



**BSc in Psychology**

Child and adolescent obesity and ADHD:

Psychological impact and bullying

**June 2017**

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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 - English

Obesity is defined as an abnormal fat accumulation that could put a person's health at risk. ADHD is a neurological disorder, which is usually diagnosed in childhood. Studies indicate that ADHD children have a higher BMI than non-ADHD children. Furthermore, studies on both ADHD children and on children with obesity show that both children with ADHD and children with obesity are more likely to have anxiety, emotional problems and be bullied than non-ADHD children and children not with obesity. Present study analyzes whether ADHD children in obesity, had other comorbid concerns than children in obesity that do not have ADHD. Participants in this study (N = 374) were patients at the Children's Medical Center in Iceland, who had undergone obesity treatment. Results showed no difference between BMI-SDS scores for those who had ADHD and other comorbid concerns and for those who did not have ADHD and other comorbid concerns. However ADHD children were more likely to have anxiety, emotional problems and be bullied than non-ADHD children. Results indicate that other comorbid concerns may not affect the obesity of ADHD children in this sample. However, there is a great need to investigate this further.

## Abstract - Icelandic

Offíta er skilgreind sem óeðlileg fitusöfnun sem getur haft skaðleg áhrif á heilsu einstaklings. ADHD er taugaprósaröskun og er oftast greind í barnæsku. Rannsóknir sýna að börn með ADHD eru með hærri líkamsþyngdarstuðul (LPS) en börn sem ekki eru með ADHD. Rannsóknir sýna að bæði börn með ADHD og börn með offitu eru líklegri til þess að vera með kvíða, lenda í einelti og eiga við tilfinningavandamál að stríða heldur en börn sem ekki eru með ADHD eða með offitu. Þessi rannsókn skoðaði hvort börn með ADHD og með offitu, hefðu annarskonar erfiðleika heldur en börn með offitu og ekki með ADHD. Þátttakendur rannsóknarinnar (N = 374) voru sjúklingar hjá Heilsuskóla Landspítalans og höfðu fengið meðferð við offitu. Niðurstöður sýndu að ekki var munur á LPS hjá þeim sem voru með ADHD og annarskonar erfiðleika og hjá þeim sem ekki voru með ADHD og annarskonar erfiðleika. Þátttakendur með ADHD voru líklegri til þess að vera með kvíða, tilfinningavandamál og verða fyrir einelti heldur en þeir sem ekki voru með ADHD. Niðurstöður benda til þess að annarskonar erfiðleikar ýta ekki undir offitu barna með ADHD. Það er hinsvegar mikil þörf á að rannsaka þetta málefni frekar.

Child and adolescent obesity and ADHD: Psychological impact and bullying

## **Obesity**

Obesity in children has increased over the years and has become one of the most common childhood disorders worldwide (Schwimmer, 2003). In the United States, it is estimated that about 6% of children are obese and about 18% of adolescents (Babey, Hastert, Wolstein, & Diamant, 2010). According to the World Health Organization (WHO) obesity is defined as an excessive or abnormal fat accumulation that could put a person's health at risk (WHO | Obesity, n.d.).

The prevalence of childhood obesity in Iceland has been rapidly increasing since the second half of the twentieth century (Briem, 1999). According to statistics from the Public Health Institute in 2009 about 5.5% of children in Iceland were obese (Helgason, 2011). However, a fairly recent study indicated that childhood obesity in Iceland was not increasing, but at the same time it was not decreasing (Jónsson & Héðinsdóttir, 2010). Results of a long-term study in Iceland showed that 51% of obese 6-year-olds also had obesity when they were 15 years old (Jóhannsson, Arngrímsson, Þórirsdóttir, & Sveinsson, 2006). A study of 277 Icelandic adolescents, showed that 7% were obese (Arngrímsson, Richardsson, Jónsson, & Ólafsdóttir, 2012).

Multiple factors can play a role when people develop obesity, such as too much food intake and insufficient physical activity, psychological, genetic, physiological and social factors (Aronne, Nelinson, & Lillo, 2009).

