A Review of Multimodal Treatment Study of Children with Attention Deficit Hyperactivity Disorder and Focused Discussion of Anxiety Comorbidity in ADHD

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***Abstract*—This review examines the Multimodal Treatment Study of Children with Attention Deficit Hyperactivity Disorder (ADHD), focusing on longitudinal treatment effects of medication and behavioural treatments for children with ADHD, and delves into the often-overlooked aspect of anxiety comorbidity. Initiated in the 1990s, the study spans over 16 years, documenting various treatment effects on symptom severity and social functions of children with ADHD. The findings suggest that while medication is generally more effective for ADHD, current treatments do not fully normalize patients. The paper emphasizes ADHD as a developmental disorder causing ongoing executive function impairment and emotional burdens for patients and their families. Notably, it addresses ADHD's multiple comorbidities, with a central focus on anxiety comorbidity, which contributes to behavioural and academic challenges and can impair functioning into adulthood. The review combs the main findings from the MTA study and its follow-ups based on time sequence, offering insights into optimizing ADHD treatments. The interplay of ADHD and anxiety symptoms and their joint impact on treatment effectiveness are critically analyzed. This paper not only sheds light on the complexities of treating ADHD, particularly in the presence of anxiety comorbidity but also highlights the need for more focused research in this area to develop more effective, tailored treatment strategies.**

***Keywords*—attention deficit hyperactivity disorder, multimodal treatment study, anxiety, comorbidity, psychostimulant, behavioural treatment**

I. Introduction

Attention Deficit Hyperactivity Disorder (ADHD) is a developmental disorder which leads to disrupted attention and impulsivity in children [1]. The symptoms of ADHD have been known for over 200 years since it was first documented by Weikard in the 1700s. During the early 20th century, ADHD was regarded as a peculiar behavioural trait or lack of moral control until it was documented as Attention Deficit Disorder (ADD) in DSM-III and became ADHD in the later version of DSM-III. Currently, in DSM-V, ADHD has a specified section which provides its diagnosis criteria for reference by clinicians. From a trait to be regarded as a mental disorder affecting both children and adults, numerous research have been conducted to study the aetiology and treatment of ADHD, to alleviate the impairment and burden it causes on the patients and their families.

As a childhood disorder, ADHD has symptoms that normally appear before seven years old with a calculated prevalence among school-age kids of about 3%–5% [2]. Some of the symptoms can be alleviated by growth and ageing, but ADHD can also be prolonged into adulthood and therefore causes impaired education and career [1]. Primary symptoms of ADHD cover inattention, hyperactivity and impulsivity. Hence, ADHD was further categorized into ADHD-I (inattention), ADHD-HI (hyperactive-impulsive) and ADHD-C (combined). With these symptoms, kids are often described by teachers and parents as disruptive, lack of control and fidgety, which can lead them to be rejected in schools and social settings.

Due to the nature of ADHD and related stress caused by the environment, children with ADHD are often found with comorbidities including internalizing disorders (e.g., anxiety) and externalizing disorders (e.g., conduct disorder and oppositional defiant disorder [1]. Unlike CD and ODD which were extensively studied, anxiety comorbidity in ADHD is a less popular research topic though it affects 25% to 33% of ADHD patients [3]. ADHD patients with anxiety disorder are heavily worried and lack self-confidence, they tend to seek reassurance from adults and can develop more than one type of anxiety disorder in the course. The anxiety symptoms often bring children more impairment in life and can lead to worse treatment responses. Therefore, this review will have a central focus on how symptoms of ADHD and anxiety overlap with one another and the impairment caused by this comorbidity.

To alleviate the symptoms, the current treatment of ADHD has a wide range of approaches. There are psychostimulants like Ritalin that can be used to reduce ADHD symptoms. Behavioural therapies and cognitive training are also popular to help children and families

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with ADHD cope with the symptoms and impairments. In order to study the long-term benefit of these treatments, the multimodal treatment study of children with ADHD (MTA) clinical trial was initiated in 1992 [2]. The original MTA study took place in medical institutions in America and Canada, with 14 months of cooperative work to systematically compare behavioural and medication treatment in ADHD children. Numerous follow-up studies were conducted in the decades after the MTA study and yielded valuable insights into the treatments and progression of ADHD.

