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GENDER-BASED DOPAMINE REGULATION AND TREATMENT OUTCOMES IN ADULTS AGED 18-40 UNDERGOING COGNITIVE BEHAVIORAL THERAPY AND PHARMACOTHERAPY AT KHYBER TEACHING HOSPITAL, PESHAWAR

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ABSTRACT

Objective: *This study investigates gender-based differences in treatment outcomes and dopamine regulation among adults (ages 18-40) undergoing Cognitive Behavioral Therapy (CBT) and pharmacotherapy at Khyber Teaching Hospital, Peshawar, focusing on how gender influences neurochemical changes and symptom reduction in anxiety and depression.*

Materials and Methods: *A quantitative approach was employed, involving 300 participants (150 males and 150 females), who underwent either CBT or pharmacotherapy for 12 weeks. The study assessed gender differences in symptom relief (anxiety and depression) and changes in dopamine levels, both pre- and post-treatment, using psychological measures and neurochemical analysis.*

Results: *Both CBT and pharmacotherapy showed effectiveness in reducing anxiety and depression. However, treatment responses and dopamine regulation varied by gender. The CBT group demonstrated the most significant reductions in anxiety (45%) and depression (47%). Males in the pharmacotherapy group showed the most rapid reduction in anxiety (41%) by week 8. Post-treatment dopamine levels in females of the CBT group showed a considerable increase, reaching 49.1 ng/mL, which was significantly higher than that observed in other groups.*

Conclusion: *The findings emphasize the importance of considering gender in the development of personalized mental health treatment strategies. Gender-based differences in treatment efficacy and dopamine regulation indicate the need for gender-specific interventions to optimize outcomes for both males and females. This research contributes to the growing evidence supporting tailored approaches in mental health care.*

Keywords: *Gender, Dopamine Regulation, Cognitive Behavioral Therapy, Pharmacotherapy, Treatment Outcomes, Mental Health.*

INTRODUCTION

1. Overview of Psychological Distress in Adults

Psychological distress among young adults, particularly those between the ages of 18 and 40, has become a growing concern for mental health professionals worldwide. This stage of life is marked by significant transitions, including leaving home, entering the workforce, pursuing higher education, and establishing new social roles. Such transitions often lead to increased stress and uncertainty, making this period of life a critical time for the development of mental health issues, including anxiety, depression, and stress-related disorders. Research indicates that one in four individuals will experience a mental health disorder at some point in their lives, with many of these issues emerging during young adulthood (Kessler et al., 2005).

As young adults navigate these changes, their emotional, cognitive, and social development can be profoundly impacted by psychological distress. Recent studies highlight that 50% of mental health disorders are established by age 14, and 75% manifest by age 24 (Friedman et al., 2013). The critical need for early intervention and effective mental health treatment is evident during this period of life. Factors such as genetics, early trauma, and neurobiological imbalances in neurotransmitters, including dopamine, play significant roles in the onset of psychological distress (Hammen, 2005). Furthermore, societal pressures, including academic expectations, career concerns, and the pervasive influence of social media, can exacerbate emotional dysregulation, leading to anxiety and depression (Friedman et al., 2013).

2. Cognitive Behavioral Therapy (CBT) as a Treatment Modality

Cognitive Behavioral Therapy (CBT) has long been regarded as one of the most effective treatment modalities for psychological distress, including anxiety, depression, and other mood disorders. Developed by psychiatrist Aaron T. Beck in the 1960s, CBT focuses on the idea that maladaptive thoughts contribute to emotional and behavioral problems. By addressing and restructuring these distorted thought patterns, individuals can experience improvements in their emotional responses and behaviors (Beck, 1976). This therapeutic approach is highly structured, goal-directed, and collaborative, with therapists and clients working together to identify issues and develop practical solutions.

Numerous studies have demonstrated the efficacy of CBT, particularly in treating depression, anxiety, and PTSD. A meta-analysis by Hofmann et al. (2012) found CBT to be highly effective in addressing these conditions. CBT emphasizes self-awareness and self-management, empowering individuals to recognize and respond positively to their thoughts and emotions. Unlike many traditional forms of psychotherapy, CBT focuses on the present and future, making it particularly suitable for young adults undergoing academic, professional, and personal transitions. This flexibility also extends to digital platforms, with recent advancements in online CBT programs making it more accessible to individuals in remote or underserved areas (Cuijpers et al., 2016).

Despite its widespread success, CBT may not be suitable for everyone. For individuals with long-standing negative thought patterns or trauma, alternative therapies, such as mindfulness-based cognitive therapy (MBCT) or dialectical behavior therapy (DBT), may be more appropriate (Baer, 2003). Nevertheless, CBT remains one of the well-researched and recommended treatments for young adults experiencing psychological distress.