## **Obesity: Psychological problems and bullying**

In Taylor and colleagues' (2011) study the relationship between obesity and emotional and behavioral problems was examined. Results showed that children with obesity were twice as likely to have emotional and behavioral problems than children

who were not obese. However, it can be difficult to determine whether the emotional and behavior problems are causing obesity or the other way around (Taylor et al., 2011). In Sawyer and colleagues' long-term study they found that children who were overweight at 4 to 5 years of age, were more likely to have developed an emotional problem at the age of 8 to 9 years (Sawyer, Harchak, Wake, & Lynch, 2011).

Some studies have found a relationship between obesity and anxiety (Bjornelv, Nordahl, & Holmen, 2011; Pervanidou et al., 2013; Rofey et al., 2009; Topcu, Orhon, Tayfun, Ucakturk, & Demirel, 2016). In Rofey and colleagues' longitudinal study, the results showed that in a sample of non-obese children, anxiety was associated with increased BMI (Rofey et al., 2009).

One study found that obese children were 2.3 – 3.1 times more likely to report having anxiety than children without obesity (Pervanidou et al., 2013).

In a research Topcu and colleagues' did, the results showed that there was a significant association between obese children and anxiety and also a higher rate of depression and lower self-esteem than for children who were not obese (Topcu et al., 2016). However, results of a study with 8090 participants showed that obesity was not associated with anxiety, but there was a relationship between self-esteem and obesity (Bjornelv et al., 2011).

Anderson and colleagues' study revealed that adolescent obesity predicted a risk for development of anxiety for girls, but not for boys (Anderson, Cohen, Naumova, Jacques, & Must, 2007).

Bullying is repeated violence (physical or mental), controlled by individuals or groups and is directed against an individual who is not able to defend himself (Unnever & Cornell, 2003). Research suggests that children who are obese are more likely to be bullied by their peers than children who are not obese. They are also not

as likely to defend themselves against their perpetrators (Jeong, Davis, Rodriguez, & Han, 2016). However it is considered that the relationship between obesity and bullying is due to the negative emotions that children with obesity experience, and therefore makes them more vulnerable to bullying (Jeong et al., 2016). Also, it is not clear whether the children are gaining weight because of the bullying or if they are bullied because of their overweight (Brixval, Rayce, Rasmussen, Holstein, & Due, 2012).

A longitudinal study on adolescents and bullying showed that adolescents who were bullied at the age of 14, were at a greater risk for obesity in adulthood (Mamun, O'Callaghan, Williams, & Najman, 2013).

## **ADHD**

ADHD is a neurological disorder and is usually diagnosed in early childhood (Wender, Wolf, & Wasserstein, 2001). About 5% of school-aged children have ADHD and it is more common in boys than girls (Stefanatos & Baron, 2007). The main characteristics of the disorder are developmentally inappropriate and impaired inattention, impulsivity and motor hyperactivity (Barkley & Fischer, 2010; Cortese et al., 2008). ADHD can have a major impact on individuals' lives, such as education and on adaptation in society (Stefanatos & Baron, 2007). It can also lead to difficulties in communication with family and friends (Holmberg & Hjern, 2008).

### **ADHD: Psychological problems and bullying**

Studies from both USA and Europe have shown that children with ADHD are more likely to develop emotional problems than children who do not have ADHD (Coghill et al., 2006; Strine et al., 2006). Emotional problems also increase with increasing symptoms of hyperactivity and impulsivity (Becker et al., 2006). Furthermore, girls tend to show greater emotional problems than boys (Becker et al.,

2006). It is believed that about two-thirds of individuals who have an ADHD diagnosis have at least one other psychiatric diagnosis (Cuffe, 2005).

Anxiety has become one of the most common comorbid disorder amongst children with ADHD and an estimated 25% of children with ADHD suffer from anxiety (Sorensen, Plessen, Nicholas, & Lundervold, 2011). A study by Sorensen and colleagues', children who had ADHD and comorbid anxiety had more impairment in inhibitory control and had less emotional control than children who had either only ADHD or only anxiety (Sorensen et al., 2011).

A group of elementary school children with ADHD reported that they were three times more often perpetrators of bullying, but up to 10 times more often victims of bullying than children who did not have ADHD (Holmberg & Hjern, 2008).

