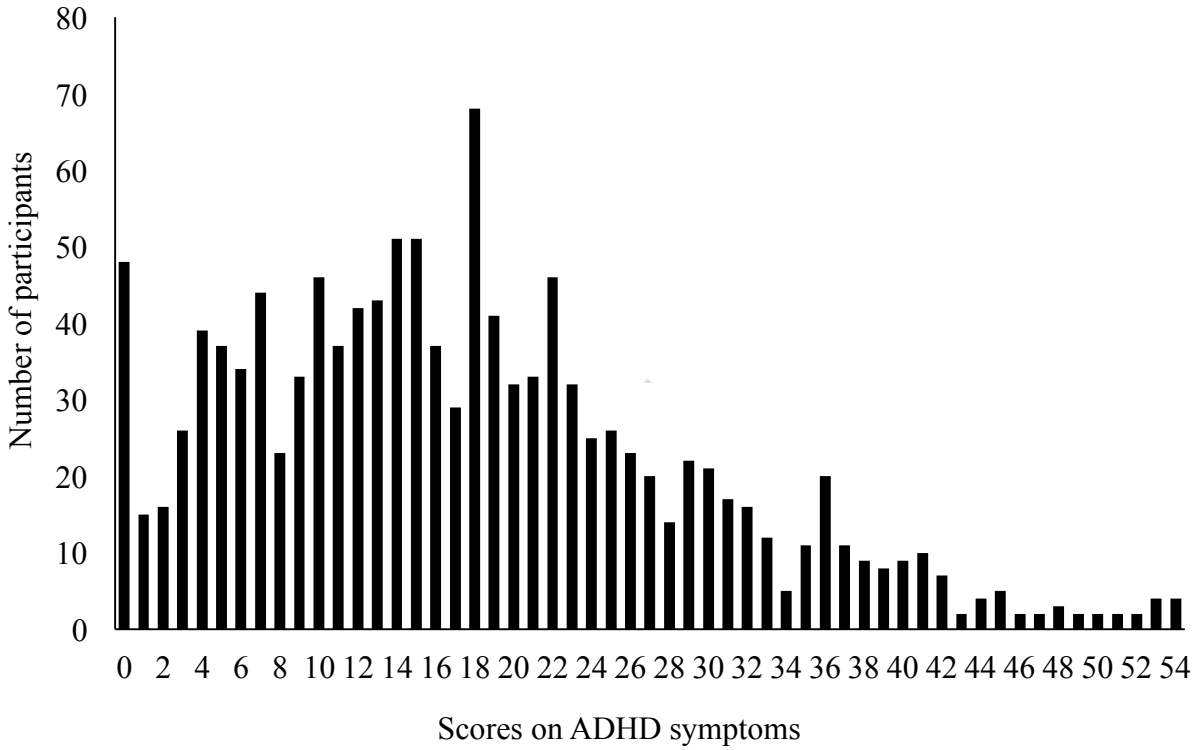

Figure 1. Frequency Scores on ADHD Symptoms Scale

The highest possible score was 54 which indicates that the participants did showed greater symptoms of ADHD. The mean value was 17.64 (*SD* = 11.38). It indicates that more than half of the participants showed low signs of ADHD symptoms during the past six months.

Figure 2 illustrates how the participants were distributed in the scores on emotional well-being scale. The emotional well-being scores were on a continuous scale that ranged from 0-42.

Figure 2. Frequency Scores on Emotional Well-Being Scale

The lowest value was 0 which indicates that participants almost never experience symptoms of poor emotional well-being. The highest value was 42 which meant that participants often experienced greater symptoms of negative emotional well-being. The mean value was 14.44 (*SD* = 11.57). That indicates more than half of the participants responded that they had never or seldom experienced unpleasant symptoms of emotional well-being in the previous week.

Table 1 shows descriptive statistics for ADHD symptoms after three groups, PA, UD and gender. Female participants who were in HPA and HUD groups had the highest ADHD symptoms (*M* = 22.02, *SD* = 10.89).

