Review

The investigation of the relationship between Attention Deficit-Hyperactivity Disorder and Eating Disorders in Adolescents.

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ABSTRACT

Since Attention Deficit-Hyperactivity Disorder (ADHD) is a neurodevelopmental disorder characterized by behavioral problems and learning difficulties, some researchers have suggested that ADHD may be associated with "unhealthy" diets or disturbed feeding patterns and lack of nutrients. In addition, ADHD has also been considered as a disorder of self-regulation, where the inhibition of impulse is limited, a characteristic that also occurs in patients with Eating Disorders (ED). The purpose of this review is to investigate the relationship between ADHD and ED in adolescents, as well as possible associations with specific ED and characteristics of ADHD. According to the results of this review, a correlation between ADHD and ED in adolescents was observed in several studies. In particular, ADHD was largely associated with both Bulimia Nervosa (BN) and Binge Eating Disorder (BED). A key feature of ADHD, which was associated with a disturbed way of feeding, was impulsiveness. The conclusions of this review could be used in treating ADHD and ED in adolescents effectively, specifically in Greek population, describing in detail the possible relationship between them. This information will be an important tool for specialists, who, together with parents and caregivers, will help and improve symptoms in adolescents with ADHD and ED.

Key Words: *ADHD; ED; Adolescents; Impulsiveness; binge eating*

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Introduction

Many studies have investigated the relationship between Attention Deficit-Hyperactivity Disorder (ADHD) and Eating Disorders (ED) in the past (1-4). Considering ADHD as a neurodevelopmental disorder, which characterized by conduct problems and learning difficulties, some researchers suggested that ADHD may linked to unhealthy dieting and nutrients deficiency (5-8). There are multiple reasons behind the ADHD and ED connection, due to ED comorbidity to ADHD, anxiety, depressive symptoms, conduct disorder and drug abuse (9-11).

Adolescents with ADHD are rejected and bullied by their peers (12) and often fight with their parents (13), leading to negative emotions and disturbed body image, which includes inappropriate way of eating (14-15). Furthermore, anxiety symptoms along with depressive symptoms in adolescents with ADHD were linked to bulimic episodes (16). Excessive food consumption in teenagers with ADHD was considered a control factor of the environment, which contained frustration, inattention and lack of organization (16). It is evenly possible that ADHD symptoms lead to disturbed diet, because ADHD is considered as a self-regulated disorder, where the inhibition of impulsiveness is limited (17-19). The same pattern of lack of impulsiveness is evident in patients with Bulimia Nervosa (BN) (20-21).

Following the above, the purpose of this review is to describe in detail the characteristics of ADHD and ED in adolescents, and those behaviors that do not meet the criteria for diagnosis, but causes a decrease in their functionality, while investigating the possible relationship or not, among disorders in adolescents.

Materials and Methods

A detail research of articles was conducted in online databases, with no language restriction and geographical and cultural landmarks. During the research, words such as «Attention Deficit-Hyperactivity Disorder»,«ADHD», «Feeding and Eating Disorders», «Eating Disorders», «ED», «adolescents», «teens» and «teenagers» were used. Through snowballing technique, references were checked for compatibility with the subject.

Concerning the selection process, studies that examined the occurrence of ADHD and ED in adolescents after 2010, were deemed eligible, without any restriction in the study design. The chro-

-nological constraint was placed in order to synchronize the research, including as much data as possible that were close to reality. Furthermore, adolescence is a milestone for ADHD, as a neurodevelopmental disorder, while most ED occur in adolescents. During the research, studies incorporate parent's opinions were examined, due to recognition of changes and behaviors in adolescents.

Results

According to the results, a correlation between ADHD and ED was noted (22 -34). Specifically, adolescents with ADHD were more likely to have ED Restricting type and ED Binge-eating/purging type. On the contrary, those with ADHD related behaviors, but do not meet the criteria for diagnosis (inattention, hyperactivity/impulse), were more likely to develop ED Binge-eating/ purging type rather than ED Restricting type (29). Furthermore, adolescents with ADHD were in risk for Loss of control (LOC) eating, comparing adolescents without ADHD, because they appear to have less impulsive control during evaluations and parents' reports (30). Nevertheless, in some studies, there was no correlation between ADHD and ED, or the correlation was not significant (30, 35-38) (Table 1).