### **ADHD and obesity**

Some studies argue that there is a connection between ADHD and obesity (Erhart, Herpertz-Dahlmann, & Wille, 2012). In Cortese and colleagues' systematic review, evidence indicates that individuals with ADHD have higher BMI scores compared to obese individuals without ADHD and that prevalence of ADHD in obese individuals are higher than expected in the general population (Cortese et al., 2008). Nigg and colleagues' study reported a possible significant association between girls that had ADHD and other comorbid disorders and obesity. However, there was a small association between ADHD only and obesity, but it was not significant (Nigg et al., 2016). Another study claimed that children with ADHD were just as likely to be obese as neurotypical children in the general population (Curtin, Bandini, Perrin, Tybor, & Must, 2005). Furthermore, one study showed that children with ADHD had lower weight than the neurotypical comparison group (Dubnov-Raz, Perry, & Berger, 2011).

Studies have examined the effects of inattentive and impulsivity components on obesity in individuals with ADHD. Cortese and colleagues' (2016) study found that inattention and impulsivity increased the risk of obesity, whereas the lack of inhibitory control in individuals with ADHD reinforced an abnormal eating pattern. Also, inattention can affect individuals when organizing normal and healthy eating patterns (Cortese et al., 2016; Davis, Levitan, Smith, Tweed, & Curtis, 2006).

Motor hyperactivity, one of the symptoms of ADHD, has also been examined in connection with obesity. Many would think that motor hyperactivity would keep individuals active and healthy (Samuele Cortese et al., 2016). However, it has been shown that children with ADHD are less involved in physical activity and watch more television than those who do not have ADHD (Kim, Mutyala, Agiovlasitis, & Fernhall, 2011).

One study inferred that ADHD children with dominant impulsivity had higher BMI compared to other ADHD children. Also, children with dominant impulsivity lost significantly less weight in treatment (Nederkoorn, Jansen, Mulkens, & Jansen, 2007).

Results of one study found that children with an ADHD diagnosis were twice as likely to have obesity than children without ADHD, even when controlling for sex, age and socioeconomic status (Erhart et al., 2012).

The aim of this study was to investigate whether children and adolescents with obesity and ADHD were struggling with other comorbid concerns than children and adolescents with obesity that did not have ADHD. Previous research indicates that having anxiety, emotional problems and being victims to bullying are associated with both obesity and ADHD.

First hypothesis of this study is that children and adolescents with obesity and ADHD are more likely to have severe obesity than children with obesity without ADHD. Second hypothesis is that children and adolescents with obesity and ADHD are more likely to have anxiety, emotional problems and being bullied rather than children and adolescents with obesity, without ADHD.

## **Method**

### **Participants**

In this study, data from the Children's Medical Centre in Iceland was used. A total of 374 children and adolescents participated in the study and had at some point received obesity treatment. The age range was from 4-18 years ( $M=11,73$ ;  $SD=3,03$ ). Participants were 199 girls and 175 boys.

According to the International Obesity Task Force (Cole, Bellizzi, & Flegal, 2000) there are special standards for age and sex in accordance with the definition of obesity among children. Preferred BMI (Body Mass Index) of children varies by their age and sex. Therefore, a standardized BMI (BMI-SDS) is used in the diagnosis of childhood obesity.

One of the admission criteria for obesity treatment at the Children's Medical Centre is for children to have reached 2.5 standard deviations from the mean BMI scores, according to Swedish guideline limits (Karlberg, Luo, & Albertsson-Wikland, 2007). Therefore, all participants in this study had BMI at least 2.5 standard deviations from the average BMI scores.

For this study, permission was received from the National Bioethics Committee. Authorization number: VSNb2013010026/03.07.

### **Instruments and Measures**

The main measuring instruments of this study were BMI-SDS and The Strengths and Difficulties Questionnaire (SDQ) (Goodman, 1997). Data was collected by paper and pen and later transferred to a computer for data analysis.

### **Psychiatric disorders**

In the intake interview, parents had to answer background questions about their children. For example, information was obtained from parents as to whether their children had an ADHD diagnosis or not. Also, the medical records of the participants were examined and verified. Diagnosis was not made on ADHD or any other disorders at the Children's Medical Centre. However, if parents provided confirmation of an ADHD diagnoses, anxiety or on other diagnoses, this was recorded accordingly.