The MTA study and its follow-ups were the first to study the developmental effect and treatment responses in the same group of ADHD children. To better understand current treatments and mechanisms of ADHD, the MTA study and its major follow-up studies will be reviewed. Research methods and results will be laid out in time sequence to comb through the large amount of findings gained from these studies. As an extension to this review, anxiety comorbidity will be centrally discussed to call for the development of future specialized treatments for this common but rarely discussed comorbidity.

II. The MTA Study and Follow-up Studies

A. The MTA Study (1999a and 1999b)

During the late 1980s, there was a trend against prescribing Ritalin (methylphenidate) since Ritalin was described as "causing children to be violent and suicidal" [1]. Research was urgently required to investigate the long-term effect of psychostimulants and to reassure the patients. It was during this period that the MTA Cooperative Group was founded and the clinical trials began. The first MTA study aimed to compare long-term medication, behavioural treatment and their combination to evaluate their benefits [2]. 579 ADHD children between ages 7.7 to 9 were recruited to participate in this 14-month randomized treatment investigation [2]. The ADHD symptoms and impairment of children were assessed using parent-, teacher-, and child-rating scales. Four treatment groups were set: medication, behavioural treatment, combination treatment and community care. The medication used was psychostimulant which was carefully titrated with a dosage higher than usual. All groups were carefully monitored with the treatments scheduled except for the community care group which only received basic community treatments. After 14 months of treatments, all four groups showed different levels of improvement compared to baseline data [2]. Overall, combined treatment and medication yielded significantly better ADHD symptom reduction than behavioural treatment and community care. On other properties like internalizing disorder and aggression, combined treatment yielded better results than behavioural treatment and community care while simple medication treatment did not. Thus, it was concluded in this first research that the titrated medication treatment could provide better outcomes for ADHD children than behavioural treatment and community care.

After the first publication, a random-effect regression analysis was conducted for the mediators and moderators to be added to the factor analysis [4]. This second study was a supplement to the first study on statistical findings. With random-effect regression, the effect that each involved factor had on the treatment outcome can be determined to aid the interpretation of prior results. The moderators included factors like gender, comorbidities and public assistance while the mediator was attendance or acceptance of the treatments. After the regression analysis, a few note-worthy results came out. For ADHD children with anxiety comorbidity, behavioural treatment was significantly more effective than community care and was no longer different from medication and combined treatment. Decreased parent-child interaction and increased social skills after taking medication were observed in families accepting public assistance [4]. With average attendance and acceptance, no difference occurred overall but low acceptance and attendance compromised the treatment effect in the medication group.

B. The 2–3 Years Follow-up Study of MTA

After the first MTA study, the public's view towards psychostimulants seemed to change and medication was being accepted by the majority of people [1]. Meanwhile, criticisms appeared suggesting that clinicians should be more cautious with medication treatment for ADHD since its effectiveness may not apply to every individual. 10 months after the 14-month initial MTA trial, the first follow-up study was conducted to verify the effect of treatments [5]. Still, it was concluded that combined treatment and medication had significantly stronger effects on treating ADHD and ODD symptoms despite a small decrease in the effect differences.

2 years after the initial treatment ended, a 3-year follow-up study was published which investigated the symptoms and functions of the MTA children [6]. Generally, children in medication and combined treatment groups had decreased medication use and children in behavioural groups increased their medication use. The main finding changed massively in this study where the significant difference between medication groups and non-medicated groups was no longer presented. Moreover, the initial moderators like comorbidity and public assistance no longer affected the result. The Cooperative Group was surprised by this follow-up result and suggested the unexpected result might further change when the children enter adolescence.

