

Pathophysiology and treatment of hoarding disorder

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Hoarding disorder (HD) is a newly listed disease in the new category of Obsessive–Compulsive and Related Disorders in the DSM-5. Patients with HD find it difficult to discard possessions regardless of their actual value and to organize those things. As a result, the possessions overflow the living space and hinder living functions. Though the hoarding symptom had been regarded as a subtype of obsessive–compulsive disorder (OCD) to date, recent studies have revealed many differences in clinical characteristics, including onset, course, degree of insight, and treatment responses, between hoarding and other subtypes. Moreover, several neuroimaging studies have found specific changes of brain

structure and function in OCD patients with hoarding symptoms compared to patients with non-hoarding OCD. Meanwhile, strategies for treatment of HD have not been standardized. At present, psychological treatment using cognitive behavioral therapy techniques has a certain effect. In this review, we outline the pathophysiology and treatment of HD.

Keywords: DSM-5, hoarding disorder, obsessive–compulsive and related disorders, pathophysiology, treatment.

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Hoarding disorder (HD) is a disease concept newly presented in the DSM-5.¹ HD is categorized in the category of Obsessive–Compulsive and Related Disorders (OCD) along with trichotillomania, excoriation disorder, and body dysmorphic disorder. A recent population-based study² found that the overall prevalence of provisional HD was around 2%. Concerning cultural aspects, a transcultural study across Eastern and Western countries showed that HD exists and presents with similar phenomenology across the studied countries, including the United Kingdom, Spain, Japan, and Brazil.³

So far, the hoarding symptom has been regarded as a subtype of obsessive–compulsive disorder (OCD) or a partial symptom of obsessive–compulsive personality disorder (OCPD). In the Yale–Brown Obsessive–Compulsive Scale (Y-BOCS)₂^{4,5} a representative assessment scale of obsessive–compulsive symptoms, hoarding symptoms are listed as hoarding/saving obsessions and hoarding/collecting compulsions. Though it is suggested that 20–40% of OCD patients show hoarding symptoms,^{6,7} from a pathophysiological aspect, the hoarding symptom is far from a typical subtype of OCD. By showing definite differences between HD and OCD, such as age at onset, clinical course, insight, and treatment response, the independency of HD was proposed in the DSM-5.

While understanding of hoarding symptoms still remains low in the psychiatric field in Japan, the Japanese mass media often discuss the topic of ‘trash-houses [gomi-yashiki],’ which has become a great social problem because of bad smells, contamination, risk of fire, and unpleasant appearances. In this review, we will give an outline of the pathophysiology and clinical view, including treatment, of HD.

Outline of HD OCD

OCD is a new DSM category that includes OCD as a core disorder and that has become independent from the Anxiety Disorder category. OCD is characterized by clinical characteristics, such as unique repetitive behaviors, early onset, tic-related behaviors, and insufficient insight. Predicted biological network models, such as the cortico-

striatal-thalamic-cortical circuit, also support the uniqueness of OCD. A meta-analysis of voxel-based morphometry studies in OCD and other anxiety disorders revealed that OCD showed specific increase in lenticular/caudate nuclei while anxiety disorders showed decreased bilateral gray matter volumes in the dorsomedial frontal/anterior cingulate gyrus.⁸

Hollander and Wong hypothesized a pathological model focusing on its compulsivity and impulsivity and proposed the concept of an obsessive–compulsive spectrum disorder (OCS) that included OCD-like compulsive behaviors, including eating disorders, pathological gambling, and tic/Tourette disorders.⁹ Based on this model, the DSM-5 working group discussed how to organize traditional anxiety disorders, OCD, and OCS. Finally, OCD became independent of the Anxiety Disorder group and became a core disorder of the OCD group, which includes some of the OCS disorders and the newly presented HD (Fig. 1).

Hoarding symptom

The hoarding symptom is defined as excessive acquisition regardless of the actual value, difficulty in discarding possessions, and disorganization of those things. Due to continuous hoarding, the possessions overflow the living space and hinder living functions. Extreme forms of this behavior can fill a living space and cause sanitation problems. Moreover, hoarding symptoms might cause injuries due to fire or collapse of stacked items, which can have a great impact not only on the person him- or herself and their family but also on neighbors.