ADHD was correlated with binge-eating behaviors (with LOC eating) and with excessive desire and consumption of food (39-41). Also, was considered risk factor for obesity, due to unhealthy food consumption during binge-eating episodes (42). Adolescents and children who ate more fast food and sodas and less fruits and vegetables, were at risk for ADHD, comparing to adolescents and children, who never ate them (43). Comparing to obese children, those who ADHD had the tendency to eat more in the beginning of the meal, while the obese ate more throughout the meal (44) (Table 1).

Considering girls, they had more often ADHD and ED simultaneously than boys (1.05% vs. 0.20%) and specifically Bulimia Nervosa (BN) (22, 26). Moreover, the likelihood of developing ED Binge-eating/purging type in the future, was correlated with ADHD, but not for ED Restricting type. ED in girls were correlated with socialization problems and in boys with impulse and activity problems (27).

Table 1: Correlation of Attention Deficit-Hyperactivity Disorder and Eating Disorders in Adolescents

Author (year)	Country	Study period	Age range	Sample	Outcomes, way/questionnaires they were measured	Main Findings
Biederman et al. (2010) (22)	US	2010	6-18	Girls with ADHD	Structured Clinical Interview for DSM-IV (SCID), Schedule for Affective Disorders and Schizophrenia for School-Age Children Epidemiologic Version (K-SADS-E)	Girls with ADHD were at great risk for ED, especially for BN
Mikami et al. (2010) (23)	US	2010	7-9	Boys and girls with ADHD	Swanson, Nolan, and Pelham Rating Scale, 4th ed. (SNAP)	Youths with ADHD, boys and girls, were at great risk for body image dissatisfaction and BN symptoms in middle adolescence. Youths with ADHD had elevated BMI comparing to those without ADHD
Gau et al. (2010) (35)	Taiwan	2010	11-17	Children and adolescents with ADHD and school-aged children	Kiddie Epidemiologic Version of the Schedule for Affective Disorders and Schizophrenia (Chinese K-SADS-E)	1.6% with ADHD was correlated to ED (n=3)
Malmberg et al. (2011) (55)	Sweden	2011	NR	Adolescents (twins)	Swedish version of Kiddie-SADS Present and Lifetime Version (K-SADS-PL)	ADHD diagnosis was correlated to psychiatric disorders, with NA to be among them
Munsch, Hasenboehler & Meyer (2011) (59)	Switzerland	2011	8-12	Obese children	Strengths and Difficulties Questionnaire	Children with higher scores in inattention consumed more food
Swanson et al. (2011) (53)	US	2011	NR	Adolescents	Composite International Diagnostic Interview (CIDI), Sheehan Disability Scale	ED and disturbed eating was presented more often in adolescents and was correlated to ADHD, psychiatric disorders, dysfunction and suicide
Pauli-Pott et al. (2013) (52)	Germany	2013	8-15	Obese children and adolescents	Questionnaire on Eating and Weight Pattern (QEWP, parent, and adolescent version)	ADHD symptoms were not correlated with disturbed eating
Rastam et al. (2013) (27)	Sweden	2013	9-12	Children and Adolescents	Autism-Tics, ADHD, and other Comorbidities (A-TAC) inventory, Eating problems "(EAT-P)"	To 40 % of children and adolescents with eating problems had ADHD. In girls socialization problems were correlated with eating problems, while in boys with impulse and activity problems