Within the same year, another study regarding the influence psychostimulants had on growth rates was published by Swanson *et al.* [7]. ADHD children were studied based on their medication status and were divided into consistently/inconsistently medicated, newly medicated and non-medicated groups. As a result, the newly medicated group of children showed a significant medication-related growth rate decrease of 2 cm in height and 2.7 kg in weight. The finding suggests that the initiation of medication might take more than 36 months to decrease the ADHD symptoms but might be accompanied by compromised growth in ADHD children [7]. This publication brought more careful

research and prescription of psychostimulants, marking the end of 3-year follow-up on the MTA study.

Overall, the results of the follow-up studies in this section showed that the different treatment responses observed in 1999 were no longer present [6]. Also, concerns were raised during this period regarding the side effects of psychostimulants [7].

C. The 8–16 Years Follow-up Studies of MTA

A major difference of 8–16 years of follow-up studies is that the Cooperative Group emphasized comparisons with a healthy control group [8]. By 24 months after the initial MTA study, 289 children from schools of ADHD children were selected to form the Local Normative Comparison Group (LNCG) that matched the same grade and sex of the ADHD children. Adding LNCG enabled the researchers to compare the development and achievements of ADHD children in the MTA study with normal children to assess the long-term effect of the treatments.

6–8 years after the initial MTA study, the ADHD children were re-assessed to test their ADHD symptoms and development in their adolescence [8]. By then, their medication rate had decreased by 62% compared with the initial study. Same with the 3-year follow-up, the treatment type in the 14-month trial did not affect the development of ADHD children. What seemed to be prognostic was the initial symptom intensity of the children. For children who showed better response to the first treatment and maintained the effect, they showed fewer symptoms in the follow-up study than the children whose symptoms had less improvement in the initial treatment. Besides, these children with better treatment responses were found with more sociodemographic and behavioural advantages like better parental care or social functioning. Overall, all groups of ADHD children showed a significant decrease in symptoms and impairment compared to their status prior to treatment. However, it was also concluded that the LNCG had significantly better functioning in all tests conducted, suggesting that the treatment was not able to normalize the ADHD children.

After the 8-year follow-up, children from the MTA study started to enter their adulthoods. Another set of data was collected 12, 14, and 16 years after the initial assessment to test the symptoms, education, occupation and behaviour of the ADHD children [9]. The ADHD children were divided into different groups based on the persistence of their symptoms. The children were grouped as desistent if their ADHD symptoms were in remission and were grouped as persistent if they experienced continued ADHD symptoms. Multiple developmental features were analyzed in this study including educational outcome, occupation, sexual behaviour, emotional outcome and other legal aspects. Regarding education level, job failure and income, public assistance and risky sexual behaviours, LNCG was significantly better than ADHD groups while ADHD desistent group was significantly better than the persistent group. For emotional liabilities and substance use, LNCG did not differ from the desistent group but the two groups both did significantly better than the persistent group. Meanwhile, the three groups did not differ in jail time, alcohol use, job count and death (though the general ADHD group had more death counts than LNCG). Thus, it was concluded that treatments of different types could not bring ADHD children to fully normalized adulthood and continuation of ADHD symptoms into adulthood (persistence) can lead to multiple severe impairments in different social and occupational areas.

Within the same year of publication by Hechtman *et al.* [9], another follow-up study was published by Roy *et al.* [10] discussing the childhood factors of MTA children that affected the persistence of their symptoms. In this study, researchers looked back into data collected in the 1990s to investigate the formation of ADHD symptoms persistence. Through regression analysis, it was found that initial symptom severity, comorbidities and parental mental health were the most significant childhood factors that were related to ADHD symptom persistence [10]. Within these factors, initial symptom severity did not consistently affect symptom persistence [10]. Psychopathology of parents, especially the mother, was able to predict symptom persistence of children. It was found that ADHD children with persistent symptoms are more likely to have a family history of anxiety. As for comorbidities, ADHD children with ODD, CD and anxiety were more likely to become symptoms persistent in their adulthood. Also, ADHD girls with symptom persistence were more likely to have mood and anxiety issues in their childhood and adolescence than boys. Other factors of interest like IQ, parental education, socioeconomic status and parent-child interaction did not show to predict ADHD symptom persistence. Overall, the significance of monitoring comorbidities of ADHD children was amplified by showing the prolonged impairment caused in this study.