So far, the hoarding symptom has been regarded as a subtype of OCD or a partial symptom of OCPD. In Y-BOCS, hoarding symptoms are listed as hoarding/saving obsessions and hoarding/collecting compulsions.^{4,5} A meta-analysis of the structure of OCD using Y-BOCS¹⁰ found that symptoms of OCD were divided into four categories: (i) symmetry, (ii) forbidden thoughts, (iii) cleaning, and (iv) hoarding. This analysis also showed that hoarding may be both a separate syndrome from OCD and, more rarely, a symptom dimension of OCD.

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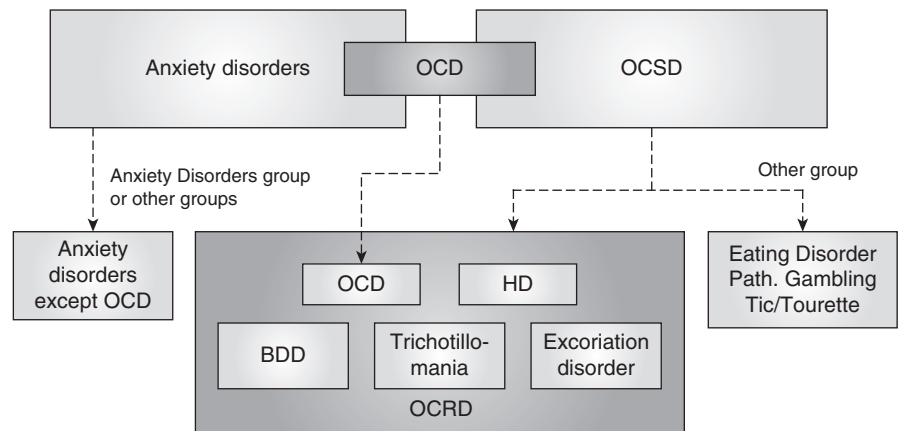


Fig.1 Obsessive-compulsive disorder (OCD) became independent of the Anxiety Disorder group and became a core disorder of the Obsessive-Compulsive and Related Disorders (OCRD) group, which includes some of the disorders of obsessive-compulsive spectrum disorder (OCSF) and the newly presented hoarding disorder (HD). BDD, body dysmorphic disorder.

HD in DSM-5

Recent studies have revealed that there are definite differences of pathophysiology between the hoarding subtype and other OCD subtypes.^{7,11} This raised the hoarding subtype to HD in the DSM-5. Because the DSM-5 includes clear diagnostic criteria for HD, it is comparatively easy to diagnose HD¹ (Table 1). In Criterion A, patients with HD are described as showing persistent difficulty in parting with possessions regardless of their actual value. Though patients with HD often hoard newspapers, magazines, old clothes, bags, mail, and documents, any material can be hoarded. The main reasons why they cannot discard them are that those items are recognized as useful or beautiful, or they are strongly attached to them.¹² Intense emotional attachment of subjects to objects is an essential feature of HD. Hoarding behavior is, therefore, quite different from the compulsive behavior of OCD, which aims to reduce anxiety or distress. As shown in Criterion C, another feature of HD is that the possessions overflow the living space and hinder living functions

(i.e., cooking in the kitchen, sleeping in a bed, or sitting on a chair). In the DSM-5, these conditions are defined as 'clutter,' which means 'a large group of usually unrelated or marginally related objects piled together in a disorganized fashion in spaces designed for other purposes (e.g., tabletops, floor, hallway).' Furthermore, as shown in Criterion D, HD causes severe impairment of living functions. This feature clearly distinguishes hoarders from collectors. Collectors collect items that have specific value and organize them without invasion of living spaces. Concerning exclusion criteria, Criterion E shows medical conditions that cause secondary hoarding, such as brain injury, vascular brain diseases, and Prader-Willi syndrome. Criterion F shows that secondary hoarding symptoms due to obsession caused by OCD, such as fear of contamination or harmful thoughts, are excluded from HD. HD, however, is often comorbid with OCD. If a patient shows both primary and secondary hoarding symptoms, he/she will be diagnosed with both HD and OCD. Concerning primary and secondary hoarding, Matsunaga *et al.* compared the two groups and found that primary hoarders are more likely to be male, have earlier onset of OCD, more severe symptomatology, and particular patterns of comorbidity, such as symmetry symptoms and OCPD.¹³ In addition, as mentioned in the following section, we should address the differential diagnosis and comorbidity of autism spectrum disorder (ASD) and attention deficit hyperactivity disorder (ADHD). The flowchart of the differential diagnosis of HD is shown in Figure 2.