### **Body mass index – standard deviation scores (BMI-SDS)**

Weight status of children was evaluated by BMI-SDS. In order to identify obesity among children BMI percentiles were utilized (Landlæknisembættið, 2004). In adults, BMI over 30 is classified as obesity. In children, BMI is converted to SDS under normal distribution where the average is 0 and standard deviation is 1. BMI of a child 2.5 SDS over the mean is equivalent to adults' BMI over 30. Severe obesity is estimated as BMI-SDS over 3.5.

To measure children's weight a digital scale from Marel was used. For measuring children's height, a digital altimeter (Ulmer stadiometer), fixed against a wall, was used. BMI was calculated from the results of the height and weight measures. To find out children's BMI-SDS age and gender were taken into account based on Swedish growth curves (Karlberg et al., 2007).

### **SDQ**

SDQ (*The Strengths and Difficulties Questionnaire*) (Goodman, 1997), is a short questionnaire that was designed to evaluate behavior, emotional well-being and social skills of children and adolescents aged 4-16 years. There are three variations of the questionnaire, parental, teacher and self-reported editions. This study involved the parental edition, where parents were supposed to complete the questionnaire regarding their children's behavior and feelings. The questionnaire consists of 25 statements that are distributed equally on five different subscales. The subscales are *Emotional symptoms* with statements such as "*Often unhappy, depressed or tearful*", *Conduct problems* with statements like "*Often loses temper*", *Hyperactivity/inattention* with statements like "*Constantly fidgeting or squirming*", *Peer relationship problems* with statements such as "*Generally liked by other children*" and lastly *Prosocial behavior* with reversed statements like "*Considerate of other people's feelings*". The statements are answered on a three-point scale, not true (0), somewhat true (1), and certainly true (2).

To get a total score of the SDQ questionnaire, each subscale must be calculated individually. For each subscale 0 points are the lowest and 10 points the maximum, more points indicate greater difficulties. The total score is obtained by calculating the total score of all the subscales except for the *Prosocial behavior*, as it evaluates skills, not difficulties. *Prosocial behavior* subscale is opposed to the other subscales, where higher score indicates better social skills. The total score can be between 0-40 points. For the parental version of the SDQ questionnaire for 4-17 year olds, the norm for the overall difficulty level is between 0-13 points (1), 14-16 points (2) are just under clinical limits and 17-40 points (3) are above clinical limits.

Research indicates that internal reliability of the overall score for the parental version is acceptable ( $\alpha = .82$ ). The internal reliability of the subscales ranges from

.57-.77, where *Prosocial behavior* is the lowest ( $\alpha = .57$ ) and *Hyperactivity/inattention* the highest ( $\alpha = .77$ ). Factor analysis showed that all of the 25 variables loaded only on the five predicted factors (Goodman, 2001).

SDQ has been translated to Icelandic (Hrafnadóttir, Njarðvík, Magnússon, Steinsson, & Guðmundsson, 2014). One study examined the internal reliability of the parental version for 5-year-olds, Factor Analysis showed five factors, which are comparable results to international studies (Goodman, 2001). However, internal reliability was in most cases insufficient for the parental version ( $\alpha = .41-.74$ ) (Hrafnadóttir, 2006). This indicates that the psychometric properties of the Icelandic version of SDQ questionnaire for parents of 5 year olds, are not sufficient (Hrafnadóttir, 2006).

Internal reliability of the total scores for 6-9-year-olds was acceptable ( $\alpha = .79$ ). The internal reliability of the subscales ranged from .61-.76 (Magnúsdóttir & Sveinbjörnsdóttir, 2011).

Internal reliability of the total score for 10-12-year-olds was relatively high ( $\alpha = .84$ ). However, the internal reliability of the subscales ranged from  $\alpha = .57$  to .77, were the *Conduct problems* subscale had the lowest reliability and *Emotional symptoms* subscale the highest (Berndsen, 2005).

For 12-16-year-olds, internal reliability of the total scores were high ( $\alpha = .84$ ) and the internal reliability of the subscales ranged from  $\alpha = .59$  to .74 (Böðvarsdóttir, 2006).

In this study, the *Emotional symptoms* subscale was used to identify emotional problems among participants and one question of the *Peer relationship problems subscale*, which was “*Picked on or bullied by other youth?*”.

## **Procedure**

To participate in the obesity program at the Children's Medical Centre, parents or healthcare professionals had to refer the children directly for treatment. Apart from being under the 2.5 BMI-SDS cut-off, no treatment exclusion criteria were set.