With the study done by Roy *et al.* [10], the follow-up studies of MTA were brought to a temporary conclusion while researchers continued to investigate the treatment effects of ADHD. Currently, no treatment for ADHD can fully normalize the patients and diminish impairment caused by the symptoms. Focus should be put on improving the administration of current treatments and monitoring treatment responses of different individuals. Among all factors affecting the treatment response of ADHD, comorbidity could bring more prolonged and consistent impairment to the patients and cause a catastrophic impact on the lifespan of the children. Anxiety comorbidity of ADHD will be emphatically discussed in the following section to gain a fuller picture of this common comorbidity.

III. Anxiety Comorbidity of ADHD and the Impact on Treatments

ADHD is a disorder with a wide range of comorbidities. In fact, “pure” ADHD without any comorbidities only occupy a small percentage of all diagnoses [11]. Anxiety disorders belong to the internalizing disorder within the comorbidities of ADHD. As an externalizing disorder, ADHD is more often

studied with other externalizing comorbidities like ODD and CD. However, all comorbidities can impair emotional functioning and lead to internalizing symptoms [3]. Hence, it is crucial to study emotional functioning exclusively in the dope of ADHD.

In the MTA studies, the internalizing disorder was a major moderator in analyzing the treatment responses. Even though anxiety comorbid with ADHD was less studied in the 1990s, it was still identified as a major contributor to the impairment [2]. In this section, the nature of anxiety comorbidity will be reviewed with a discussion of its impact on the treatments.

A. Prevalence and Symptomatology

Internalizing disorders occupy 13%–51% of comorbidity in ADHD while the prevalence of anxiety disorders is 25% in the general clinical samples [11]. In multiple other studies, the concluded rate of this comorbidity ranges from 9% to 43%, suggesting variability in people's understanding towards ADHD with anxiety [3]. While this prevalence is high, it is found that children with ADHD can have multiple types of anxiety disorders at the same time. Between the subtypes of ADHD, studies generally agreed that the prevalence of anxiety disorders does not vary between subtypes. However, it was briefly mentioned that females with ADHD-I are more likely to have separation anxiety while females with ADHD-C are more prone to generalized anxiety [12]. This result from a single study needs to be further verified.

The presence of comorbidity can be assessed by clinical testing. Child-rating and parent-rating scales like the Multidimensional Anxiety Scale for Children are often used to rate the symptom severity [2]. Generally, ADHD children with anxiety comorbidity are heavily worried [3]. They are constantly bothered by their performance at school, their social skills and their appearance. During clinical assessments, they frequently seek reassurance of their performance from the clinicians or researchers. These children are nervous and neophobic, they tend to avoid new activities and risk-taking behaviours. The symptoms also include irritability, sleep disturbance and inattention, which are highly overlapping with ADHD symptoms [11]. To distinguish ADHD and ADHD with comorbidity, it is crucial to note the psychosocial impairment in the children. ADHD children with anxiety are shown with impaired academic performance in tasks involving working memory and demanding processing [3]. Also, they appear to have very low self-esteem which can be tested using self-report.

The children also present major ADHD symptoms and these symptoms can interact with their anxiety in different ways. In the MTA study, it was found that ADHD children with anxiety were more inattentive than impulsive, compared with other ADHD children [2]. Controversially, Tannock notes that children with anxiety were less inattentive, and less overactive and were found with fewer behavioural problems [3]. When elaborating on the reason for this clinical manifestation difference, she also suggested that this clinical representation might be due to that these children were observed in a new environment and this caused them to be more alert than usual. Hence, there are also teachers reporting that ADHD children with mood disorders like anxiety are more hyperactive and aggressive than children with ADHD alone. Thus, ADHD children with anxiety comorbidity share similar symptoms like overly worried but these symptoms can interact with their ADHD symptoms in very different ways. Generally, since anxiety is an internalizing disorder, it is possible that the comorbidity can suppress some manifestations of ADHD as an externalizing disorder. However, this suppression might also cause accumulated stress in these ADHD children and lead to more severe emotional liability in the course of the disorder. In the end, it is hard to summarize a disorder's symptomatology due to individual differences and it is even harder in disorders interacting with comorbidities.

