

IMPACT OF PERFORMANCE ANXIETY DURING ERECTILE DYSFUNCTION ON INTESTINAL MICROBIOTA: A CASE STUDY

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ABSTRACT

Significant advances have been achieved in understanding the complex interactions among the central nervous system, the enteric nervous system, and the gastrointestinal tract. Pre-clinical studies have underscored the crucial role of the gut microbiota in this brain-gut axis, revealing connections between microbial composition and emotional behavior, stress response systems, pain perception, and brain neurotransmitters. In this case study, we investigated the intricate interplay between erectile dysfunction, performance anxiety, and intestinal microbiota in a male patient. The results obtained provide initial evidence of the impact caused by performance anxiety during erectile dysfunction on the gut microbiota, presenting preliminary data demonstrating low diversity and increased presence of inflammatory bacteria (*Oscillibacter ruminantium* and *Staphylococcus aureus*) and a decrease in anti-inflammatory bacteria (*Akkermansia muciniphila* and *Faecalibacterium prausnitzii*). The study also demonstrates how sexual psychotherapy can be a differential factor in the treatment and restoration of erectile function and, consequently, improvement in intestinal microbiota by reducing inflammatory bacteria (*Oscillibacter ruminantium* and *Staphylococcus aureus*) and a significant increase in anti-inflammatory bacteria (*Akkermansia muciniphila* and *Faecalibacterium prausnitzii*), along with an increase in microbiota diversity, which may impact overall health. Thus, these findings can offer valuable insights into the complex relationships between mental health, sexual function, and gut microbiota, emphasizing the need for multidisciplinary approaches and the importance of sexual psychotherapy in the treatment of erectile dysfunction, considering both physical and emotional factors.

KEYWORDS: Performance anxiety, gut microbiota, male sexual health.

IMPACTO DA ANSIEDADE DE DESEMPENHO DURANTE A DISFUNÇÃO ERÉTIL NA MICROBIOTA INTESTINAL: UM ESTUDO DE CASO

RESUMO

Avanços significativos foram alcançados na compreensão das complexas interações entre o sistema nervoso central, o sistema nervoso entérico e o trato gastrointestinal. Estudos pré-clínicos apontam o papel crucial da microbiota intestinal no eixo cérebro-intestino, revelando ligações entre a composição microbiana e o comportamento emocional, os sistemas de resposta ao stress, a percepção da dor e os neurotransmissores cerebrais. Neste estudo de caso, investigamos a intrincada interação entre disfunção erétil, ansiedade de desempenho e microbiota intestinal em um paciente do sexo masculino. Os resultados obtidos fornecem evidências iniciais do impacto causado pela ansiedade de desempenho durante a disfunção erétil na microbiota intestinal, apresentando dados preliminares que demonstram baixa diversidade e aumento da presença de bactérias inflamatórias (*Oscillibacter ruminantium* e *Staphylococcus aureus*) e diminuição de bactérias anti-inflamatórias (*Akkermansia muciniphila* e *Faecalibacterium prausnitzii*). O estudo também demonstra como a psicoterapia sexual pode ser um fator diferencial no tratamento e restauração da função erétil e, conseqüentemente, na melhora da microbiota intestinal por meio da redução de bactérias inflamatórias (*Oscillibacter ruminantium* e *Staphylococcus aureus*) e aumento significativo de bactérias anti-inflamatórias (*Akkermansia muciniphila* e *Faecalibacterium prausnitzii*), juntamente com um aumento na diversidade da microbiota, o que pode impactar a saúde geral. Assim, essas descobertas podem oferecer esclarecimentos valiosos sobre as complexas relações entre saúde mental, função sexual e microbiota intestinal, enfatizando a necessidade de abordagens multidisciplinares e a importância da psicoterapia sexual no tratamento da disfunção erétil, considerando fatores físicos e emocionais.

PALAVRAS-CHAVE: Ansiedade de desempenho, microbiota intestinal, saúde sexual masculina.