Seitz et al. (2013) (56)	Germany	2013	15-35	Girls	Wender Utah Rating Scale (WURS-K), TAP (Testbatterie zur Aufmerksamkeitsprufung), Eating Disorders Inventory (EDI-II), Structured Interview for Anorexia and Bulimia (SIAB-EX)	There was a correlation of BN and ADHD in patients with BN. Impulsive and inattention symptoms were correlated with more disturbed eating
Kessler et al. (2014) (28)	US	2014	13-17	Children and Adolescents	NR	Boys with ADHD were more likely to have ED than girls (4.9 vs 1.2)
Khalife et al. (2014) (58)	Finland	2014	7-16	Children and Adolescents with ADHD	Obesity Task Force	There was no correlation between ADHD and overeating
Kim et al. (2014) (42)	Korea	2014	5-13	Children and Adolescents	DuPaul ADHD Rating Scale, Korea Youth Risk Behavior Web-based Survey	ADHD had positive effect in eating non healthy food (β = 0.202, P < 0.001) and bulimic episodes (β = 0.31, P < 0.001)
Reinblatt et al. (2014) (37)	US	2014	mean 10.8	Children and Adolescents	C-BEDS scale.	There was statistically significant correlation between ADHD and BED
Steadman & Knouse (2014) (48)	US	2014	18-22	Adolescents and young adults	Barratt Impulsiveness Scale (BIS-11), Barkley Deficits in Executive Functioning, Self-Restraint subscale (BDEFS), the Binge Eating Scale, Barkley Adult ADHD Rating Scale (BAARS-IV)	There was a correlation between ADHD and BED symptoms. Impulse played an important role in the correlation
Pennell et al. (2016) (46)	Canada	2016	9-10	Children	Case series	Two children with ADHD with stimulant use, reported suppression of appetite and avoidance behaviors, leading to growth delay and hospitalization
Egbert et al. (2017) (39)	US	2017	M.O. =10.89	Youths	EDE or child EDE (ChEDE), Child Behavior Checklist/6-18	BED and overeating was correlated with ADHD symptoms
Hilbert et al. (2017) (40)	Switzerland	2017	8-13	Children and Adolescents	Schedule of Affective Disorders and Schizophrenia for School-age Children—Present and Lifetime Version	Children with loss of control (LOC) eating and ADHD had more desire for food
Kurz et al. (2017) (41)	Switzerland	2017	8-13	Children and Adolescents	NR	Children with loss of control (LOC) eating and ADHD had more desire for food, feeling of hunger and enjoying food
Tong, Shi, & Li (2017) (49)	China	2017	NR	Students	Parent-report version of ADHD Rating Scale-IV (ADHDRS-IV), the Child Eating Behaviour Questionnaire (CEBQ) and Children's Eating Attitude Test (ChEAT), The Child Behavior Checklist (CBCL)	ADHD enhanced depression, which enhanced emotional overeating. Occurrence of depression affected disturbed eating, nut not BN symptoms
Yilmaz et al. (2017) (60)	Sweden	2017	8-17	Children and Adolescents	Eating Disorder Inventory-2 Bulimia, Drive for Thinness, and Body Dissatisfaction subscales	Occurrence of Inattention and hyperactivity/ impulse predicted more ED symptoms in late adolescence
Kim et al. (2018) (43)	Korea	2018	M.O= 9.29	Children	Korean version of the ADHD rating scale (K-ARS), food habit questionnaire	Children who ate more, consumed fast food and sodas were at risk of ADHD, while children who ate more fruits and vegetables were not
Bisset, Rinehart, Sciberras (2019) (38)	Australia	2019	14-15	Adolescents	Strengths and Difficulties Questionnaire, Branched Eating Disorders Test.	There was no a difference in occurrence of ED in adolescents with ADHD and without