B. Aetiology of Comorbidity

In the early 20th century, ADHD was seen as an environmental-caused disease originating from brain trauma [1]. Although this debate was soon proved invalid, it still led to the discussion of the aetiology of ADHD. Nowadays, from the nurture side of the debate, ADHD comorbid with anxiety was often seen as caused by environmental and prenatal stress. In the research done by Bergh *et al.* [13], it was shown that maternal anxiety during pregnancy can increase the risk of developing ADHD in the fetus. Also, maternal stress was shown to lead to emotional and cognitive impairment in the offspring. Thus, antenatal maternal stress is a potential cause of the combination of ADHD and anxiety. Another popular approach is that the accumulating stress ADHD children experience in school and social settings can trigger the symptoms of anxiety disorder [3]. Moreover, childhood maternal anxiety, maternal over-protection (paternal role not so profound) and negative parenting styles can also exacerbate anxiety in ADHD children. Hence, it was concluded that parent training programs should be applied for ADHD children with presenting anxiety to be raised with independence and acceptance towards risks.

As for the nature approach, the genetic evidence of ADHD with anxiety has been extensively studied in recent years. Family studies have shown that the hereditability for ADHD is 70% to 80% and for anxiety is about 35%, which suggests that the comorbidity of these two disorders is likely to be associated with genetic vulnerability [1–3]. Neurobiological factors also contribute to this comorbidity. Levy [14] proposed that comorbid anxiety can originate from 1: The impairment in the mesolimbic dopaminergic system causes impaired reinforcement and impulsivity which can lead to ADHD symptoms and 2: Abnormal processing of fear response in the prefrontal cortical area from the amygdala can cause anxiety. Thus, when the two abnormalities in neurotransmitter omission are present at the same time, ADHD with anxiety can be seen as a consequence of neurobiological impairment. This finding provides support for the psychostimulant and antidepressant treatment for ADHD comorbid with anxiety since the

dopaminergic and amygdala abnormality can be alleviated by neuropharmacological approaches [3].

C. Treatment and Clinical Management

Treatment of ADHD is the main topic discussed in the MTA studies. Although anxiety comorbidity is a less popular field in the research of ADHD, it was still identified as an important moderator in the analyses of treatment responses [2]. In the 1999b study of MTA study, children with anxiety comorbidity were shown to react very differently to ADHD treatments. In the overall result, behavioural treatment yielded significantly less response than medication and combined treatment. However, this difference no longer presented in ADHD children with anxiety, they responded better to behavioural treatments than children with ADHD alone. To better understand this result from the MTA studies, different treatments of ADHD with anxiety need to be understood first.

The most commonly used treatment for ADHD with anxiety is still psychostimulants [3]. It usually works by blocking dopamine reuptake through the dopamine transporter to increase dopamine signals in the brain. Overall, medication like Ritalin can effectively decrease the behavioural symptoms of ADHD regardless of the comorbid anxiety [15]. In earlier reports, it was found that ADHD patients with anxiety can experience more side effects compared to non-anxious patients [16]. However, contradictory findings were gained which suggested that psychostimulants can improve internalizing symptoms with no observations of increased side effects. So far, there is no research showing that anxiety comorbidity can be exacerbated by psychostimulants while the anxiety symptoms also cannot be effectively relieved by psychostimulants.

Except for psychostimulants, there have been studies using atomoxetine (norepinephrine reuptake inhibitor) in treating ADHD with anxiety patients who did not respond well to psychostimulants [17]. Patients generally experienced alleviated ADHD and internalizing symptoms afterwards but alleviated depression symptoms were more profound than anxiety. Also, studies combined atomoxetine or psychostimulants with SSRIs to further alleviate depression or anxiety symptoms. However, these studies found no significant difference between this combination treatment and monotherapy of psychostimulants or atomoxetine [15–17]. In MTA studies, children with comorbid ADHD and anxiety in medication and combined groups were given carefully titrated psychostimulants [2]. The findings aligned with the current findings that psychostimulants can reduce ADHD symptoms while internalizing symptoms were not profoundly reduced.