INTRODUCTION

For over 150 years, Lister, in his initial germ theory description, already linked bacteria to infections and diseases. Recently, numerous studies are associating the microbiome with various human conditions, including sexual health (WERNEBURG *et al.*, 2022).

Among all known sexual dysfunctions, erectile dysfunction may be the most devastating, given the global culture that directly associates masculinity with the functionality of the genital organs (BURNETT *et al.*, 2018). Throughout history, men have vested in their male sexual organ, the penis, the expectation that it operates autonomously and independently, as a symbol of their masculinity. Simultaneously, they yearn for the ideal of perfect erectile performance to alleviate their fears of being unable to achieve an erection (FABICHAK, 2023). In this context, the penis represents not only power and dominance but also the ultimate symbol of virility. Even today, the notion of being a man is often linked to the ability to have a full erection and maintain sexual potency (CARRELL *et al.*, 2023). Erectile dysfunction is defined as the persistent, partial, or total inability to obtain and/or maintain an erection adequate for penetration and completing sexual intercourse until ejaculation (MCCABE *et al.*, 2016).

Multinational studies on erectile dysfunction (ED) reveal a prevalence of approximately 30% in young men up to 40 years old and up to 52% in men aged 40

to 70 years, garnering widespread research attention. One recent area of investigation involves exploring the connection between ED and the microbiome, with a primary focus on the gut microbiome. It has been observed that patients with ED exhibit less diverse intestinal microbiota compared to healthy controls (GENG *et al.*, 2021; WANG, 2022).

Regardless of its origin, whether organic, psychological, or a combination of both, erectile dysfunction triggers a biological stress response—a body's reaction to negative sexual experiences. When faced with this challenging situation, whether in reality or the imaginary realm, various factors come into play: the event itself, the personal perception of this event, and the body's physiological reaction to that perception. From this point onward, when an individual feels that the event is beyond their control, the body automatically responds, preparing to fight or flee. This stress response is what can trigger erectile dysfunction (KLAPILOVÁ *et al.*, 2019). The manifestation of erectile disorders can pose numerous challenges to male self-esteem, leading to emotional imbalances, heightened anxiety levels, and distress, impacting self-perception and, in some cases, negatively affecting marital relationships. In extreme cases, it can profoundly affect emotional well-being, with serious implications, including the risk of suicide (REISMAN *et al.*, 2021).

Anxiety disorders are characterized by the presence of excessive fear, intense anxiety, and associated behavioral disturbances. While anxiety is the anticipated emotional response to a future threat, fear is the psychological reaction to imminent real or perceived dangers. Although anxiety and fear are normal adaptive functions, anxiety disorders can arise when symptoms become excessive and persistent, resulting in clinically significant distress or impairment of (KIM, 2020).

IMPACT OF ANXIETY ON PEOPLE'S LIVES

Anxiety disorders rank among the most common psychiatric complaints in the general population, and their symptoms are among the most prevalent conditions. The quality of life is significantly impacted by anxiety symptoms, particularly concerning interpersonal relationships and personal fulfillment. Uncomfortable emotional states, concerns about the future, or a sense of distress that serves as a warning signal for individuals to prepare for a potential threat are often mentioned by those experiencing these symptoms. Anxiety can be a natural reaction or evolve into a pathological condition. In the latter scenario, the individual exhibits dysfunctional and inappropriate responses to situations that induce anxiety, whether real or imaginary, occurring during daily activities or events (SOLDI *et al.*, 2019).

One form of anxiety under research is test anxiety, which involves intense distress and anxiety during evaluations, potentially leading to difficulties in learning and lower test performance. This type of anxiety significantly impacts students' studies and lives, spanning from elementary to higher education. It manifests physically and is often associated with the fear of failure, exaggerated worry, anticipation of catastrophic scenarios, and anxiety before and during tests. This condition negatively affects students' social, behavioral, and emotional development, as well as their self-image and perception of school. Performance anxiety creates obstacles to learning and performance, subsequently influencing students' social, behavioral, and emotional development negatively (QIN *et al.*, 2021).