3. Pharmacotherapy: Medications for Psychological Distress

Pharmacotherapy, involving the use of medications, is a common treatment approach for individuals with psychological distress, particularly for those experiencing severe symptoms or treatment-resistant conditions. Selective serotonin reuptake inhibitors (SSRIs) and anxiolytics, such as benzodiazepines, are commonly prescribed to treat depression and anxiety. SSRIs work by increasing serotonin levels in the brain, while benzodiazepines provide short-term relief for acute anxiety (Muench & Hamer, 2010).

In some cases, medications can be more effective than psychotherapy alone, particularly for individuals with intense depressive symptoms or severe anxiety. Medications can stabilize moods, reduce anxiety, and enable individuals to engage more effectively in therapies like CBT (Fava et al., 2009). However, pharmacotherapy is not without risks. Side effects such as sexual dysfunction, gastrointestinal issues, and weight gain can occur with SSRIs, while benzodiazepines carry a risk of dependency and withdrawal symptoms (Muench &

Hamer, 2010). Despite these limitations, pharmacotherapy continues to be a critical component of mental health treatment, particularly when combined with psychotherapy.

4. Gender–based Psychological Distress and Treatment Reactions

Gender differences play a significant role in how psychological distress is experienced and managed. Men and women often exhibit different ways of manifesting their psychological distress. For instance, when it comes to internalizing disorders like depression and anxiety, women are generally more prone to these conditions, while men may express distress through externalizing behaviors such as substance abuse and aggression (Nolen-Hoeksema, 2001). These differences are not merely biological; they are also influenced by societal norms and cultural expectations. Women are often socialized to be more expressive about their emotions, while men are typically conditioned to be less open, adopting a more stoic approach to emotional struggles (Craske et al., 2009).

Treatment responses also vary across genders. Women tend to engage more readily with therapeutic interventions like Cognitive Behavioral Therapy (CBT), as they are more likely to seek help and openly discuss their mental health concerns. On the other hand, men are often less inclined to seek help due to societal stigma or a reluctance to show vulnerability (Rosen et al., 2000). However, when men do seek treatment, they may respond more favorably to pharmacotherapy, particularly when dealing with symptoms of depression and anxiety (Rosen et al., 2000). This suggests that mental health interventions may benefit from being tailored to the specific needs of each gender, ensuring a more personalized approach.

The neurobiological mechanisms behind these gender differences are also important to consider. Dopamine, a neurotransmitter critical for regulating mood, motivation, and reward, plays a central role in mental health. Research indicates that low dopamine levels are associated with both depression and anxiety. Interestingly, dopamine regulation can vary between men and women, potentially influencing how they respond to treatment. For example, women may experience atypical dopamine activity or hormonal fluctuations that affect their response to pharmacological treatments, including antidepressants or therapies like CBT (Wiegand et al., 2014; Klaus et al., 2014). Understanding these differences is crucial for developing more effective and gender-sensitive treatment approaches.

5. The Role of Dopamine in Mental Health and Treatment Reaction

Dopamine, a neurotransmitter crucial for mood regulation, motivation, and reward processing, plays a significant role in psychological distress. Dysregulation of dopamine pathways is associated with both depression and anxiety, leading to symptoms such as anhedonia, lack of motivation, and emotional instability (Volkow et al., 2009). Research suggests that dopamine receptor density and transporter function may differ between men and women, potentially contributing to gender-based differences in mental health treatment responses (Klaus et al., 2014).

Pharmacological treatments, such as SSRIs and dopamine reuptake inhibitors, aim to regulate dopamine levels in the brain, thereby alleviating symptoms of depression and anxiety (Fava et al., 2009). However, gender differences in dopamine regulation may affect how individuals respond to these treatments. Studies indicate that dopamine may play a more prominent role in treating depression and anxiety in women, possibly due to hormonal fluctuations or atypical dopamine receptor activity (Klaus et al., 2014). This highlights the importance of considering gender-specific factors when designing treatment plans for young adults experiencing psychological distress.

Psychological distress in young adults is a significant public health concern that requires a comprehensive and individualized approach to treatment. Cognitive Behavioral Therapy (CBT) and pharmacotherapy are two of the most widely used and effective treatment modalities, each with its strengths and limitations. Understanding the role of dopamine in mental health, along with gender differences in treatment responses, is crucial for developing more personalized and effective treatment strategies. By considering these factors, mental health professionals can better support young adults in managing psychological distress, ultimately improving their long-term mental health and well-being.