Upon being accepted into the program, children and their parents were invited to the initial interview by a doctor and a nurse or psychologist, where a doctor evaluated their physical condition. A nurse or psychologist obtained information on several factors related to health status such as nutrition, physical activity and screen time usage. A Psychologist or nurse handed the SDQ questionnaire to the parents of the participants. They were also asked to fill out the questionnaire on behalf of their children. Also, parents were asked to answer a questionnaire about background information regarding themselves and their children, such as parental education level and children's psychiatric diagnoses. Participant's height and weight were then measured and their BMI and BMI-SDS was calculated.

### **Design and data analysis**

This study was between-subjects design. The association between ADHD/non-ADHD participants on BMI-SDS scores, anxiety, bullying and emotional problems was evaluated. Study results were processed in SPSS statistical software version 21.

BMI-SDS scores were divided into two groups (low/high), where standard deviation scores from 0 to 3.49 represented low BMI-SDS group and were assigned the value "1". Standard deviation scores from 3.5 and higher represented the high BMI-SDS scores group and were assigned the value "2". Bullying was also divided into two groups, that is, those who responded "Not true" represented not being bullied and were assigned the value "0". The second group, which responded "Somewhat true", or "Certainly true" represented being bullied and were assigned the value "1".

Furthermore, *Emotional symptoms* were also divided into two groups. Those who responded “Not true” or “Somewhat true” were placed in a group one and were assigned the value “0”, which represented no emotional problems. Those who responded “Certainly true”, represented emotional problems and were assigned the value “1”. Those participants who had ADHD were assigned the value “1” and those who did not have ADHD, were assigned the value “0”. Same for the scores on anxiety, those participants who had anxiety were assigned the value “1” and those who did not have anxiety, were assigned the value “0”.

The data was analyzed using the Independent-Samples T-tests. For the T-test the dependent variable was the BMI-SDS scores and the independent variables were ADHD, ADHD and anxiety, anxiety, bullying and emotional problems. Kolmogorov-Smirnov test of normality showed significant results ( $p < .05$ ) on some of the levels of the independent variables. This violates the assumption of normal distribution of the data for Independent-Sample T-test. However, it was justified to use the T-test because of how robust it is for such violations. A chi-square test for association was also performed between ADHD/Non-ADHD and BMI-SDS, anxiety, bullying and emotional problems. For the chi-square test the dependent variable was ADHD which had two levels, ADHD and non-ADHD and the independent variables who also had two levels were anxiety and no anxiety, emotional problems and no emotional problems and had been bullied and had not been bullied.

Some missing cases were in the study. In total, 432 participants were in the initial sample. However, all those who did not specify whether they had a psychiatric disorder or not, were removed from the database. Also, all outliers that had BMI-SDS higher than 6.00, were removed from the database, which lead to 374 participants. Information on BMI-SDS was available for 367 participants.

## Results

Table 1 shows the results of the background questions which parents were asked to answer regarding themselves and their children. Gender, age and BMI-SDS scores for participants and education and marital status of the parents.

Table 1.

*The Mean (M), Std. Deviation (SD) and percentage of descriptive statistics for children and their parents.*

	N	M (SD) or %
<b>Children</b>		
Girls	199	53.2%
Boys	175	46.8%
Age (years)	374	11.73 ± 3.03
BMI-SDS	367	3.48 ± .82
<b>Parents</b>		
Education		
Elementary school	50	27.6%
Secondary school	62	34.3%
Undergraduate	44	24.3%
Postgraduate	25	13.8%
Marital status		
Cohabiting/married	159	54.2%
Divorced	56	19.1%
Divorced & re-cohabiting/married	36	12.3%
Single parent	35	11.9%

Other	7	2.5%
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The mean BMI-SDS scores for participants were 3.48 ( $SD = .82$ ). Out of 374 participants a total of 115 (30,7%) had ADHD, 97 (25,9%) had anxiety and 62 (16,6%) had ADHD and anxiety. Out of 248 participants 90 (36.3%) had emotional problems and out of 246 participants 148 (60,2%) had been bullied. Table 2 shows the BMI-SDS mean scores of the independent variables.

Table 2.