Table 1

Means, Standard Deviations and Number of Participants for ADHD Symptoms after Physical Activity, Gender and Unhealthy Diet

	Gender																	
	Male						Female						Total					
	LUD			HUD			LUD			HUD			LUD			HUD		
	M	*SD*	*n*	*M*	*SD*	*n*	*M*	*SD*	*n*	*M*	*SD*	*n*	*M*	*SD*	*n*	*M*	*SD*	*n*
LPA	16	12	56	18	12	113	17	12	82	22	13	52	17	12	138	19	12	165
MPA	13	10	81	19	12	94	19	12	101	18	9	46	16	11	182	19	11	140
HPA	16	12	156	18	11	124	19	11	109	22	11	43	17	11	265	19	11	167
Total	15	11	293	18	11	331	18	12	292	21	11	141	17	11	585	19	11	472

Male participants who were both in, MPA and LUD groups, had the lowest symptoms of ADHD ($M = 13.3$, $SD = 10.0$).

Descriptive statistics for emotional well-being scores after, PA, UD and gender, in participants, are presented in Table 2.

Table 2

Means, Standard Deviations and Number of Participants for Emotional Well-Being after Physical Activity, Gender and Unhealthy Diet

	Gender																	
	Male						Female						Total					
	LUD			HUD			LUD			HUD			LUD			HUD		
	M	*SD*	*n*	*M*	*SD*	*n*	*M*	*SD*	*n*	*M*	*SD*	*n*	*M*	*SD*	*n*	*M*	*SD*	*n*
LPA	12	11	59	13	11	116	21	12	85	21	12	54	17	12	144	16	12	170
MPA	9	10	86	13	10	97	20	12	105	20	11	47	15	12	191	15	11	144
HPA	9	8	162	11	9	123	18	11	113	20	13	41	12	10	275	13	11	164
Total	10	9	307	13	10	336	19	12	303	20	12	142	14	12	610	15	11	478

Female participants in both LPA and LUD tended to show higher symptoms of negative feelings of emotional well-being (M = 20.7, SD = 12.1). Male participants who were both in, HUD and LPA, almost never or seldom experience, feelings of negative emotional well-being (M = 8.8, SD = 8.0).

Factorial ANOVA

There was a significant difference in ADHD symptoms between LUD and HUD, F (1, 1045) = 13.78, $p < .001$, partial η2 = .013. Participants who consumed smaller amount of unhealthy food (M =16.79, SD = 11.46) showed lower symptoms of ADHD compared to those who consumed unhealthy food to a greater extent (M =18.93, SD = 11.44). There was a non-significant main effect between, LPA, MPA and HPA on ADHD symptoms in participants, F (2, 1045) = 1.161, p = .314, partial η2 = .002. The main effect of gender was significant for ADHD symptoms in participants, F (1, 1045) = 11.975, $p < .001$, partial η2 = .011. The effect indicates that males showed lower signs (M = 16.68, SD = 11.76) on ADHD symptoms than females (M = 19.09, SD = 12.38).

There was a non-significant interaction between gender and UD on the ADHD symptoms, F (1, 1045) = .025, p = .874, partial η2 = .000. No significant difference was between gender and PA on ADHD symptoms, F (2, 1045) = .224, p = .799, partial η2 = .000. There was also no significant interaction between PA and UD on ADHD symptoms, F (2, 1045) = .102, p = .903, partial η2 = .000. The test of interaction revealed significant interaction between gender, PA and UD on ADHD symptoms, F (2, 1045) = 3.725, p = .024, partial η2 = .007.

Looking at significant values for each simple effect on ADHD symptoms between gender in PA and UD groups, it appears that females in LPA and HUD group showed greater signs of ADHD symptoms (M = 21.94, SD = 13.20) than male (M = 17.78, SD = 11.82) (p = .713). There were non-significant differences on ADHD symptoms between gender in LPA

and LUD group (p = .713). There were no differences on ADHD symptoms on males on LPA, in LUD or HUD groups (p = .409). There was difference on ADHD symptoms between females on LPA in UD groups (p < .001). Females in LPA group who consumed more of unhealthy food showed more symptoms (M = 22.40, SD =13.17) than those low in consumption of unhealthy food (M = 16.97, SD =11.52).