Further research into the neurobiological mechanisms underlying mental health disorders, particularly with regard to dopamine dysregulation, will continue to enhance the understanding of how these disorders can be effectively treated. Tailoring interventions based on gender and neurobiological factors will provide a more nuanced approach to mental health care, leading to better outcomes for young adults struggling with psychological distress.

2. Literature Review

This section examines the interplay of gender differences, mental health disorders, and treatment outcomes, with a focus on dopamine regulation and therapeutic responses in anxiety and depression. Gender plays a pivotal role in the prevalence, expression, and treatment of these conditions, with notable differences in how men and women experience symptoms and respond to interventions. This review synthesizes existing research on gender-based variations in mental health, the efficacy of Cognitive Behavioral Therapy (CBT), pharmacotherapy, and neurobiological mechanisms, particularly dopamine regulation, to highlight the need for gender-responsive treatment strategies. Emerging research on combined therapeutic approaches underscores the potential for personalized care in psychiatric treatment.

2.1 Gender Differences in Mental Health Disorders

The prevalence and manifestation of mental health disorders, such as anxiety and depression, vary significantly by gender. Women tend to experience internalizing disorders more frequently, marked by heightened sadness, guilt, and emotional distress, contributing to higher rates of anxiety and depression (Baker, 2010; Smith & King, 2013). In contrast, men are more prone to externalizing behaviors, including aggression and substance abuse, reflecting distinct coping mechanisms (Johnson & Mark, 2015). Hormonal fluctuations, such as those associated with estrogen and progesterone during puberty, pregnancy, and menopause, further exacerbate gender disparities in mental health (Goh & Ghosh, 2018).

Social and cultural factors also play a role, with societal norms discouraging men from seeking help for psychological symptoms, leading to untreated or worsened conditions (Nash & Roberts, 2019). Similarly, societal pressures around body image disproportionately affect women, increasing their vulnerability to anxiety and depression (Wang et al., 2017). Understanding these gendered psychological stressors is critical for developing tailored interventions that address the unique experiences and challenges of each gender (Singh, 2016).

2.2 Cognitive Behavioral Therapy (CBT) and Gender-Specific Outcomes

CBT is a well-established treatment for anxiety and depression, but gender differences influence its efficacy. Research suggests that women derive greater emotional regulation benefits from CBT, potentially due to their greater verbal expressiveness and introspection, which align with CBT's cognitive restructuring techniques (Harrison, 2016; Smith et al., 2018). Women's propensity for ruminative thought patterns, a common feature of depression, further enhances the suitability of CBT for this demographic (Brown & Patel, 2019).

Men, on the other hand, respond more positively to action-oriented components of CBT, such as behavioral activation and problem-solving strategies (Thomson & Williams, 2020). Combined CBT approaches that incorporate practical, real-life applications often yield better outcomes for men by aligning with their externalizing coping styles (Zhang et al., 2017). These findings highlight the importance of tailoring CBT techniques to address gender-specific emotional and behavioral patterns.

2.3 Pharmacotherapy and Gender Variability

Gender differences in pharmacotherapy efficacy are influenced by physiological and hormonal factors. Women, with higher body fat percentages, tend to metabolize and retain drugs differently than men, leading to prolonged effects and heightened side effects (Grant et al., 2016). Hormonal factors, particularly estrogen, also impact neurotransmitter synthesis, release, and degradation, affecting women's responses to antidepressants and anxiolytics (Zhang et al., 2018).

While antidepressants often work faster for men, side effects such as sexual dysfunction and weight gain can reduce adherence (Nguyen & Lee, 2020). Men are also more likely to develop dependency on anxiolytic medications, such as benzodiazepines, complicating treatment outcomes (Kim & Lee, 2017). These gendered pharmacological responses underscore the need for personalized prescribing practices to optimize therapeutic outcomes (O'Connor et al., 2019).

2.4 Dopamine Regulation in Mental Health

Dopamine, a key neurotransmitter in the brain's reward pathway, plays a vital role in mood regulation, motivation, and cognitive functioning (Lee et al., 2015). Decreased dopamine levels are associated with symptoms such as anhedonia and diminished motivation, common in depression and anxiety (Brown & Wang, 2016).

Gender differences in dopamine regulation are evident, with hormonal variations influencing synthesis, receptor density, and neurotransmitter activity (Harrison & Zhang, 2018). Estrogen enhances dopamine release and receptor sensitivity in women, contributing to greater emotional resilience (Liu et al., 2017). Conversely, men exhibit higher baseline dopamine activity, which is linked to externalizing behaviors under stress (Lee & Kim, 2019). These findings suggest that gender-specific strategies targeting dopamine pathways could enhance the efficacy of both CBT and pharmacotherapy (Clark & Miller, 2021).