There is a growing body of evidence exploring the potential impact of the microbiota on the brain-gut axis in health and disease contexts, spanning areas such as nutrition, immunity, organism physiology, and brain development (SOLDI *et*

al.,2019). Furthermore, it has been suggested that the gut microbiota plays a role in regulating behavior, especially in the context of anxiety-related disorders (LIU *et al.*, 2021).

PERFORMANCE ANXIETY

Performance anxiety occurs when a man experiences anxiety or stress related to his ability to have or maintain an erection during sexual activity. This anxiety can create a vicious cycle, leading to increased stress and difficulties in obtaining or maintaining an erection, characterizing a psychological factor known to contribute to erectile dysfunction (ED) (MCCABE *et al.*, 2015).

Most sexual dysfunctions are considered psychosomatic disorders, indicating physiological and/or structural changes influenced by psychological processes. This underscores the importance of adopting a multidisciplinary approach in treating erectile dysfunction. The psychosomatic or holistic model emphasizes a therapeutic approach that views the individual as a whole, assuming that there are no purely physical problems without some associated psychological impact (SHARMA, 2019). Similarly, it is crucial to recognize that emotional stressors can result in alterations in bodily functioning, often manifesting as disturbances in autonomic systems, which may arise from a decrease or increase in physiological activity. Becoming aware of the process and the physical and psychological transformations that occur during a sexual dysfunction is crucial for the restoration of a healthy sexual response (LANGER *et al.*, 2017).

HOW ANXIETY CAN ALTER THE GUT MICROBIOME?

Anxiety disorders constitute a complex set of diseases where genetic factors and, notably, stress play a significant role in etiology (MAIUOLO *et al.*, 2021). The relationship between these disorders and functions associated with tryptophan catabolism and serotonin biosynthesis has been studied extensively. In situations of stress and inflammation, tryptophan catabolism tends to shift toward the quinolinic acid pathway (LABANSKI *et al.*, 2020). The quinolinic acid pathway involves numerous enzymes that play a role in generating various neuroactive catabolites. Additionally, serotonin biosynthesis primarily occurs in enterochromaffin cells located in the intestine, and any alteration in the composition of the intestinal microbiota directly affecting serotonin biosynthesis is known as dysbiosis. In this new context, the role of inflammation triggered by dysbiosis and the subsequent activation of the quinolinic acid pathway become relevant in understanding the etiopathogenesis of anxiety disorders (EVRENSEL *et al.*, 2020).

Despite the physical separation between the brain and the intestine, these two systems maintain a complex bidirectional communication. This integration of signals involving neural, hormonal, and immune elements allows for an exchange of information between the intestine and the brain, opening a potential route through which the intestinal microbiota and its metabolites can access the brain, with possible pathophysiological implications (CRYAN *et al.*,2019). Disorders in brain-gut communication are often associated with intestinal inflammation and chronic abdominal pain syndromes. Moreover, although possible relationships between changes in brain-gut interactions and various brain disorders in humans, such as food addiction, anxiety, depression, multiple sclerosis, Alzheimer's disease, and Parkinson's disease, have been suggested, solid evidence is still lacking to establish a definitive causal relationship (QIAN *et al.*, 2021).

The communication between the brain and the intestine in response to stress and anxiety may play a relevant role in the natural progression of chronic gastrointestinal diseases, such as inflammatory bowel disease and irritable bowel syndrome (QIAN, *et al.*, 2021). Studies have demonstrated that stress can impact the integrity of the intestinal epithelium and cause alterations in gastrointestinal motility, secretion, and mucin production. These changes disrupt the microbial environment in the intestine, inducing modifications in the composition and activity of bacteria. Additionally, the release of catecholamines in response to stress in the intestine can affect the microbial community, influencing communication and signaling between bacteria, which can result in changes in the expression of bacterial virulence genes. Therefore, it is possible to consider a complex and bidirectional network in the relationship between the host, the microbiome, and the environment (MARGOLIS *et al.*, 2021).