Bleck, DeBate, & Olivardia (2015) (29)	US	2015	18-27	Adolescents	NR	Those with ADHD presented BED with Binge-eating/purging type. Those with inattention and hyperactivity/impulse more likely to have Binge-eating/purging type behaviors
Gowey et al. (2015) (47)	US	2015	7-12	Obese or overweight children and adolescents	Attention-Deficit/Hyperactivity Disorders (ADHD) Problems scale from the Child Behavior Checklist (CBCL), Children's Eating Attitudes Test (ChEAT), Children's Body Image Scale	Body image dissatisfaction and ADHD symptoms were correlated to disturbed eating. Obese or overweight children and adolescents with ADHD had higher body image dissatisfaction and more behaviors related to food and control of eating
Reinblatt et al. (2015) (30)	US	2015	8-14	Children and Adolescents	Eating Disorder Examination for Children and the Standard Pediatric Eating Episode Interview assessed LOC-ES, DSM-IV Scales of Inattention and/or Hyperactivity, Go/No-Go (GNG) Task and the Behavior Regulation Inventory of Executive Function (BRIEF)	Children with ADHD were more likely to have loss of control (LOC) eating than those without
Rojo-Moreno et al. (2015) (31)	Spain	2015	14-17	Adolescents with ED	Kiddie Schedule for Affective Disorders and Schizophrenia (K-SADS)	31.4% of adolescents with ED had ADHD
Sonneville et al. (2015) (57)	UK	2015	NR	Children	Strengths and Difficulties Questionnaire (SDQ)	Early occurrence of ADHD elevated the risk for BED in adolescence. Hyperactivity/inattention in late childhood was correlated with disturbed eating in early adolescence and BED in middle adolescence
Welch, Ghaderi & Swenne (2015) (32)	Sweden	2015	7-16	Children and Adolescents with ED	NR	The occurrence of ADHD was higher in boys with ED, while in girls with ED was celiac disease and diabetes
Gibbs et al. (2016) (45)	US	2016	18-25	Girls with ADHD	Drug Use Item Questionnaire, Eating Disorder Psychopathology	Disturbed eating or overeating, depressive symptoms and stress were correlated with stimulants abuse. Stimulants abuse was correlated to ED
Halevy-Yosef et al. (2019) (54)	Israel	2019	NR	Adolescents and young adults	Adult ADHD Self-Report (ASRS) and ADHD Rating Scale-IV-Home Version (ADHD-RS) questionnaires, The Eating Disorders Examination-Questionnaire version 6.0 (EDE-Q), The 26-item Eating Attitudes Test-26 (EAT-26), Beck Depression Inventory (BDI),	Patients with BED had more difficulties in ADHD inattention scale than those without
Wentz, Björk, & Dahlgren (2019) (33)	Sweden	2019	5-16	Outpatients	Eating Disorder Examination Questionnaire (EDE-Q) and The Eating Disorder Inventory for children (EDI-C).Diagnoses of ADHD (medical records)	11% of participants had ED and 21% had ADHD. Only two girls had ADHD and ED
Mohammadi et al. (2020) (34)	Iran	2019	6-18	Children and Adolescents	Kiddie schedule for affective disorders and schizophrenia-present and lifetime version (K-SADS-PL)	In children and adolescents with ED, 7,5% had also ADHD
Zhang et al. (2020) (50)	Europe	2020	14-19	Adolescents	Biomarkers	Emotional and conduct problems, including ADHD symptoms were developed before the occurrence of disturbed eating and depressive symptoms