Clinically, patients with HD show early onset and a chronic course. Typically, HD starts in the early teenage years, causes impairment of daily function in the mid-20s, and definite impairment in the 30s. The clinical course of HD is very chronic, and patients rarely show spontaneous remission. Living alone, absence of a partner, and living space are considered factors that affect the course.¹⁴

HD and related disorders

Differences between HD and OCD

The excessive anxieties, collecting behaviors, and avoidance of discarding possessions seen in HD are similar to the obsessions and compulsions seen in OCD. However, in contrast to OCD, patients with HD typically do not report invasive and uncomfortable thoughts or images. Their desire to hoard things is very ego-syntonic and distinguished from the obsessions seen in OCD. From a theoretical aspect of behavioral therapy, typical compulsive behaviors in OCD are negative reinforcements to avoid fear or pain. In contrast, while avoidance of discarding may be similar to compulsive behaviors in OCD, the emotional attachments to obtained things seen in HD are likely positive reinforcements.¹¹ Furthermore, HD patients show poor insight compared to those with OCD. Several researchers found that patients with hoarding symptoms had significantly poorer insight compared to patients without hoarding.^{13,15} The hoarding symptom is

Table 1. Diagnostic criteria for hoarding disorder

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|----|--|
| A. | Persistent difficulty in parting with possessions, regardless of their actual value. |
| B. | This difficulty is due to a perceived need to save the items and the distress associated with discarding them. |
| C. | The difficulty discarding possessions results in the accumulation of possessions that congests and clutters active living areas and substantially compromises their intended use. If living areas are uncluttered, it is only because of the interventions of third parties (e.g., family members, cleaners, authorities). |
| D. | The hoarding causes clinically significant distress or impairment in social, occupational, or other important areas of functioning (including maintaining a safe environment for self and others). |
| E. | The hoarding is not attributable to another medical condition (e.g., brain injury, cerebrovascular disease, Prader-Willi syndrome). |
| F. | The hoarding is not better explained by the symptoms of another mental disorder (e.g., obsessions in obsessive-compulsive disorder, delusions in schizophrenia or another psychotic disorder, cognitive deficits in major neurocognitive disorder, or restricted interests in autism spectrum disorder). |