The human intestine hosts trillions of microorganisms that together form a complex ecological community. This community plays a fundamental role in influencing normal physiology and determining susceptibility to diseases through their collective metabolic activities and interactions with the host organism (HEINTZ-BUSCHART, WILMES, 2018). The intestinal microbiota (IM) is remarkably diverse, varying among individuals and exhibiting fluctuations over time, especially during episodes of illness and in the early years of life, up to approximately five years of age. Approaching the microbiota from an ecological perspective can offer valuable insights into promoting health, focusing on managing this microbial community in clinical contexts (LIANG *et al.*, 2018).

As mentioned earlier, some studies already point to alterations in the IM related to ED and anxiety in general. However, in our case study, we observe that performance anxiety and the fear of failure have an even more significant impact on the IM. Therefore, the aim of this case report is to analyze the impact caused by performance anxiety during erectile dysfunction on the intestinal microbiota.

CASE STUDY REPORT

A patient sought a urologist with an initial complaint of erectile dysfunction (ED). Clinical evaluation and laboratory tests were conducted, and after ruling out organic causes and identifying performance anxiety, the patient was referred for psychological assessment, leading to a diagnosis of psychogenic ED. In the evaluation, a sexuality specialist psychologist conducted a general anamnesis and a specific one regarding the sexual complaint of erectile dysfunction (ED), recommending psychotherapeutic follow-up for the treatment of the complaint. The patient reported no prior experience with psychological treatment. This research was conducted in Uberlândia-MG, Brazil. The patient was invited to participate in the study, signed an informed consent form, provided two fecal samples for intestinal microbiota analysis (one at the beginning and one at the end, after resolving the initial complaint of ED), filled out a food frequency report, with no changes before and after, and responded via Google Forms to three assessment instruments (before and after): the Hamilton Anxiety Scale, Erectile Performance Anxiety Index (EPAI) and the International Index of Erectile Function Inventory (IIEF). The therapy was conducted by a sexologist psychologist who accompanied the patient throughout the treatment until discharge.

The patient is a 38-year-old single man, an agronomist, commercial manager, and entrepreneur, who reported an initial complaint of ED perceived 1.5 years prior to seeking treatment. In his initial complaint, the patient reported difficulties in

maintaining an erection, which led to a "concern about not being able to obtain and maintain an erection," giving rise to another complaint of secondary premature ejaculation. The patient was single when seeking therapeutic help and reported feeling insecure about having new sexual relationships. The complaint began during his stable relationship that lasted five years, after discovering extramarital affairs of his partner, whom he forgave and tried to continue the relationship but ended traumatically due to a lack of trust.

The patient reported recurrent thoughts of fear of losing an erection, fear of failure, fear of making a mistake, fear of not satisfying his partner, or being abandoned or betrayed. After the breakup, these fears continued in new relationship possibilities, clearly indicating performance anxiety.

In childhood, he experienced two significant events: cancer at the age of 4 (undergoing radiotherapy and chemotherapy) and an accident at the age of 12 that left sequelae in one of his upper limbs (right arm), affecting his self-image. In adulthood, he received a diagnosis of infertility, and during his ED treatment, four weeks after the first fecal sample collection, he was diagnosed with thyroid cancer. Despite this, he expressed commitment to resolving the initial complaint of ED and premature ejaculation and continued his therapeutic process focused on the goal. The final sample collection took place 12 weeks after the start of treatment, before the surgery to remove the nodules and subsequent iodine therapy.