Figure 3 indicates the values for each simple effect, on ADHD symptoms for MPA group, after gender and UD group. Males in MPA and LUD groups, showed fewer symptoms of ADHD (M = 13.32, SD =10.01) compared to males in HUD group (M = 19.15, SD = 11.68) (p < .001). There was no difference on ADHD symptoms for females in MPA group, after LUD or HUD groups (p = .892).

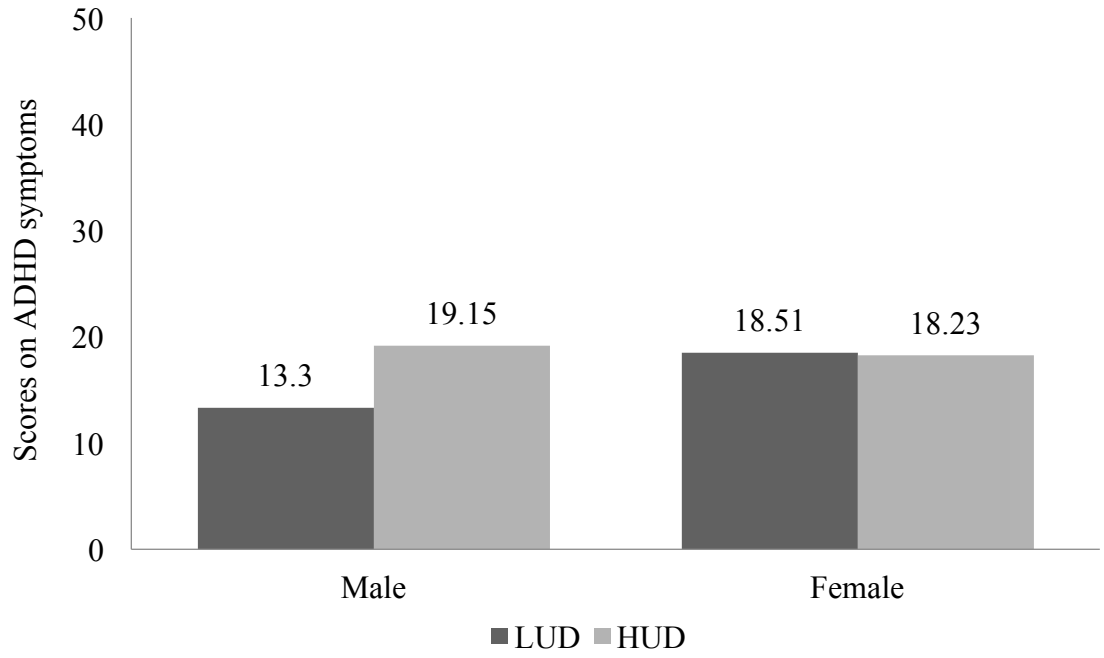

Figure 3. The Interaction between Gender and Consumption of Unhealthy Diet, in Moderated Physical Activity Group, on ADHD Symptoms

Figure 3 shows that females in MDA and LUP groups, showed higher symptoms of ADHD (M = 18.51, SD =11.79) compared to males (M = 13.32, SD = 10.01) (p < .001). No

significant differences, $p = .653$, were on ADHD symptoms between gender in MPA group, on HUD.

There was no difference on ADHD symptoms in both males, $p = .296$, and females, $p = .098$, in HPA group, on LUD or HUD groups. There was a significant difference in ADHD symptoms between females and males in HPA group, on HUD, $p < .001$. Females showed higher symptoms of ADHD ($M = 22.02$, SD= 10.89) than males (M= 17.74, SD= 10.80). There was no difference in ADHD symptoms between gender in HPA, after LUD group ($p = .104$).

Looking at the significance values for each simple effect on ADHD symptoms between males and females on UD and PA groups, it appears that there was no difference on ADHD symptoms between gender, on LUD and LPA, LUD and MPA or LUD HPA ($p > .005$). There was also no difference between gender, after HUD and LPA, HUD and MPA or HUD and LUD ($p > .005$).

The emotional well-being scores in participants differed significantly between LUD and HUD groups, $F (1, 1076) = 137.80$, $p < .001$, partial $\eta 2 = .007$. Participants who consumed unhealthy foods to a greater extent showed more negative emotional well-being ($M = 16.38$, $SD = 11.34$) than participants who consumed smaller amounts of unhealthy foods ($M = 14.72$, $SD = 11.52$).