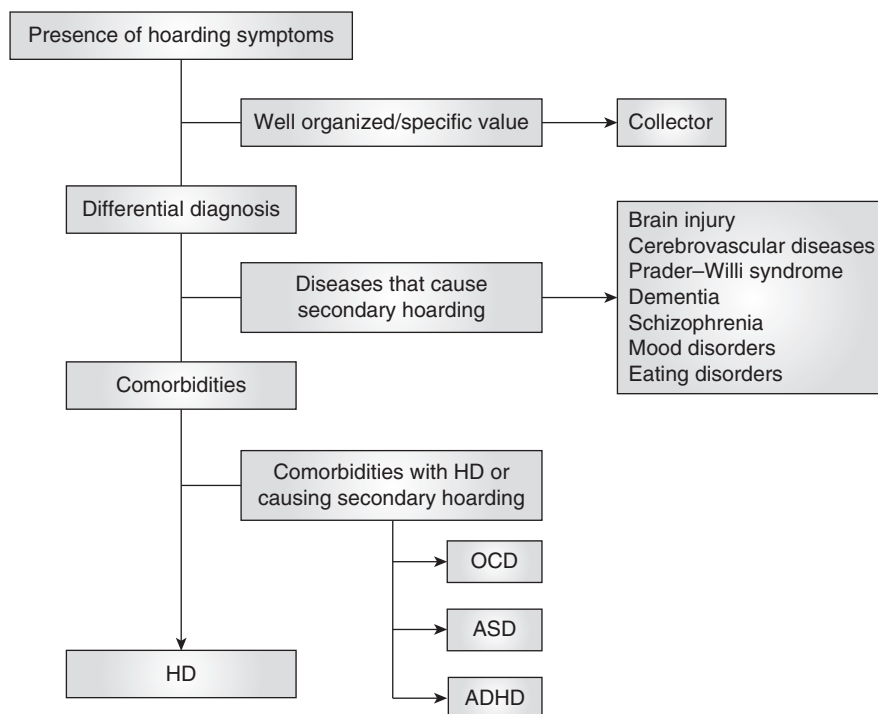


Fig.2 If possessions are well organized and have a specific value, the owner is defined as a 'collector.' Medical conditions that cause secondary hoarding, such as brain injury, brain vascular diseases, and Prader-Willi syndrome, are excluded from hoarding disorder (HD). When seeing symptoms of obsessive-compulsive disorder (OCD), autism spectrum disorder (ASD), or attention deficit hyperactivity disorder (ADHD), we should perform a differential diagnosis of these disorders.

quite stable and gets worse gradually over a long period. A recent population-based study showed that the prevalence of provisional HD diagnoses increased linearly by 20% with every 5 years of age, while provisional OCD diagnoses showed bimodal distribution in younger individuals and in individuals over age 65 years.² Patients with HD rarely accept someone's help or intervention until they come to severe impairment of their daily life.

Association between HD and neurodevelopmental disorders

It is suggested that HD has a close relationship with neurodevelopmental disorders, including ASD and ADHD, other than OCD. Concerning ADHD, a clinical study¹⁶ showed that 20% of the patients who had hoarding rituals met ADHD criteria, while 4% with OCD and 3% of healthy volunteers met ADHD criteria. Another study found that attention deficit disorder is more predictive of hoarding behavior than OCD.¹⁷ Neurocognitive studies also demonstrated lowered neurocognitive function in patients with HD, especially in attention.¹⁸ Several studies of ASD reported relatively high frequencies of hoarding behaviors in ASD samples.^{19,20} Recently, Ruta *et al.*²¹ found that patients with Asperger syndrome showed higher frequencies of hoarding behaviors compared to a typically developing control group. Based on these findings, it is pointed out that HD and ASD share a considerable number of clinical features. Meanwhile, Pertusa *et al.* compared patients with HD to other disease groups, including ASD, OCD, and anxiety disorders, and found that patients with HD do not display more autistic traits than the psychiatric controls.²²

Our group conducted a clinical study assessing hoarding behavior by using a structural interview of HD patients.²³ Among 20 participants, 12 met the inclusion criteria of HD, and four of them showed a comorbid ADHD condition. This is higher than comorbid OCD ($n = 2$) or other anxiety disorders ($n = 3$; Table 2). However, the relationships between hoarding behavior/HD and neurodevelopmental disorders are still unknown. Further investigation is needed based on the definition of HD in the DSM-5.

Neuroimaging studies of hoarding symptoms and HD

The neurobiological mechanisms of HD have not yet been investigated in detail. Several studies reported a correlation between hoarding symptoms and specific brain regions. A positron emission tomography research study revealed significantly lower glucose metabolism in the posterior cingulate gyrus and cuneus in OCD with compulsive hoarding.²⁴ An fMRI study revealed that the OCD patients with prominent hoarding symptoms showed greater activation in the bilateral anterior ventromedial prefrontal cortex than patients without hoarding symptoms and healthy controls in response to a hoarding-related anxiety provocation.²⁵ Furthermore, several structural studies using voxel-based morphometry (VBM) indicated the association between hoarding symptom scores in OCD and gray matter (GM) volume in the left caudate,²⁶ left Brodmann area (BA)6,²⁷ left lateral orbitofrontal cortex (OFC), and right parahippocampal gyrus.²⁸ These findings, however, are inconsistent, and most studies focused on compulsive hoarding as a subtype of OCD. Only one fMRI study reveals that HD patients diagnosed with DSM-5 criteria exhibited significantly greater activity than controls in the anterior cingulate cortex and right dorsolateral prefrontal cortex during conflict-monitoring and response-inhibition conditions in the Go/No-Go task.²⁹ As far as we know, no studies have examined the structural changes relevant to hoarding by applying the diagnostic criteria of HD in the DSM-5. Recently, we examined 17 patients who met the DSM-5 criteria for HD by using VBM methods.³⁰ The HD group showed a significantly increased GM volume compared to the OCD and healthy control groups ($P < 0.05$) in OFC, including both BA10 and BA11. Though OFC has been frequently suggested as being associated with the pathophysiology of OCD, the results in VBM studies so far are inconsistent. It is undeniable that a mixture of hoarding symptoms might have influenced the results of these studies. Therefore, our result showing a significant increase in the prefrontal regions in HD compared to OCD without hoarding has important implications. We speculated that increased GM volumes in prefrontal regions are specific changes in HD. This is the first study examining the brain structure of HD patients, and the results are convincing after