*Mean (M) and Std. Deviation (SD) for BMI-SDS scores of the independent variables.*

	<i>M</i>	<i>SD</i>	<i>N</i>
ADHD	3.54	.83	114
Non-ADHD	3.45	.81	253
Total	3.48	.82	367
Anxiety	3.50	.72	94
No-Anxiety	3.47	.85	273
Total	3.48	.82	367
ADHD & anxiety	3.50	.76	61
Non-ADHD & anxiety	3.47	.83	306
Total	3.53	.82	367
Bullied	3.48	.80	144
Not bullied	3.35	.73	98
Total	3.43	.78	242
Emotional problems	3.39	.76	88
No emotional problems	3.46	.79	156

Total	3.44	.78	244
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Almost half or 42% of participants with ADHD had anxiety compared to 19% of participants without ADHD. More than half or 72% participants with ADHD had been bullied compared to 55% participants without ADHD and a total of 46% of participants with ADHD had emotional problems compared to 32% participants without ADHD.

The alpha criterion for significance was set at .05. To determine if there was a difference between BMI-SDS scores on the independent variables, Independent-Samples T-tests were used. Table 3 shows the results of the Independent - Samples T-tests, comparing the mean scores of the BMI-SDS between dichotomous groupings of ADHD, anxiety, ADHD & anxiety, bullying and emotional problems.

Table 3.

*Comparing mean scores of BMI-SDS between the independent variables.*

Independent variables		<i>t</i>	df	<i>p</i>	Mean difference
ADHD	ADHD	-1.028	365	.304	-.095
	Non-ADHD				
Anxiety	Anxiety	-.306	365	.760	-.030
	No-anxiety				
ADHD & Anxiety	ADHD & Anxiety	-.220	365	.816	-.025
	No-ADHD & Anxiety				
Bullying	Bullied	-1.371	240	.172	-.139
	Not Bullied				
Emotional problems	Emotional problems	.609	242	.543	.063

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 No emotional problems
 

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No significant differences were found between ADHD and non-ADHD group on any of the measures: BMI-SDS scores  $t(365) = -1.028, p = .304$ , anxiety  $t(365) = -.306, p = .760$ , bullying  $t(240) = -1.371, p = .172$  or emotional problems  $t(242) = .609, p = .543$ .

Chi-square tests for association was performed and all expected cell frequencies were greater than five. Table 4 shows the results of the Chi-square tests for association between ADHD/non-ADHD and BMI-SDS, anxiety and emotional problems.

Table 4.

*The results of the Chi-square tests, Odds ratio (OR) and Confidence interval (CI 95%)*

	$\chi^2$	d	$p$	OR (CI 95%)
BMI-SDS	.404	1	.525	NS
Anxiety	21.590	1	< .001	3.08 (1.893 – 4.981)
Bullying	5.670	1	.017	2.06 (1.129 – 3.725)
Emotional problems	3.931	1	.047	1.79 (1.008 – 3.095)

There was no significant association between ADHD and non-ADHD children in terms of whether they were in the high or low BMI-SDS group  $\chi^2(1) = .404, p = .525$ .

There was a significant association between ADHD and non-ADHD in terms of whether they had anxiety or not  $\chi^2(1) = 21.590, p < .001$ , whether they had been bullied or not  $\chi^2(1) = 5.670, p = .017$  and whether they had emotional problems or not

$\chi^2(1) = 3.931, p = .047$ . Based on the odds ratios, the odds of having anxiety were 3.1 times higher if participant had ADHD, the odds of being bullied were 2.1 times higher if participant had ADHD and the odds of having emotional problems were 1,8 times higher if participants had ADHD than if they did not have ADHD.

### **Discussion**

The aim of this study was to investigate whether children and adolescents with obesity and ADHD were struggling with other comorbid concerns than children and adolescents with obesity that did not have ADHD. First hypothesis that children and adolescents with obesity and ADHD are more likely to have severe obesity than children with obesity without ADHD, was not supported. Participants with ADHD had slightly higher average scores on BMI-SDS compared to those who did not have ADHD, but the difference was not significant. These findings are consistent with the results of Curtin and colleagues' study which stated that ADHD children were just as likely to be obese compared to non-ADHD children (Curtin et al., 2005).