Figure 4 illustrates the difference in emotional well-being after LPA, MPA and HPA. There was a mean difference in emotional well-being between groups of physical activity $F (2, 1076) = 3.637$, $p = .027$, partial $\eta 2 = .007$. Bonferroni *post hoc* test was conducted to test this further and revealed that emotional well-being symptoms differed significantly between, LPA and HPA ($p < .001$). Participants in HPA group ($M = 12.82$, $SD = 10.59$) showed more emotional well-being, rather than LPA group ($M = 16.40$, $SD = 12.11$).

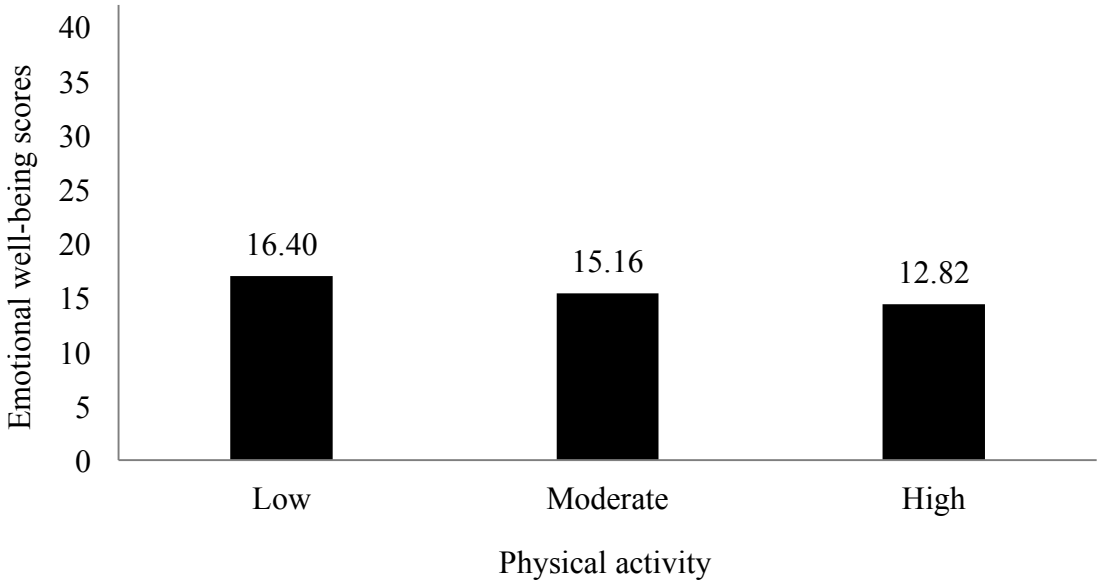

Figure 4. The Means for Emotional Well-Being after Groups of Physical Activity

There was also difference in emotional well-being symptoms between MPA and HPA groups ($p < .001$). Participants in HPA group ($M = 12.82$, $SD = 10.59$) showed greater signs of emotional well-being, compared to MPA group ($M = 15.16$, $SD = 11.70$). The difference in emotional well-being symptoms between LPA and MPA groups, was non-significant ($p = .418$).

There was a significant main effect of gender on emotional well-being symptoms, $F (1, 1076) = 137.7$, $p < .001$, partial $\eta 2 = .114$. Females showed more negative emotional well-being ($M = 19.45$, $SD = 11.78$) than males *(*$M = 11.20$, $SD = 9.96$). There was a significant interaction between LUD and HUD groups, on emotional well-being, $F (1, 1076) = 5.570$, $p = .018$, partial $\eta 2 = .005$. Participants in LUD group showed more positive symptoms of emotional well-being ($M = 14.72$, $SD = 11.70$), compared to HUD group ($M = 16.38$, $SD = 11.70$).

There was a non-significant interaction between UD and gender on emotional well-being symptoms, $F (1, 1052) = 1.890$, $p = .169$, partial $\eta 2 = .114$. The interaction differences were non-significant between PA and gender on emotional well-being symptoms, $F (2, 1052)$

= 0.437, p = .646, partial η2 = .114. No significant interaction was between UD, PA and gender, on emotional well-being symptoms, F (2, 1052) = 0.772, p = .462, partial η2 = .114.