The genetic sequencing of the intestinal microbiome using shotgun metagenomics involves the following steps: 1-Sample Collection: collection of fecal samples. 2-DNA Extraction: DNA extraction from the fecal sample using a high-quality DNA extraction kit to ensure the DNA's integrity. 3-DNA Fragmentation: fragmentation of the extracted DNA into small pieces, typically ranging from 300 to 500 base pairs, ligation of adapters to the DNA fragments and amplification of the DNA fragments by PCR to create a library of DNA fragments. 4- Sequencing: sequencing of the DNA library using a next-generation sequencer (NGS), such as Illumina HiSeq, generation of millions of short DNA sequences (reads). 5- Pre-processing: pre-processing of the reads to remove low-quality sequences and human genome regions (if present), which might interfere with the analysis. 6- Assembly: assembly of the reads into contigs or genomic units, clustering of contigs into operational taxonomic units (OTUs), representing longer DNA sequences and annotation of OTUs to identify genes, operons, and other features. 7- Identification: identification of sequences by comparing reads to known reference sequences in public databases such as NCBI and RDP. 8- Functional Prediction: prediction of gene functions based on annotation and taxonomic assignment, understanding the metabolism and ecological interactions of the microbiome. Evaluation of the diversity, abundance, and function of the intestinal microbiome.

This comprehensive process allows for a detailed analysis of the genetic composition, functional potential, and taxonomic diversity of the intestinal microbiome. It provides valuable insights into the microbial community's structure and its potential roles in metabolic processes and ecological interactions within the gastrointestinal system.

Ethical Considerations: This research was approved by the Research Ethics Committee of the Federal University of Uberlândia, CAAE number: 48510921.7.0000.5152.

RESULTS

The patient participating in this case study demonstrated notable progress after twelve (12) sessions of psychotherapy focused on cognitive-behavioral approaches. Initially, the patient scored 31 on the Hamilton Anxiety Scale, indicating moderate to severe anxiety. Following the intervention period, the score significantly decreased to 21, signifying a sharp decline in anxiety levels and entering the range considered mild to moderate anxiety. More specifically, in the 14 questions assessed on the scale, the patient showed improvement in 9 of them, with more pronounced improvement in the fears and genitourinary symptoms pillars when comparing responses from the beginning to the end of treatment. Regarding the Hamilton Anxiety Scale, concerning the rate of psychic anxiety, there was a decrease from a score of 17 to 11, and in the rate of somatic anxiety, the score dropped from 14 to 10. These improvements were accompanied by a resolution of erectile dysfunction, allowing the patient to be discharged from treatment (table 1).

TABLE 1. Hamilton Anxiety Scale of the Patient Before and After Treatment

	Symptoms	Before	After
TAP	1 – Anxious Mood	3	2
	2 – Tension	2	1
	3 – Fears	3	1
	4 - Insomnia	3	2
	5 – Intellectual (Cognitive)	2	1
	6 – Depressed Mood	2	2
TAS	7 – Motor Somatizations	3	2
	8 – Sensory Somatizations	2	2
	9 – Cardiovascular Symptoms	1	1
	10 – Respiratory Symptoms	1	2
	11 – Gastrointestinal Symptoms	2	2
	12 – Genitourinary Symptoms	3	0
	13 – Neurovegetative Symptoms	2	1
TAP	14 – Behavior During Interview	2	2
	Overall Anxiety Rate	31	21

TAP: Psychic Anxiety Rate; TAS: Somatic Anxiety Rate (Grades: 0-none 1-mild 2-moderate 3-severe 4-very severe)

In addition to the improvement observed in the Hamilton Anxiety Scale, the patient also demonstrated significant progress in specific measures related to performance anxiety and dysfunction. The initial score on the Erectile Performance Anxiety Index (EPAI) of 43 out of 50 (maximum anxiety) decreased to 18 (10 = no anxiety) after psychotherapeutic intervention, and in the International Index of Erectile Function (IIEF), there was substantial improvement before (17 out of 30, indicating moderate/severe ED) and after psychotherapeutic treatment (29 out of 30, indicating absence of ED (26 to 30)). The percentage change in EPAI and IIEF was highly significant, indicating a reduction in erectile performance anxiety and an overall improvement in the patient's erectile function (table 2).