Table 2. Clinical characteristics of patients with hoarding disorder

Patient no.	Age (years)/sex	Age at onset	Marital status/ living with others (±)	Education	Jobs	Objects hoarded	Comorbidities
1	55/M	45 years	Married/+	College	None	Documents	Depression
2	21/F	12 years	Single/+	High school (dropped out)	None	Newspapers, magazines	ADHD
3	35/F	Childhood	Married/+	Graduate	Yes	Books, clothes, toys, cardboard boxes, PET bottles	ADHD
4	40/F	Childhood	Single/+	College	Yes	Clothes, dolls, boxes, books	Depression/ SAD/phobia
5	29/M	Childhood	Single/–	High school	None	Books, magazines, manga items, clothes, trash	ADHD, depression
6	73/F	Unknown	Married/+	Junior high	None	Photos, clothes, mail, handmade things	Depression
7	41/F	31 years	Single/+	Vocational school	None	Books, DVDs, cosmetics, religious items	OCD, bipolar II disorder
8	50/F	Childhood	Divorced/–	High school (dropped out)	None	Receipts, clothes, memorial items	OCD, depression, panic disorder
9	24/M	7 years	Single/–	Graduate	None	Documents, books, bottles, trash	ADHD
10	42/M	Twenties	Married/+	College	Yes	Empty bags, documents, books	ASD

ADHD, attention deficit hyperactivity disorder; ASD, autism spectrum disorder; OCD, obsessive-compulsive disorder; SAD, social anxiety disorder.

considering the clinical features of HD. It suggested that structural abnormalities in the prefrontal regions might relate to the pathophysiology of HD. To clarify the pathophysiology of HD, further studies are needed.

Treatment of HD

Findings about treatment responses of hoarding symptoms and HD

Strategies for treatment of HD have not been standardized because HD was defined only 5 years ago. Concerning hoarding symptoms as a subtype of OCD, however, there are some findings about treatment responses. Most studies indicate a poorer response in patients with hoarding symptoms compared to patients with other subtypes of OCD. Mataix-Cols *et al.*³¹ detected five dimensions, including symmetry/ordering, hoarding, contamination/washing, aggression/checking, and sexual/religious, by factor analysis in 354 patients with OCD and conducted a random controlled trial (RCT) using serotonin reuptake inhibitors/selective serotonin reuptake inhibitors (SSRI). As a result, a higher hoarding score correlated with poorer treatment response. Stein *et al.*³² also reported poorer treatment response in patients with hoarding symptoms in their RCT using escitalopram for 466 OCD patients. Recently, a meta-analysis by Bloch *et al.*³³ of 21 RCT studies of treatment response in OCD found that the presence of hoarding lowered the treatment effects of cognitive behavioral therapy (CBT), pharmacotherapy, and their combination. It is suggested that early onset, strong attachment to possessions, poor insight, comorbid depression/anxiety disorders, cognitive impairment, and biological abnormality in the ventral prefrontal cortex might be related to the poor treatment response of HD.

On the other hand, Saxena *et al.*³⁴ conducted a comparison of pharmacotherapy using paroxetine in 32 severe compulsive hoarders and 47 OCD patients without hoarding and reported that both groups showed good treatment response. They also conducted an open-label trial of venlafaxine extended-release for HD and found that 70% of the participants were classified as responders.³⁵

Though most of the previous studies indicated that HD does not respond well to standard OCD treatment, most of these studies were conducted before the definition of HD in the DSM-5. We should do further investigations of treatment responses for HD.