Besides medication, behavioural treatments of different kinds are also necessary to relieve anxiety symptoms in comorbid patients [3]. In the MTA studies, it was one of the main findings that comorbid ADHD and anxiety patients showed better treatment responses to behavioural treatment like summer programs and school-based interventions than children with ADHD alone. The treatment response towards behavioural monotherapy was not different from medications in the comorbid children with doubled treatment-related effect sizes [18]. Moreover, parents-reported disruptive behaviours, anxiety and inattention also decreased after psychosocial intervention and the children showed fewer conduct problems. Overall, the findings agree with MTA studies that children with comorbid ADHD and anxiety showed more improvement with combined treatment and behavioural monotherapy than with medication treatment alone.

However, the behavioural treatment used in the MTA studies did not include any kind of therapy like Cognitive-Behavioural Therapy (CBT), which can lead to gaps in research regarding the effect of all behavioural interventions [2]. In a study done by Safren *et al.* [19], it was shown that adults with comorbid ADHD and anxiety showed significant improvement after being given anxiety-specific CBT with their ongoing medication. Moreover, this combination of CBT and medication yielded better responses than medication alone. However, there is no research so far that tests monotherapy of CBT or other psychotherapy and the effect of CBT has never been tested on ADHD children or adolescents [3]. Overall, it has been found that behavioural treatments can most effectively alleviate ADHD and anxiety symptoms in comorbid patients. Due to the trend of them being heavily worried, behavioural treatments might provide them with the reassurance that they seek in daily life.

Overall, the treatment response for this comorbidity is significantly different from other groups, leaving comorbid ADHD and anxiety with more gaps in research. So far, we understand that the initial treatment response might be prognostic for future impairments [8]. Hence, developing thorough anxiety-specific treatment plans is crucial to alleviate the lifelong impairment caused by these comorbid ADHD children from the very beginning of the disease course.

IV. Discussion

From reviewing the current literature on MTA studies and ADHD with comorbid anxiety, we get to map out the long-term development of ADHD children, understand moderators in treatment response, and focus on the nature of comorbid anxiety. The MTA studies provided us with a 16-year longitudinal research which covered the childhood, adolescence and adulthood of 579 ADHD children [9]. This was the first study that focused on the disease course and treatment response of ADHD in the history of mental illnesses research. Findings from MTA studies provided insight into numerous research on the mechanism of ADHD, symptomatology and treatments. It is also the reason why comorbid ADHD and anxiety are discussed in this review. Before the MTA studies, researchers mainly focused on the externalizing comorbidities of ADHD and internalizing disorders, especially anxiety, which were often only studied peripherally in research. The MTA studies brought anxiety comorbidity into the spotlight by emphasizing its unique impact on treatment response and its psychosocial impact on the life course of ADHD children [2, 9]. In

current clinical assessments, anxiety disorder will be closely screened in ADHD children to adjust their treatments [3]. However, the specialized treatment for this comorbidity is yet to be found. In this section, two aspects will be discussed. The research gaps brought by MTA studies and questions about current comorbid anxiety research will be proposed. In the end, areas and topics for future ADHD treatment studies will be suggested.