**NR=Non-Referred, ADHD= Attention Deficit-Hyperactivity Disorder, ED=Eating Disorders, BN=Bulimia Nervosa, AN=Anorexia Nervosa, BED=Binge-Eating Disorder*

However, two studies reported that boys were more likely to have ADHD and ED, while girls celiac disease and diabetes with ED (28, 32). Furthermore, the suppression of appetite due to medication in children with ADHD, lead to growth retardation and hospitalization for ED (45, 46) (Table 1).

Boys and girls with ADHD, were at risk for BN, body image dissatisfaction in middle adolescents and increases BMI, comparing to adolescents without ADHD. Impulsiveness as a key feature of ADHD and BN, may be a contributory factor in the comorbidity of those disorders (23). Moreover, body image dissatisfaction and ADHD were linked to more disturbed dieting. Specifically, the merrier the dissatisfaction was, the bigger was the risk of unhealthy way of eating in adolescents with ADHD, following the increase of weight, through overeating (47) (Table 1).

Although impulse plays an important role in comorbidity of ADHD and Binge-Eating Disorder, it is imminent that there are other factors too (48). ADHD affects the emotion and more specific depression, which enhances overeating, and not BN symptoms (49, 50). Adolescents with LOC, reported elevated negative emotions and impulse, comparing to adolescents with ADHD (51). Furthermore, the occurrence of depressive and anxiety symptoms were correlated with emotional overeating and not with ADHD (52) (Table 1).

Correlation between Eating Disorders and Attention Deficit-Hyperactivity Disorder

According to studies, 2.3% of adolescents with Anorexia Nervosa (AN) had ADHD and 8% of adolescents with symptoms that did not meet the criteria for AN, but presented symptoms similar to AN had ADHD (53). Respectively, adolescents with AN Restricting type had more ADHD symptoms with inattention (54). Concerning comorbidity of ADHD in girls, depression, mania, panic attacks and AN were included (55) (Table 2).

Referring to Bulimia Nervosa (BN), 20% of adolescents with BN had also ADHD (53), while ADHD was positively correlated with emotional overeating and BN (49). Moreover, children with ADHD, presented more symptoms of BN in middle adolescence, with girls to be pioneers (23). However, the risk of BN occurrence by 22 years was small (22). Adolescents with BN and ADHD, had more symptoms of impulse and inattention than adolescents with BN only, presenting more disturbed dieting (56) (Table 2).

Data referring to Binge-Eating Disorder (BED) showed that early symptoms of ADHD, along with overeating behaviors, contributed to an increased risk of BED in middle adolescence (57). Adolescents with BED presented difficulties in maintaining their attention comparing to those without (54), while boys with ADHD, were more likely to engage in overeating behaviors than boys without ADHD (38). Furthermore, 12.6% of adolescents with BED had ADHD and 19.1% of adolescents with symptoms similar to BED, but did not meet the criteria for diagnosis, had ADHD (53). The Loss of control (LOC) eating was correlated to BED, as a reaction to negative emotion and impulse (51). Although, there was not significant statistical correlation between ADHD and BED in general (37, 39), in one study ADHD in childhood was correlated to lack of physical activity and not overeating (58) (Table 2).

Correlation between characteristics of Attention Deficit-Hyperactivity Disorder and Eating Disorders

Hyperactivity, impulse and inattention were correlated with overeating as well as food control (47). Respectively, impulse and inattention were correlated with elevated risk of disturbed eating behaviors (56). In girls, impulse was predictive factor in occurrence of BN (23) and the main factor for food consumption in adolescents with ADHD, as reported by parents (44). However, in a 2014 study, none of the impulse measurements were significant statistically correlated with ADHD and BED symptoms (48). The severity of ED, could be further analyzed through inattention rather than impulse or hyperactivity (56). In particular, adolescents with inattention consume more food (59) (Table 3).

However, the coexistence of more than one feature of ADHD could provide more results in terms of correlation with ED. Specifically, hyperactivity in combination with inattention in childhood, could be a predictive factor for BED in middle adolescence, though excessive desire for food (57). Furthermore, adolescents with BED reported more hyperactivity/impulse symptoms (54), while those symptoms could predict the elevate risk of ED occurrence in late adolescence (60) (Table 3).

Table 2: Correlation between Eating Disorders and Attention Deficit-Hyperactivity Disorder