Discussion

The aim of this study was to examine ADHD symptoms and emotional well-being after three groups, level of physical activity, consumption of unhealthy diet and gender difference, in adolescents diagnosed with ADHD. The hypotheses set out in the research were, 1) Males students with ADHD reported more ADHD symptoms than females, 2) Students diagnosed with ADHD who were low on consumption of unhealthy foods had less ADHD symptoms compared to students high on unhealthy foods, 3) Students diagnosed with ADHD who engaged in moderate to high intensity physical activity had less ADHD symptoms than students who engaged in low physical activity, 4) Students diagnosed with ADHD who were low on consumption of unhealthy foods had more positive emotional well-being compared to students high on unhealthy foods, 5) Students diagnosed with ADHD who engaged in moderated to high intensity physical activity reported more positive emotional well-being than students who engaged in low physical activity, 6) Female students with ADHD reported more negative emotional-wellbeing than males.

Results findings shown that female participants had greater ADHD symptoms than males which is interesting since there seems to be a great sex differences among the ADHD population, where the majority are males (Schlack et al., 2006; Verret et al., 2012; Smith et al., 2013). This effect might raise questions and concerns that female's ADHD symptoms can be underestimated. Both previous and obtained studies revealed consistency on the improvements in ADHD symptoms, after low consumption of unhealthy diet, among adolescents diagnosed with ADHD (Azadbakt et al, 2012; Howard, 2011; Woo et al., 2014; Park et al., 2012; van Egmond-Fröhlich et al., 2012; Liu et al., 2014). Unlike previous studies, this study indicates that various level of physical activity were in no association to

the prevalence of ADHD symptoms (Verret et al., 2012; Smith et al., 2013; Pontifex et al., 2013; Kang et al., 2011; Ahmed et al., 2011; Abramovitch et al., 2013; Khalife et al., 2014). This result might be due to the fact that individuals with ADHD, in this study, might be dealing with various mental health issues which could affect the improvements on ADHD symptoms.

Students with ADHD who were low on consumption of unhealthy diet such as sugary and processed food, in the obtained study, showed more positive symptoms of emotional well-being than those high on consumption of unhealthy food. It is interesting that previous researches have only examined this effect in normal population and report that unhealthier diet could lead to higher signs on depression or anxiety (Jacka et al., 2010; Sánchez-Villegas et al., 2012). It indicates that these findings display new knowledge that further studies need to explore. Although, the study did not reveal difference in ADHD symptoms between various level of physical activity. It did provide evidence that individual with ADHD who engage in high physical activity, four to six times a week, might benefit more emotional well-being compared to those who engaged in low or moderated physical activity. This effect on emotional well-being is fascinating because most previous studies on physical activity and ADHD symptoms have a way of focusing only on reduced symptoms, regardless of the improvements on emotional well-being. Although, few studies have shown that moderate to high physical activity can improve emotional well-being in individuals with ADHD (Abramovitch et al., 2013; Verret et al., 2012; Kiluk et al., 2008; Gawrilow et al., 2016). Previous findings have indicated that males show more issues regarding mental health than females (Biederman et al., 2009; Klassen et al., 2004). However, this obtained study reported that females showed more negative emotional well-being than males. The difference might be due to lack of females among the ADHD populations in previous findings. It is therefore very important to focus on girls as much as boys in ADHD populations.

In summary, the study showed no association between physical activity and ADHD symptoms. However, low consumption of unhealthy diet and ADHD symptoms was related to reduce symptoms. This study also provide evidence that low consumption of unhealthy diet and high physical activity might play a big role, especially on emotional well-being in adolescents diagnosed with ADHD.

Therefore, this research finding might bring some new information that both high physical activity and low consumption of unhealthy diet can be beneficial for individual with ADHD and especially individuals with ADHD who have other problem concerning mental health. This might be an effective augmentation to medication for those who do not response to medication or those who search for other treatment than medication.