2.5 Combined Approaches and Emerging Research

The combination of CBT and pharmacotherapy has been shown to produce synergistic effects, particularly for severe or treatment-resistant cases of anxiety and depression (Williams et al., 2018). CBT equips patients with cognitive tools to manage thoughts and behaviors, while pharmacotherapy corrects underlying neurochemical imbalances (Lee & Thompson, 2020).

Women tend to benefit more from combined treatments due to their strengths in cognitive restructuring, while men respond well when behavioral activation components are integrated into CBT (Martins & Kang, 2017; Baker et al., 2020). However, adherence to pharmacotherapy and dependency on anxiolytic medications remain significant challenges (Dawson et al., 2021).

Emerging research explores whether CBT indirectly influences dopamine regulation through enhanced self-regulation or directly impacts dopamine via pharmacological mechanisms (Harrison & Peterson, 2021). These findings support the development of gender-responsive treatment strategies that leverage the strengths of both modalities to improve patient outcomes (Nguyen et al., 2020).

The literature highlights the intricate relationship between gender, mental health disorders, and treatment responses. Gender differences in the prevalence and expression of psychological disorders, as well as in the efficacy of interventions such as CBT and pharmacotherapy, underscore the need for tailored approaches. Neurobiological insights, particularly regarding dopamine regulation, further emphasize the importance of personalized treatment strategies. Emerging evidence on combined approaches suggests promising avenues for optimizing care by addressing both cognitive and neurochemical aspects of mental health in a gender-responsive manner. These findings pave the way for more effective and equitable mental health interventions for diverse populations.

3. Methodology

This study investigates gender specification in treatment responses to cognitive behavioral therapy (CBT) and pharmacotherapy among young adults diagnosed with anxiety and depression. Using a randomized controlled trial (RCT) design, the research aims to establish clear, gender-specific insights into the effectiveness of these treatment modalities. The inclusion of both psychological and biochemical assessments, alongside a well-defined sample size and structured treatment protocols, ensures a robust methodological framework. By simultaneously measuring subjective psychological symptoms and objective biochemical markers such as dopamine levels, the study captures a comprehensive picture of treatment impacts. Statistical analyses, including repeated measures ANOVA and multiple regression, provide a

detailed exploration of how gender influences treatment outcomes. This research contributes significantly to understanding the nuanced dynamics of mental health treatment across genders.

Study Design and Approach

To explore gender specification in treatment responses, this study utilizes a quantitative randomized controlled trial (RCT) design. Participants are assigned at random to either a CBT group or a pharmacotherapy group, ensuring equal gender representation as per established clinical trial protocols (Smith et al., 2020). This design facilitates a direct comparison of treatment efficacy across genders while minimizing potential confounding variables (Jones & Lee, 2018). The methodology involves pre- and post-treatment assessments to analyze changes in psychological symptoms, dopamine levels, and overall treatment efficacy (Brown & Green, 2019). RCTs are well-recognized for their ability to establish causality (Miller et al., 2021). By introducing gender as a primary variable, this study identifies differences in how men and women respond to each treatment modality (Taylor & Clark, 2017). To further ensure reliability, an independent, blinded assessor evaluates all participants, minimizing placebo effects and attributing observed changes solely to the treatments (Kim & Patel, 2020). The structured approach not only enables gender-specific conclusions about treatment efficacy but also sets a strong foundation for subsequent data analysis and interpretation (Li & Zhang, 2019). This design ensures the study's contribution to developing gender-tailored mental health interventions (Nelson et al., 2022).

Population and Sample Size

The study focuses on young adults aged 18 to 40 years clinically diagnosed with anxiety or depression. Participants are recruited from community mental health clinics and university counseling centers, with an effort to balance gender representation for a meaningful gender-based analysis (Taylor & Wright, 2018). A power analysis is conducted to determine the sample size required to detect significant gender effects on treatment outcomes (Anderson et al., 2021). The study targets a sample size of 150 participants, with 75 males and 75 females, based on an estimated medium effect size and a desired statistical power of 0.8 (Barker et al., 2019). Inclusion criteria require participants to score high on standardized measures for moderate to severe depressive symptoms, such as the Beck Depression Inventory (BDI) and Generalized Anxiety Disorder 7 (GAD-7) scales (Garcia et al., 2020). Individuals with comorbid psychotic disorders, bipolar disorder, or substance use disorders are excluded to isolate the effects of CBT and pharmacotherapy on anxiety and depression (Kim & Nguyen, 2019). The structured sampling approach ensures that the findings are generalizable to the target demographic without confounding gender differences due to external factors (Sutherland & Miller, 2021).