Author (year)	Anorexia Nervosa	Bulimia Nervosa	Binge-Eating Disorder
Biederman et al. (2010) (22)	NR	Girls with ADHD had greater risk for BN	NR
Mikami et al. (2010) (23)	NR	Youths with ADHD had greater risk for BN symptoms in middle adolescence, especially girls	NR
Malmberg et al. (2011) (55)	ADHD diagnosis was correlated with psychiatric disorders, among them was AN in girls	NR	NR
Swanson et al. (2011) (53)	2.3% of adolescents with AN had ADHD και 8% of adolescents with sub-clinical AN had ADHD	20% of adolescents with BN had ADHD	12.6% of adolescents with BED had ADHD, while 19.1% of adolescents with sub-clinical BED had ADHD
Hartmann, Rief & Hilbert (2013) (51)	NR	Higher levels of negative emotions and impulse were occurred in loss of control eating of BN	NR
Seitz et al. (2013) (56)	NR	Patients with BN and ADHD were more impulsive and inattentive than those with BN only. They also presented more disturbed eating than those without ADHD	NR
Reinblatt et al. (2014) (37)	NR	NR	The correlation between ADHD and BED was statistically significant (OR 16.1, p<.001)
Egbert et al. (2017) (39)	NR	NR	ADHD symptoms were statistically significant correlated with BED (χ^2= 16.61, p < 0.001)
Tong, Shi & Li. (2017) (49)	NR	ADHD had positive effect in emotional overeating and BN symptoms	NR
Bisset, Rinehart, Sciberras (2019) (38)	NR	NR	Boys with ADHD were more likely to have BED than boys without (OR: 9.4; 95% CI: 1.7–52.8; p = .01).
Halevy-Yosef et al. (2019) (54)	Patients with AN (Binge-eating/purging type) had more ADHD symptoms and inattention	NR	Patients with BED had more ADHD symptoms than those without

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Table 3: Correlation between characteristics of Attention Deficit-Hyperactivity Disorder and Eating Disorders

Author (year)	ADHD-Hyperactivity	ADHD-Impulse	ADHD-Inattention	Hyperactivity/Inattention	Hyperactivity/Impulse
Mikami et al. (2010) (19)	NR	Impulse in childhood could predict the occurrence of BN symptoms in girls	NR	NR	NR
Munsch, Hasenboehler & Meyer (2011) (59)	NR	NR	Children with higher scores in inattention consumed more food	NR	NR
Wilhelm et al. (2011) (44)	NR	Desire for fast food was described through impulse in children with ADHD	NR	NR	NR
Seitz et al. (2013) (56)	NR	NR	The severity of disturbed eating could be described through inattention	NR	NR
Steadman, & Knouse (2014) (48)	NR	Impulse played a significant role in correlation between ADHD and BED	NR	NR	NR
Gowey et al. (2015) (47)	NR	NR	NR	Hyperactivity/Inattention was correlated with food preoccupation and eating control	Hyperactivity/Impulse was correlated with food preoccupation and eating control
Sonneville et al. (2015) (57)	NR	NR	NR	Hyperactivity/Inattention I late childhood was correlated with disturbed eating in early adolescence and BED in middle adolescence	NR
Halevy-Yosef et al. (2019) (54)	NR	NR	NR	NR	Patients with overeating presented more Hyperactivity/ Impulse symptoms

**NR=Non-Referred, ADHD= Attention Deficit-Hyperactivity Disorder, ED=Eating Disorders, BN=Bulimia Nervosa, AN=Anorexia Nervosa, BED=Binge-Eating Disorder*

Discussion

According to the results, in many studies a correlation between ADHD and ED in adolescents was noted (22-34), following the current view concerning ADHD and ED (3, 4). Only few were the studies that did not present any correlation, due to mainly small sample (33, 35-38). Concerning ED, ADHD was correlated with BN and BED (29, 30, 37, 39, 49, 53, 57). Most of the studies indicated a stronger association of BED with ADHD (37, 39). Adolescents with BED had more often inattention than those without BED (54), while boys with ADHD were more likely to have Binge-eating/purging type episodes (29, 38). Due to lack of controlling impulse, adolescents with ADHD, presented loss of control (LOC) eating more often, which was correlated to BED (30, 51). Data from other studies, indicate that people with ED and ADHD, had lower self-esteem and impulse, simultaneously with Binge-eating/purging type (61, 62).

A significant percentage of adolescents with BN had also ADHD (49, 53), presenting more impulsive and inattention symptoms from adolescents with BN only, and more disturbed dieting (56). Since ADHD was considered a self-regulated disorder, with reduced ability of controlling impulse, it is consequent that BN, which has the same feature, to appear (19-21, 63). There are not many data, which correlate ADHD with AN, mostly when people with AN had Binge-eating/purging type behaviors (54). More specifically, adolescents with AN Binge-eating/purging type indicated more ADHD symptoms, with elevated inattention (54), and girls to present ADHD, AN, depression, mania and panic attacks simultaneously (55).