Furthermore, there was no difference in the average BMI-SDS scores between those who had anxiety/no-anxiety, ADHD & anxiety/no-ADHD & anxiety and for those who had been bullied/not been bullied. Surprisingly, participants who had emotional problems had on average lower BMI-SDS scores compared to those who did not have emotional problems, but the difference was not significant. This findings are not consistent with previous research, which indicated that anxiety was associated with increased BMI (Rofey et al., 2009).

Second hypothesis of this study was that children and adolescents with obesity and ADHD are more likely to have anxiety, emotional problems and being bullied rather than children and adolescents with obesity, without ADHD, was supported. There was a significant association between ADHD/non-ADHD and anxiety, bullying

and emotional problems. However, there was not a significant association between ADHD and non-ADHD in terms of whether they were in the high or low BMI-SDS group. Participants with ADHD were 3.1 times more likely to have anxiety, 2,1 times more likely to have experienced bullying and 1,8 times more likely to have emotional problems than those who did not have ADHD. These results are consistent with previous research in that children with ADHD are more likely to develop emotional problems than children without ADHD (Coghill et al., 2006; Strine et al., 2006). The results of this study are consistent with studies on ADHD and anxiety, in which 25% of children with ADHD suffer from anxiety (Sorensen et al., 2011). However, in this study almost half or 42% of participants with ADHD had anxiety. These results are also consistent with a study on ADHD and bullying, where as children with ADHD are 10 times more likely to be a victim of bullying compared to non-ADHD children (Holmberg & Hjern, 2008).

The main benefit of this study was that the study provides insights into problems that affect children with ADHD such as anxiety and bullying, which are often closely related to obesity as well. There was also an almost equal gender distribution of participants, which is a benefit for this study.

There were several limitations to the study. Firstly, all those who participated in the study were obese and there was no comparison group, which could affect results of the study, as there may be significant differences between obese and non-obese children and adolescents, and whether they experience anxiety, emotional problems or bullying. But in this case, it is difficult to tell whether anxiety, emotional problems and being bullied, as some of the participants experience, came as a result of obesity or not.

Second limitation was that it lacked many responses from parents on the SDQ questionnaire, which could also lead to response bias.

About 30% of participants of this study had ADHD, which is more than is found in the general population (Stefanatos & Baron, 2007). The findings of this current study indicate that the relationship between ADHD and obesity are not necessarily due to psychological factors and bullying. Even though participants with ADHD are more likely to have anxiety, emotional problems and to be victims of bullying, there was no significant difference between the mean BMI-SDS scores for those who had anxiety, emotional problems and had been bullied and for those who did not have anxiety, emotional problems and had not been victims of bullying. Under normal circumstances this could mean that anxiety, emotional problems and bullying had no effect on obesity. But as previously mentioned, all participants were already obese, so it may be difficult to get a significant difference in BMI-SDS scores between the groups.

It is worrying that approximately 60% of the participants had been bullied and out of 71 participants with ADHD, 51 had been bullied. Also, that a total of 46% of participants with ADHD had emotional problems compared to 32% participants without ADHD. Furthermore, 42% of participants with ADHD had anxiety compared to 19% participants without ADHD. These numbers show that children and adolescents with ADHD and obesity are rather experiencing comorbid concerns than children with obesity, without ADHD.

Following this study there is a need for future research to investigate further the topics identified in this study, with an addition of a control group with participants who are not obese. Many ADHD children and adolescent in this sample have anxiety, emotional problems and have been bullied, it is therefore important to examine it

further in relation to obesity, since many research indicate that there is association between obesity and anxiety, bullying and emotional problems (Bjornelv et al., 2011; Jeong et al., 2016; Mamun et al., 2013; Rofey et al., 2009; Sawyer et al., 2011; Taylor et al., 2011).

It might also be interesting to see whether lowered self-esteem enhances obesity in children and adolescents with ADHD, since studies indicate a negative relationship between obesity and self-esteem (Bjornelv et al., 2011; Topcu et al., 2016), and ADHD and low self-esteem (Unnever & Cornell, 2003).

Furthermore it would be interesting to investigate the characteristics of ADHD further in relation to obesity since children with ADHD have been shown to lose significantly less weight in weight loss treatment than children without these characteristics (Nederkoorn et al., 2007). It would also be of interest to examine the primary symptoms of ADHD – predominantly hyperactivity, impulsivity or attention deficit – in relation to anxiety, bullying and emotional problems.

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