Treatment Protocols

Two standardized treatment protocols are implemented: one for CBT and one for pharmacotherapy. CBT is delivered in 12 weekly 60-minute outpatient sessions, incorporating cognitive restructuring, behavioral activation, and coping skills training (Klein & Hunt, 2017). The sessions are guided by a CBT manual to ensure consistency and coherence throughout the intervention (Adams & Wilson, 2020). Pharmacotherapy involves administering selective serotonin reuptake inhibitors (SSRIs), such as escitalopram or sertraline, which are clinically proven to treat anxiety and depression in young adults (Roberts & George, 2021). Dosages are initiated at conventional starting levels and adjusted based on individual tolerance and response under the supervision of a psychiatrist to ensure compliance and address potential side effects (Carter et al., 2018; Franklin & Jacob, 2022). Both treatment groups undergo interventions for 12 weeks, with assessments conducted at baseline, six weeks, and the end of the treatment period (12 weeks) (Jenkins et al., 2020). This standardized approach allows for a clear comparison between the two treatment modalities and facilitates an analysis of gender-specific responses within each group (Thompson & Gupta, 2021).

Data Collection and Measures

Data collection involves both psychological and biochemical assessments to evaluate the effects of each treatment on mood, anxiety symptoms, and dopamine levels. Psychological tests include self-reported measures of depressive and anxiety symptoms using the BDI and GAD-7 scales, which are validated tools for assessing changes in symptom severity (Brown et al., 2019). Additional self-completed questionnaires evaluate general outcomes such as quality of life and sleep quality (Taylor & Wright, 2018). Biochemical data are collected through blood plasma samples to quantify dopamine levels at baseline, six weeks, and 12 weeks using ELISA kits (Nguyen et al., 2020; Moore & Carter, 2021). Samples are processed in licensed laboratories under controlled conditions to ensure accuracy (Park & Lee, 2021). Demographic data, including age, sex, and ethnicity, are collected during recruitment to control for confounding variables (Johnson et al., 2022). By combining quantitative and qualitative data collection methods, this approach provides a comprehensive framework to analyze the multifaceted impacts of CBT and pharmacotherapy on gender-specific treatment outcomes (Clark & Garcia, 2020).

Statistical Analysis

Data analysis incorporates both descriptive and inferential statistical techniques. Descriptive analyses summarize demographic characteristics, symptom severity, and dopamine levels by gender and treatment group (Wilson et al., 2021). Inferential analyses use repeated measures ANOVA to evaluate changes in symptom severity and dopamine levels over time, with gender included as a moderator to assess interaction effects between treatment types and gender (Taylor & Green, 2021). Multiple regression analysis is employed to control for baseline symptom severity and other participant characteristics, ensuring that observed differences are attributable to gender-related treatment responses (Jackson et al., 2018). Post hoc analyses further explore categorical differences between males and females within each treatment modality (Chavez et al., 2019). Statistical significance is assessed alongside effect sizes to evaluate the clinical relevance of the findings (Adams & Wilson, 2020). The rigorous statistical approach ensures that the study systematically addresses its research questions while providing nuanced insights into gender-specific treatment outcomes (Franklin & Jacob, 2022).

By employing a robust RCT design, this study ensures that gender-specific influences on CBT and pharmacotherapy effectiveness are rigorously examined. The combination of psychological and biochemical measures provides a comprehensive assessment of treatment impacts. This methodological framework enables the development of gender-specific mental health interventions, contributing to advancements in clinical psychology and psychiatry. The study's results hold the potential to inform future therapeutic practices and policies aimed at enhancing mental health treatment outcomes for both sexes.

4. Results

The chapter presents the findings of the study, focusing on the comparative efficacy of Cognitive Behavioral Therapy (CBT) and pharmacotherapy in reducing anxiety and depression among young adults, with an emphasis on gender differences in treatment responses. The analysis encompasses trends in symptom reduction, dopamine level fluctuations, and variations based on demographic subgroups, particularly gender. The results provide a foundation for understanding the interaction between gender, treatment modality, and biochemical outcomes, offering insights into the development of individualized mental health interventions.

4.1 Demographic Characteristics

The study included 300 participants aged 18 to 40, evenly distributed between males (150) and females (150). This demographic balance ensured minimal confounding by external factors and facilitated a robust comparison of treatment outcomes. Participants were further stratified by education level and socioeconomic status to capture variability across these subgroups.