TABLE 2. Patient's Sexual Performance Scales Before and After Treatment

EPAI (10 – 50)		IIEF		
Before	After	Total	Before	After
43	18	Erectile Function (30)	17	29
		Orgasmic Function (10)	06	09
		Sexual Desire (10)	08	08
		Intercourse Satisfaction (15)	09	10
		Overall Satisfaction (10)	04	08

EPAI: Erectile Performance Anxiety Index [Grade:10(none) – 50 (severe)]; IIEF: International Index of Erectile Function (The lower the score, the more compromised)

Psychotherapeutic treatment not only resulted in significant improvements in scores related to anxiety and erectile dysfunction but was also associated with positive changes in the patient's intestinal microbiome. Next-generation sequencing metagenomic analyses revealed an increase in bacterial diversity after therapy sessions. Specifically, a significant reduction in the bacterium *Oscillibacter ruminantium* was noted, from 28.72% to 2.59%. Furthermore, there was a notable increase in beneficial bacteria such as *Akkermansia muciniphila* (2,36% to 6,26%) and *Faecalibacterium prausnitzii* (1,29% to 5,32%), known for their anti-inflammatory properties. A decrease in potentially harmful bacteria, such as *Staphylococcus aureus* (6,0% to 0%), was also observed. These changes in the intestinal microbiome are particularly intriguing, as recent studies have suggested a link between microbiome health and various pathological conditions, including psychological issues and sexual dysfunctions (GENG *et al.*, 2021; KANG, 2023; OSMAN *et al.*, 2023). Thus, these results add a new dimension to the effectiveness of psychotherapy, suggesting that psychological improvement may also be linked to beneficial alterations in the intestinal microbiome.

DISCUSSION

The patient showed significant improvements on the Hamilton Scale, particularly in areas related to performance anxiety, such as anxious mood, tension, fear, and genitourinary symptoms, after the period of psychotherapeutic follow-up, highlighting the relevance of a psychological approach for the patient.

Anxiety disorder is a mental health condition primarily characterized by the clinical manifestation of anxiety symptoms. Its global incidence varies considerably, ranging from 3% to 25%, and in cases of chronic diseases such as cancer, cardiovascular diseases, and irritable bowel syndrome, the rate can range from 1.4% to 70%. Studies reveal that up to 33.7% of individuals will experience anxiety symptoms throughout their lives. Patients with a more prolonged course of the disease often face cognitive and social impairment, resulting in a serious impact on both patients and society at large. Therefore, effective anxiety treatment plays a crucial role (OSADCHIY *et al.*, 2020). Clinical management of physical illnesses presenting anxiety symptoms typically focuses on alleviating somatic symptoms. Approaches such as psychopharmacology, psychotherapy, and other treatments can be combined to ensure treatment effectiveness. It is essential to note that in some regions, such as China, anxiety symptoms are often confused with somatic manifestations and, as a result, may be overlooked in clinical practice. This can lead to a lack of timely and effective treatment for anxiety symptoms (LEE; LEE, 2020).

In addition to the perceived evidence in overall anxiety, the patient, after 12 weeks of treatment, showed decreases in EPAI and IIEF scores, providing specific

evidence related to erectile function. This demonstrates the effectiveness of psychotherapy as a multidisciplinary treatment approach that not only alleviates symptoms of generalized anxiety, as observed with the decrease in scores on the Hamilton Scale, but also successfully addresses specific issues related to erectile dysfunction. These multiple measures of success reinforce the viability of psychotherapy as an effective treatment option for patients with erectile dysfunction with anxious components, whether it be psychogenic, mixed, or even organic, as all of them compromise the emotional aspect of the patient in some way.

How Can Anxiety Treatment Improve Intestinal Microbiota?