Future direction of treatment for HD

It is expected that treatment for HD will develop by trial and error. At present, a psychological treatment using CBT techniques shows some effect. Tolin *et al.*³⁶ developed a CBT program focusing on motivation, decision-making, and skill training for organizing possessions. Other research is developing a program that applies CBT to group therapy and Internet self-help.³⁷

Concerning pharmacotherapy, as mentioned above, it is suggested that the treatment effect of SSRI is insufficient for HD. Therefore, developing a novel treatment strategy is needed. Though augmentation with atypical neuroleptics, D-cycloserine, and an NMDA modulator or methylphenidate and atomoxetine are options, the effects of these drugs on HD are still unknown.

Case presentation

We are performing case formulation of patients with HD and attempting to intervene with CBT techniques. We treated a 42-year-old woman with HD. She had started hoarding in her early teenage years and had had impairment of daily function by her mid-20s. At 35 years of age she had experienced her mother's death and her hoarding symptoms had become much worse. When she was 42 years old, she visited our clinic and started CBT treatment. She hoarded various things, such as magazines, videos, flyers, envelopes, bags, receipts, foods, drinks, incense sticks, and rosaries. We discussed with her how to organize these items. After assessment of these items, we divided them into five groups with advice about how to treat them: (i) hobby things, such as magazines – discard duplicate items; (ii) daily use items, such as bags – discard all of them; (iii) documents, such as receipts – preserve for 1 year only; (iv) consumables, such as foods – discard when expired; and (v) memorial things belonging to her mother, such as rosaries –

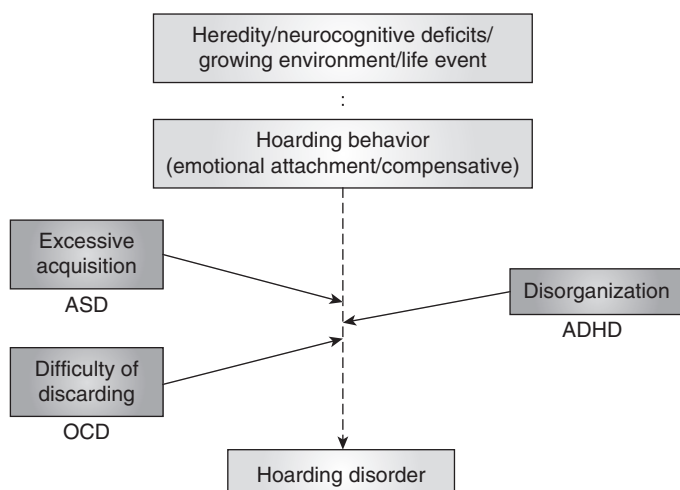


Fig.3 We speculated that patients with hoarding disorder have biological background and environmental factors, such as loss experiences, that strengthen emotional-attachment behavior and could have a mutual relationship with autism spectrum disorder (ASD), attention deficit hyperactivity disorder (ADHD), and obsessive-compulsive disorder (OCD) regarding its onset process.

donate to temples. With this approach, her living function improved significantly.

Conclusion

In this review, we have outlined the newly defined HD, including clinical aspects, pathophysiology, its relation with OCD and neurodevelopmental diseases, and treatment. Although the medical examination rate of patients with hoarding symptoms is relatively low, even in medical institutions experienced with anxiety disorders and OCD, the prevalence rate of HD is estimated to be relatively high (2–5%). As there are many patients and families who are suffering from HD, it would be meaningful to conduct clinical and biological research on HD.

Meanwhile, the relation between HD and OCD/ASD remains unclear. In the future, we should discuss the independency of HD when it has comorbid OCD or ASD. We speculate that patients with HD share a biological background involving neurocognitive impairment, such as decision-making, attention switching, and inattention.^{38,39} Further, based on our clinical experience, we suppose that environmental factors, such as loss experiences, strengthen emotional-attachment behavior. We also speculate that HD will have a mutual relationship with ASD, ADHD, and OCD regarding its onset process (Fig. 3). In the treatment of HD, therefore, we should address psychosocial aspects, such as familial relationships and environmental control, while attempting CBT or pharmacotherapy and taking comorbid conditions into consideration.

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Disclosure statement

The authors declare that they have no conflicts of interest.

Author contributions

Drafting of manuscript: T.N. Supervisor and critical revision: S.K. Both authors read and approved the final manuscript.

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