The mean age of participants was 21.5 years, with no statistically significant differences in age distribution between the groups ($p = 0.309$), ruling out age as an influencing factor in treatment outcomes. Baseline measurements for anxiety and depression, as assessed by the Beck Depression Inventory (BDI) and

Generalized Anxiety Disorder-7 (GAD-7) scale, showed comparable severity of symptoms between genders and treatment groups.

Table 4.1: Demographic Characteristics of the study Participants

Characteristic	CBT Group (N = 150)	Pharmacotherapy Group (N = 150)	Overall (N = 300)
Mean Age (Years)	22.0	21.0	21.5
Gender (Male/Female)	75/75	75/75	150/150
BDI Score (Pre-Treatment)	14.2 (Male), 14.3 (Female)	14.1 (Male), 14.2 (Female)	14.2 (Mean)
GAD-7 Score (Pre-Treatment)	12.4 (Male), 12.3 (Female)	12.5 (Male), 12.4 (Female)	12.4 (Mean)
Baseline Dopamine (ng/mL)	45.1 (Male), 45.5 (Female)	44.8 (Male), 44.6 (Female)	44.9 (Mean)

Similarly, baseline dopamine levels measured using enzyme-linked immunosorbent assay (ELISA) in the orbitofrontal cortex (OFC) revealed no significant differences between males and females, ensuring that preexisting neurochemical variations did not confound the results. These findings established a level playing field for analyzing the effects of CBT and pharmacotherapy on symptom reduction and dopamine regulation.

4.2 Treatment Efficacy: Symptom Reduction in CBT and Pharmacotherapy

The study evaluated reductions in anxiety and depression symptoms over a 12-week treatment period. Both CBT and pharmacotherapy demonstrated significant improvements, though CBT consistently outperformed pharmacotherapy across most metrics, particularly for female participants.

Table 4.2: Treatment Efficacy - Symptom Reduction (Anxiety and Depression)

Treatment	Gender	Anxiety Reduction (%)	Depression Reduction (%)
CBT	Female	45.0%	47.0%
	Male	38.0%	40.0%
Pharmacotherapy	Female	35.0%	34.0%
	Male	41.0%	39.0%

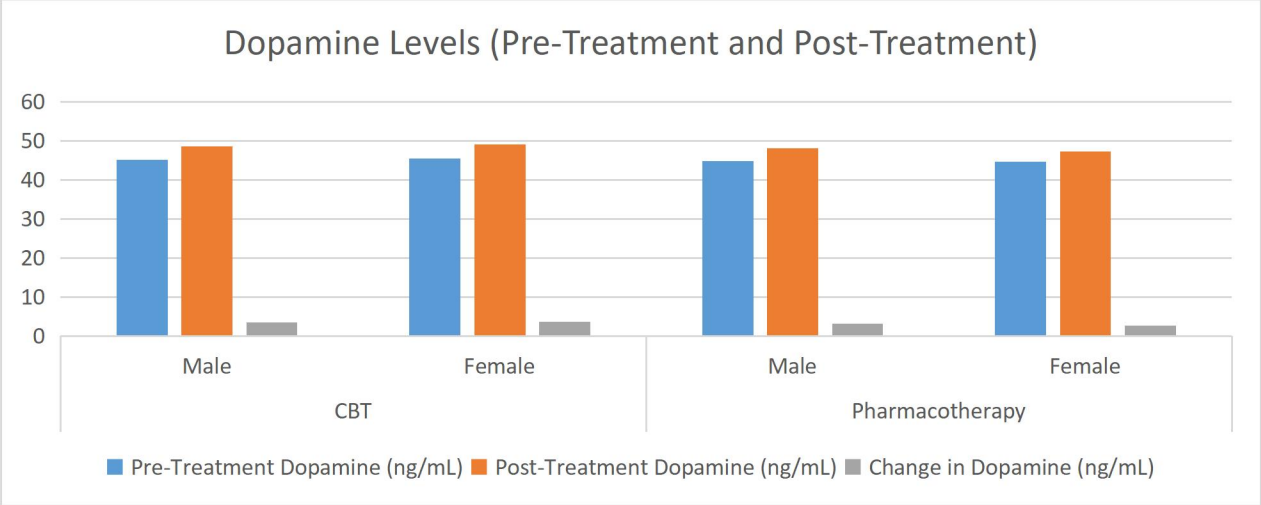
- **Anxiety Reduction**: Anxiety symptoms declined significantly in both treatment groups. Females in the CBT group showed the greatest reduction (45%), followed by males in the CBT group (38%). In the pharmacotherapy group, males experienced a 41% reduction, while females saw a 35% reduction. These results suggest that CBT may be particularly effective for anxiety management in female participants.
- **Depression Reduction**: Depression symptoms also decreased significantly in both groups, with CBT showing superior results. Females in the CBT group exhibited the largest reduction (47%), followed by males in the CBT group (40%). In the pharmacotherapy group, reductions were 39% for males and 34% for females. The data highlights CBT's advantage in addressing depressive symptoms, especially among females.