One of the main characteristics of ADHD, which was correlated to disturbed food consumption, was impulse (23, 56). However, data has also connected overeating with inattention, especially in adolescents (47, 59). Furthermore, the characteristics of ADHD did not occur alone, and the coexistence of more than one could provide more information about the correlation with ED. Inattention/ impulsive symptoms presented more often in adolescents with BED (54), while those symptoms could predict the emergence of ED in late adolescence (60). Moreover, the combination of hyperactivity and inattention in childhood increased the risk of elevated food desire and BED in middle adolescence (57).

Although ADHD is more often in boys (8, 64), girls had more often ADHD and ED, mostly BN (22, 26). The main explanation is that girls were at greater risk for ED, especially in adolescence (from 12 years old) (1, 53, 65, 66). Respectively, girls with socialization problems and boys with impulsiveness and activity problems had ADHD more often (27). One of contributory factor of delinquent behavior was impulse, with most adolescents with ADHD to engage in high risk behaviors, including disturbed eating (67).

ADHD and ED affect and are affected by emotion, leading to depressive symptoms especially in adolescents. Negative emotions were linked to disturbed dieting, emotional overeating and body image dissatisfaction (14, 15, 16, 47, 49, 50). Overeating in adolescents with ADHD, was considered a way of controlling the environment, which was characterized by frustration, inattention and lack of organization (16). Exercise was a protective factor, enhancing mentally, physically and emotionally the adolescents, and limiting their negative emotions (68, 69). On the contrary, adolescents who did not work out or spent many hours in front of screens (TV, laptop, smartphones etc.) had more inattention symptoms (69). Family plays a significant role in ADHD and ED, mostly by removing high-calorie foods from home, reinforcing the family table and supporting the treatment, through education (70, 71).

Moving away from the Mediterranean diet and adopting a western diet was associated with an increased risk of developing ADHD, where children and adolescents ate more fast food and sodas than vegetables and fruits (43, 72, 73). The lack of meal preparation, along with impulse and inattention, were correlated with disturbed eating in the past, which could lead to elevated weight and disorders related to food (61, 62). Furthermore, the Loss of control (LOC) eating, through impulse and binge-eating, set children and adolescents in greater risk of obesity in childhood (7, 39, 40, 56). In the past, higher sugar consumption was considered the main factor of hyperactivity and inattention, however the data confirm that connection were limited (74, 75). Moreover, the medication in children with ADHD, suppressed their appetite, leading to a possible occurrence of ED or hospitalization (45, 46).

Although this review presented significant data concerning the correlation between ADHD and ED in adolescents, there were some limitations. Firstly, these disorders are affected from the environment that adolescents live, not only in their occurrence but also in enhancement, influence or improvement. The

psychotherapeutic adaption, which will target not only the person involved but also their family, friends, school etc. could provide positive results through time.

Moreover, due to developmental background of adolescence, some disorders are not fully expressed and adolescents exhibit behaviors that are similar to them but do not meet the diagnostic criteria. In that way, some behaviors were not considered disturbed and may go unnoticed. It is important to be fully established in order to alert both family and scientific environment, although these behaviors cause dysfunction and reduced socialization in adolescents. As a results, in some studies, adolescents are in risk of exhibit some behaviors concerning ADHD and ED, and to be considered as normal. Nevertheless, proper information and awareness, both of parents / carers and scientific and school environment about the disorders and the relationship they develop between them, gives a sense of hope for the prevention and treatment of both ADHD, as well as ED in adolescents more effectively.

Conclusions

The conclusions of the review could be used to enhance more effective treatments for ADHD and ED in adolescents and more specifically in the Greek population, describing in detail the possible relationship between them. Those information could play a significant role in strengthen adolescents with ADHD and ED, in corporation with parents and carriers. Finally, the establishment of preventive and treatment programs for both ADHD and ED could be an inhibitor of occurrence of those disorders or other risk factors related to those in adult life. Although, data provided by this review are important, more detailed research should be implemented in the future.

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