As the first longitudinal study on ADHD treatments, MTA studies brought multiple gaps and questions to us. One major argument around MTA studies is on the long-term treatment response. It was mentioned that three years after the initial study, there was no longer a significant difference between each treatment type, suggesting diminished specific treatment response that was found in the 1999 studies [6]. This finding was astonishing to the researchers back then and its mechanism is still unclear. One possible explanation was that after 14 months of the initial study, the treatment of participating children was no longer closely monitored and thus the initial response diminished over time. However, it is still concerning that without proper regulation, any treatment response might diminish over time. If optimal treatment response can only be achieved by constant and rigorous monitoring, it can cause a severe burden to the patients and lead to less available clinical resources for all patients. Also, despite great improvement in symptoms after treatments, these ADHD children were never normalized, which means they still present more impairment compared to the healthy control group [8]. Even with great effort by researchers, ADHD patients still suffer from different degrees of impairment and require carefully titrated treatments to sustain their daily lives. There is still a long way to go in developing efficient and manageable treatments for ADHD patients. Another gap in MTA studies is in the application of results to cultural and social fields. In the studies, there were children from ethnic groups other than Caucasian but the effects of ethnicity were not investigated. In the U.S., it was found that Caucasian children have a significantly higher rate of ADHD diagnosis and more medication prescriptions than African-American and Latino children [20]. Thus, the treatment and diagnosis can be massively affected by patients' ethnic groups and sociodemographic factors which were not mentioned in the treatment response studied in MTA studies. Since ADHD is an externalizing disorder that can massively change family and social dynamics around the patient, extra focus needs to be put on investigating the cultural and social impact of ADHD to treat not only the symptoms but also its impairment.

Besides the discussion on MTA studies themselves, research gaps can also be found under the subject of comorbid ADHD and anxiety disorders. The first important concern is simply that there are numerous controversial findings in this field. One of them was mentioned above about how the interaction between ADHD and anxiety symptoms was unclear. There is still no certain answer to whether anxiety aggregates or suppresses inattention and impulsivity in ADHD [3]. On the treatment side, researchers have been concerned by the contradictory findings on whether psychostimulants can trigger anxiety symptoms in ADHD children and no conclusion has been met so far [15, 16]. More generally, since the comorbidity system for ADHD is complex and often involves overlaps between disorders, there are no official diagnostic criteria for determining whether the patient has comorbid anxiety or two distinct disorders. Due to the ambiguity in diagnosis, it is even harder to assess treatments for comorbid patients. Even though behavioural treatments yielded significant improvement, it is seldom used as monotherapy in real life and different combinations of treatment are present for clinicians to assess [3, 4]. Treatments are often tested in a trial-and-error style on different individuals to achieve the most effective treatment response since the mechanism is unclear and neurodiversity is profound in this comorbidity [3]. However, this drawback is common for many other mental illnesses since psychopathology is a field in active development. In many countries and areas, behavioural treatments are hard to access for most patients since they require consistently visiting clinical facilities. To ensure the attendance of behavioural treatments, the procedure can be highly time- and economically consuming. This nature of behavioural treatments can cause many patients to drop out of treatment or be left untreated, aggravating their psychosocial impairment.

For future research on comorbid ADHD and anxiety, focus shall be put on conducting more long-term studies in monitoring treatment responses in different individuals. One important aspect for future studies is to gain neurophysiological data to aid the comprehension of current statistical findings. Due to technical development, neural imaging data was not included in MTA studies. Observing the structural and functional changes of ADHD brains should also bring important insight to treatment research. Hence, imaging techniques like EEG and fMRI should be used in future studies to monitor long-term neural and brain structural changes in ADHD patients. Moreover, the combination of treatments is more common in current clinical interventions [19]. Future studies should focus more on different combinations of treatment like different types of medication combined with different therapy styles. Even though treatment combination effects are different for each individual, they can still be categorized and compared in a between-group manner to visualize differences in long-term effects longitudinally. When assessing treatments, therapies and behavioural treatments should be made available for comorbid patients to access since they have been proven to be effective in most research. For instance, more clinicians and social workers can be trained to acquire basic psychotherapy skills to give behavioural treatments in more communities. More importantly, the awareness of seeking effective treatments needs to be raised to the general public. In many areas, ADHD is still seen as a behavioural trait and anxiety in children is constantly devalued by parents [1]. If awareness can be raised for

parents and patients to understand this disorder, more interventions can be assessed before any prolonged impairments settle on the patients. As a developmental disorder, optimal intervention can improve the overall quality throughout the life courses of ADHD children and can relieve numerous families from the burden of mental illness.

CONFLICT OF INTEREST

The author declares no conflict of interest.

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