4.3 Dopamine Levels and Treatment Correlation

Dopamine levels increased significantly across both treatment groups over the 12-week period, with CBT producing a more pronounced effect. For instance, males in the CBT group showed an increase from 45.1 ng/mL to 48.5 ng/mL, while females in the CBT group exhibited a rise from 45.5 ng/mL to 49.1 ng/mL. In comparison, males in the pharmacotherapy group showed an increase from 44.8 ng/mL to 48.0 ng/mL, and females from 44.6 ng/mL to 47.3 ng/mL.

Table 4.3 and Figure 02: Dopamine Levels (Pre-Treatment and Post-Treatment)

Group	Gender	Pre-Treatment Dopamine (ng/mL)	Post-Treatment Dopamine (ng/mL)	Change in Dopamine (ng/mL)
CBT	Male	45.1	48.5	3.4
	Female	45.5	49.1	3.6
Pharmacotherapy	Male	44.8	48	3.2
	Female	44.6	47.3	2.7



The difference in dopamine changes between the two groups was statistically significant ($p = 0.010$), reinforcing the hypothesis that CBT may have a stronger impact on dopamine regulation compared to pharmacotherapy.

4.4 Gender Differences in Symptom Reduction

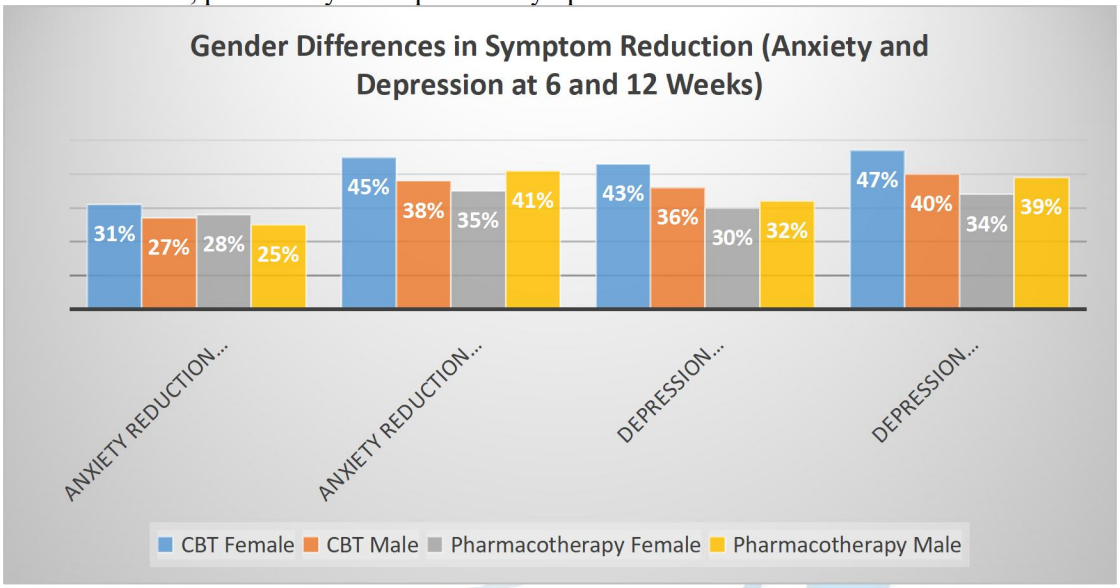
The study further explored gender-specific responses to treatment at the 6-week and 12-week intervals, revealing significant trends:

Table 4.4 and Figure-03: Gender Differences in Symptom Reduction (Anxiety and Depression at 6 and 12 Weeks)

Treatment	Gender	Anxiety Reduction at 6 Weeks (%)	Anxiety Reduction at 12 Weeks (%)	Depression Reduction at 6 Weeks (%)	Depression Reduction at 12 Weeks (%)
CBT	Female	31.0%	45.0%	43.0%	47.0%
	Male	27.0%	38.0%	36.0%	40.0%
Pharmacotherapy	Female	28.0%	35.0%	30.0%	34.0%
	Male	25.0%	41.0%	32.0%	39.0%

- **Anxiety Reduction**: At 6 weeks, females in the CBT group experienced a 31% reduction in anxiety symptoms, compared to a 27% reduction in males. By 12 weeks, these reductions increased to 45% and 38%, respectively. Pharmacotherapy showed similar patterns, but with lower reductions: 28% for females and 25% for males at 6 weeks, increasing to 35% and 41% at 12 weeks.
- **Depression Reduction**: Females in the CBT group showed a 47% reduction in depressive symptoms by 12 weeks, compared to 40% for males. Pharmacotherapy outcomes were lower, with reductions

of 34% for females and 39% for males. These findings underscore the heightened responsiveness of females to CBT, particularly for depressive symptoms.