Despite this positive evidence, this research is limited and therefore require caution regarding interpretations. The research was a cross-sectional study and therefore the causal relationship cannot be determined. The strength in this study is that the population included only students who were diagnosed with ADHD. However, sex difference was among groups were males were more than females. Future researches need to focus on these changes and examine which activities and dietary pattern is most effective on both mental health and symptoms in children and adolescents diagnosed with ADHD.

It would be interesting to examine this relationship further by conducting a large research that would only include adolescents with ADHD that have comorbidity of anxiety, depression and dyslexia for example. I think that more research findings on these issues could have great impact on life and future of young students in the school system. Teachers and others working with young children and adolescents would gain information that could help them to improve instructional matters and health programs and therefore, be closer to meet student's individual needs.

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Appendix A

Chosen questions

25. Merktu í þann reit sem lýsir best þinni hegðun síðustu 6 mánuði (ADHD symptoms)

☐ Aldrei ☐ Sjaldan ☐ Stundum ☐ Nokkuð oft ☐ Mjög oft

a) Huga illa að smáatriðum eða geri fljótfærnislegar villur í vinnu eða námi

b) Er mikið með hendur og fætur á hreyfingu eða á iði þegar ég sit

c) Á erfitt með að halda athygli vakandi við verkefni eða leiki

d) Fer úr sæti mínu í aðstæðum þar sem ætlast er til að ég sitji kyrr

e) Virðist ekki hlusta þegar talað er til mín

f) Hreyfi mig óhóflega mikið í aðstæðum þar sem það á ekki við,

ofvirk(ur), finnst ég vera eirðarlaus

g) Fylgi ekki fyrirmælum til enda og tekst ekki að ljúka verkefnum

h) Á erfitt með að vera hljóð(ur) þegar ég sinni tómstundum

i) Á erfitt með að skipuleggja verkefni og athafnir

j) Er alltaf á ferðinni eða “eins og þeytispjald”

k) Forðast verkefni (t.d. í vinnu eða heima) sem krefjast mikillar beitingar hugans

l) Tala óhóflega mikið

m) Týni hlutum sem eru nauðsynlegir til verkefna eða athafna

n) Grípfram í með svari áður en spurningum er lokið

o) Er auðtrufluð/auðtruflaður

p) Á í erfiðleikum með að bíða eftir að röðin komi að mér

q) Er gleymin

n) í athöfnum daglegs lífs

r) Grípfram í eða ryðst inn í samræður eða athafnir annarra

28. Hversu oft varðst þú var/vör við eftirfarandi vanlíðan eða óþægindi síðastliðna viku? (Emotional well-being affect)

☐ Aldrei ☐ Sjaldan ☐ Stundum ☐ Nokkuð oft ☐ Mjög oft

a) Höfuðverk

b) Verk í maga

c) Taugaóstyrk

d) Skyndilega hræðslu án nokkurrar ástæðu

e) Þú varst uppspennt/ur

f) Þú varst leið/ur eða hafðir lítinn áhuga á að gera hluti

g) Þú hafðir litla matarlyst

h) Þér fannst þú einmana

i) Þú grést auðveldlega eða langaði til að gráta

j) Þú áttir erfitt með að sofna eða halda þér sofandi

k) Þú varst niðurdregin(n) eða dapur/döpur

l) Þú varst ekki spenntur fyrir að gera nokkurn hlut

m) Þér fannst þú vera hægfara eða hafa lítinn mátt

n) Þér fannst framtíðin vonlaus

42. Hversu oft borðar þú eða drekkur þú eftirfarandi? (Dietary patterns)

☐ Oftar en einu sinni á dag ☐ Einu sinni á dag ☐ Í hverri viku ☐ Sjaldnar en 1 sinni í viku

☐ Aldrei

a) Ávexti

b) Sælgæti/sætt kex

c) Grænmeti

d) Kjötmáltíð

e) Fiskmáltíð

f) Pasta

g) Kartöfluflögur, snakk

h) Franskar kartöflur

i) Hamborgara eða pylsu

j) Pizzu

k) Mjólk eða mjólkurvörur

l) Sykurlausa gosdrykki

m) Sykraða gosdrykki

n) Vatn

67. Eftirfarandi spurningar eru um íþróttir og líkamsrækt? (Physical activity)

☐ Nær aldrei ☐ 1 sinni í viku ☐ 2 sinnum í viku ☐ 3 sinnum í viku ☐ 4-6 sinnum í viku

☐ Á hverjum degi

d) Hversu oft reynir þú á þig líkamlega þannig að þú mæðist verulega eða svitnir?