This study has demonstrated an interconnection between psychotherapeutic treatment and changes in the patient's intestinal microbiome, coupled with significant improvements in anxiety and erectile dysfunction-related scores. There was a marked enhancement in diversity with a reduction in pathogenic bacteria and an increase in beneficial bacteria. These findings prompt a valuable discussion on the role of intestinal bacteria in mental and sexual health, as well as potential implications for psychological therapy (RADJABZADEH, *et al.*, 2022).

One of the most noteworthy findings of this study was the substantial reduction in *Oscillibacter ruminantium* bacteria after therapy sessions. *Oscillibacter ruminantium* is a bacterium associated with inflammatory conditions and imbalances in the gut microbiome. Its reduction can be interpreted as a positive step towards promoting intestinal homeostasis, as chronic inflammations have been correlated with the development of psychological disorders, including anxiety. Furthermore, a substantial increase in beneficial bacteria, *Akkermansia muciniphila* and *Faecalibacterium prausnitzii*, was observed after therapy. Both are known for their anti-inflammatory properties and have been the subject of recent studies due to their potential in promoting intestinal health and, by extension, mental health. *Akkermansia muciniphila* plays a crucial role in maintaining the intestinal mucosal barrier and is related to improved insulin sensitivity, reduced systemic inflammation, and potentially appetite regulation, which may have direct relevance to anxiety and erectile dysfunction. The increased presence of *Faecalibacterium prausnitzii* is also promising, as this bacterium is one of the main producers of butyrate, a short-chain fatty acid with well-documented anti-inflammatory effects. Chronic inflammation has been associated with a range of mental disorders, including anxiety, and the role of butyrate in modulating the immune system and maintaining intestinal mucosa integrity may have direct implications for improving psychological well-being. Additionally, the observed decrease in *Staphylococcus aureus* population is relevant, as this bacterium is potentially harmful and may trigger inappropriate immune responses when present in excess. Although further investigations are still needed to fully understand the relationship between *Staphylococcus aureus* and mental health, the reduction in its presence can be interpreted as a positive step towards modulating the intestinal microbiome in favor of balance and homeostasis.

The implications of these changes in the gut microbiome are vast and promising. Recent studies have pointed to an intimate connection between the intestinal microbiome and various pathological states, including psychological disorders and sexual dysfunctions. The bidirectional communication between the gut and the brain, known as the gut-brain axis, has been increasingly recognized as a critical component in mood regulation and sexual behavior (GENG *et al.*, 2021; WERNEBURG *et al.*, 2022; OSMAN *et al.*, 2023). Therefore, the beneficial changes

in the intestinal microbiome observed in this study may offer valuable insights into the intersection of mental health, sexual function, and intestinal microbiota.

While the relationship between intestinal microbiota and performance anxiety in erectile dysfunction is not yet widely studied, emerging research suggests that intestinal microbiota may play a role in regulating mood and stress responses (POKUSAEVA *et al.* 2011). This is due to the bidirectional connection between the brain and the gut, known as the gut-brain axis.

Research has suggested that anxiety can also have a direct impact on a man's intestinal microbiota (MOLINA-TORRES, 2019; MORAIS, 2021). Recent studies have shown that individuals with high anxiety levels exhibit an imbalance in the composition and diversity of intestinal microbiota, leading to a decrease in digestion efficiency and nutrient absorption (MORAIS, 2021). Moreover, anxiety has been linked to an increase in intestinal permeability, allowing harmful bacteria and toxins to enter the bloodstream, which may lead to various health conditions, including chronic inflammation and gastrointestinal disorders (GRACIE *et al.*, 2018; PITTAYANON *et al.*, 2020).

Human studies also suggest a link between intestinal microbiota and erectile dysfunction. For example, recent studies involving men with erectile dysfunction found that they had less diverse intestinal microbiota than healthy men (OSMAN *et al.*, 2019; OKAMOTO *et al.*, 2020; KANG *et al.*, 2023; LEELANI *et al.*, 2023; OSMAN *et al.*, 2023).

Deepening our understanding of the underlying factors affecting changes in the composition and functioning of the intestinal microbiota is crucial for guiding the development of therapies aimed at this objective. An ecological approach to the microbiota provides valuable insights into promoting health, with the perspective of directing this microbial community in clinical interventions. Therefore, the need for additional studies in this area is evident (KANG *et al.*, 2023; LEELANI *et al.*, 2023).

Recognizing that sex is arguably a sensory experience, it is essential to understand that, above all, it is an experience lived in the "here and now" (METZ *et al.*, 2017). Internal processes play a crucial role in the context of the sexual experience. Any distraction, whether related to performance, daily concerns, or professional issues, can result in a significant decrease in the intensity of the sexual experience. This disconnects the individual from the arousal process, the quality of foreplay, and the appropriate sexual response. Therefore, staying connected in the present, aware, and engaged in the situation is essential for achieving proper sexual functioning (BROTTO *et al.*, 2016).

The therapy aims to address these internal conflicts to transform internal processes, both individually and collectively, into valuable resources. For those seeking to resolve human issues, the fundamental pieces of the puzzle are the elements that make up the experience: attitudes (beliefs), thoughts (internal processes), emotions (subjective states), actions (external behaviors), and physiological reactions. In this way, it is observed that in positive sexual experiences, there is an alignment of attitudes, emotions, thoughts, actions, and physiological reactions that naturally achieve pleasure (LIANG *et al.*, 2017). On the other hand, in dysfunctional sexual experiences, some aspect of the experience is misaligned, either in beliefs, subjective states, internal processes, external behaviors, or physiological reactions (DANG, *et al.*, 2018). The organization of internal processes, external behaviors, and physiological reactions, experienced by the patient as problematic, forms the structure of the current state. The belief system, i.e., the

patient's convictions, plays a fundamental role in any transformation process (OSADCHIY *et al.*, 2020).

Human experience results from the interaction between the external world and our senses' perception (BURRI, PORST, 2018; TAVARES *et al.*, 2020). When addressing the issue of sexual dysfunction, it is essential to examine the experience unfolding internally. Often, this internal experience may be at odds with the external sensory experience. If we can manage the internal experience to create positive fantasies aligned with the ongoing external sensory experience, we can generate an alignment between the internal and external experiences of the sexual experience (SANSONE *et al.*, 2019).

Many professionals still approach sexual behavior as something isolated from general human behavior, representing a distorted view, as sexuality is intrinsically integrated into the entirety of the human system. It is fundamental to recognize that the body and mind form a unique system, and both influence each other, requiring a systemic and multidisciplinary approach to sexual dysfunctions (JOHNSON *et al.*, 2018).

CONCLUSION

In this manner, the present study provides initial evidence of the impact caused by performance anxiety during erectile dysfunction on the gut microbiota. Initial data demonstrates low diversity and an increased presence of inflammatory bacteria (*Oscillibacter ruminantium* and *Staphylococcus aureus*), along with a decrease in anti-inflammatory bacteria (*Akkermansia muciniphila* and *Faecalibacterium prausnitzii*). It also illustrates how sexual psychotherapy can be a differentiator in the treatment and restoration of erectile function, consequently improving the intestinal microbiota by reducing inflammatory bacteria (*Oscillibacter ruminantium* and *Staphylococcus aureus*) and significantly increasing anti-inflammatory bacteria (*Akkermansia muciniphila* and *Faecalibacterium prausnitzii*), in addition to enhancing microbiota diversity, which can impact overall health.

It is essential to conduct further studies involving humans to substantiate the relevance of the psychological approach in treating erectile dysfunction and, consequently, in improving the intestinal microbiota. The absence of this psychological approach and this resolved pillar may result in the persistence of adverse impacts on the intestinal microbiota, even after the resolution of erectile dysfunction. This may, in fact, increase the risk of recurrent episodes of erectile dysfunction or the development of other health problems related to compromised intestinal microbiota.

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