1. Ert þú strákur eða stelpa? (Gender)

☐ Strákur ☐ Stelpa

Appendix B

Form for passive consant

RANNSÓKNIR & GREINING
Háskólanum í Reykjavík

Reykjavík, 19. janúar 2015

Ungt fólk 2015

Rannsókn á högum og líðan nemenda í 5. – 10. bekk á Íslandi.

Ágætu foreldrar / forráðamenn,

Dagana 3.- 5. febrúar næstkomandi er fyrirhugað að gera könnun meðal nemenda í 5. til 7. bekk á Íslandi í samræmi við áherslur menntamálaráðuneytisins og samkvæmt rannsóknaráætlun um hagi og líðan ungs fólks á Íslandi til ársins 2016. Samhliða verður lögð fyrir örstutt könnun meðal nemenda í 8. til 10. bekk um vímuefnaneyslu. Hvort tveggja er beint framhald rannsókna undanfarinna ára og sér Rannsóknir & greining við Háskólann í Reykjavík um framkvæmdina að vanda.

Markmiðið er annars vegar að rannsaka hagi og líðan nemenda í 5. – 7. bekk (tekur um 50 mínútur í svörun) og hinsvegar vímuefnaneyslu nemenda í 8. – 10. bekk (tekur um 10 mínútur í svörun).

Ungt fólk rannsóknaröðin hefur verið unnin á Íslandi samfellt frá árinu 1992. Slík samfella í rannsóknum á högum og líðan ungs fólks er ungu fólki og þeim sem að málaflokknum starfa afar mikilvæg. Upplýsingar úr rannsóknunum hafa allt frá upphafi verið notaðar við stefnumótun og aðgerðir í málefnum ungs fólks og eru grunnur að vinnu þeirra sem vinna að því að bæta líf og hagi ungs fólks á Íslandi.

Meginákherslur rannsóknanna ***Ungt fólk*** eru þær sömu í ár og áður hefur verið og lúta að því að kanna hagi og líðan ungmenna og félagslega þætti svo sem tengsl við foreldra og vini, íþróttir og tómstundir, félagslíf, líðan, einelti, streitu, mataræði, nám, brottfallsáhættu, félagslega stöðu, svefnvenjur, lestur, tölvunotkun (skjánotkun), vímuefnaneyslu, framtíðaráform og annað mikilvægt.

Sem fyrr er ***Ungt fólk*** könnunin unnin samkvæmt lögum um persónuvernd, er nafnlaus og því ekki hægt að rekja neinar upplýsingar til einstaklinga. Nemendur eru

sérstaklega beðnir að rita hvorki nafn sitt né kennitölu á spurningalistann. Þegar útfyllingu spurningalistanna er lokið leggja nemendur þá í lokað umslag og loka vandlega áður en listunum er safnað saman. Listarnir eru svo sendir greiningaraðilum sem tölvuskrá upplýsingarnar án þess að geta með nokkru móti vitað hverjum þær tilheyra. Að skráningu lokinni er spurningalistunum eytt.

Þessar upplýsingar eru sendar til að upplýsa þig um fyrirhugaða gagnaöflun. Ef þú óskar eftir að barn þitt barn þitt taki ekki þátt í ***Ungt fólk*** könnuninni í ár, hafðu þá samband við starfsfólk Rannsókna & greiningar með tölvupósti rannsoknir@rannsoknir.is eða í síma 599 6431.

Verði þátttaka góð koma upplýsingarnar til með að skila mikilsverðum niðurstöðum, bæði hagnýtum og fræðilegum líkt og fyrri kannanir af þessu tagi hafa gert.

Ef nánari upplýsinga er óskað þá vinsamlega hafið samband við Rannsóknir & greiningu.

Með kærri kveðju
Starfsfólk Rannsókna & greiningar