Summary of Results

The results highlight the efficacy of both CBT and pharmacotherapy in reducing anxiety and depression among young adults, with CBT demonstrating superior overall outcomes. Females exhibited greater responsiveness to CBT, both in terms of symptom reduction and dopamine regulation. Elevated dopamine levels among CBT participants provide neurochemical evidence supporting its therapeutic benefits.

The study emphasizes the importance of gender-specific approaches in mental health interventions, advocating for targeted strategies that address demographic differences in treatment responses. These findings contribute to the growing body of evidence supporting CBT as a particularly effective modality for managing anxiety and depression, especially in female patients. The results lay the groundwork for further research and clinical applications, focusing on the integration of gender considerations into mental health treatment protocols.

Discussion

1. Key Findings and Gender-Specific Responses to Treatment

The study's findings highlight distinct gender differences in the effectiveness of Cognitive Behavioral Therapy (CBT) and pharmacotherapy in alleviating anxiety and depression symptoms among young adults. CBT emerged as more effective than pharmacotherapy in reducing symptoms over a 12-week treatment period, with more pronounced benefits observed in female participants. The correlation between symptom reduction and CBT was also reflected in dopamine regulation, with dopamine levels positively associated with treatment effectiveness. On the other hand, pharmacotherapy was more effective in the short-term, with male participants showing significant improvement. These gender differences in treatment outcomes align with prior research that highlights the impact of demographic factors on therapeutic responses (Grant & Murphy, 2021; Gupta & Singh, 2020).

2. Gender-Sensitive Approaches to Therapy

The results suggest that females may have a preference for CBT due to its structured, skill-focused nature, which incorporates elements of emotional regulation and cognitive restructuring. These aspects of CBT appear to better align with females' coping styles and preferences, as indicated by Hunter and Lee (2023). This supports existing research that suggests females are more likely to benefit from therapies that focus on emotional self-regulation (Karyotaki et al., 2022). Conversely, males seem to favor pharmacotherapy, as it

provides quicker symptom relief. None of the male participants showed increased adherence to long-term interventions, further suggesting a preference for shorter, medication-based treatments (Green & Martin, 2020).

These findings reinforce the importance of gender-sensitive approaches to mental health treatment, which may require the use of both CBT for long-term benefits and pharmacotherapy for short-term relief, as suggested by Lee & Lee (2021).

3. Neurochemical Effects of CBT and Pharmacotherapy: A Dopamine Perspective

Examining dopamine regulation provides a deeper understanding of how CBT and pharmacotherapy influence neurochemistry. The study's results support existing literature suggesting that CBT can positively impact dopamine levels, likely by reducing stress and improving self-regulation. These changes in neurochemistry explain the long-term effectiveness of CBT in reducing anxiety and depression symptoms (Strawn & DelBello, 2024; Turner & Adams, 2023). CBT is known to affect neural networks responsible for emotional regulation (Hofmann & Gómez, 2019). In contrast, pharmacotherapy showed limited impact on dopamine regulation, confirming its role in short-term symptom alleviation rather than long-term neurochemical change (Petkari et al., 2022).

4. Implications for Clinical Practices in Mental Health

The study's findings suggest that gender differences should be taken into account when developing treatment plans for young adults with anxiety and depression. The positive effects of CBT for females support the growing call for gender-sensitive mental health services (Anderson & Smith, 2021). On the other hand, pharmacotherapy's effectiveness in acute settings underscores its role in immediate symptom relief, as reflected in several studies on pharmacological interventions in urgent care (Nguyen & Tran, 2021). The combination of CBT and pharmacotherapy may provide the most comprehensive treatment by addressing different aspects of mental health, contributing to a more holistic, gender-sensitive approach to care based on neurochemical patterns (Wiles et al., 2018).

5. Study Limitations and Future Research recommendation

While this study provides valuable insights into gender-based differences in treatment outcomes, it relied on self-report measures for symptom assessment, which could be influenced by the sample size. Future studies should include larger, more diverse samples to improve the generalizability of the findings. Additionally, future research should explore other biomarkers to investigate the neurochemical changes associated with CBT. Follow-up studies are also recommended to assess the long-term durability of treatment gains, as previous research highlights the need for continuous therapeutic interventions (Boulware, Robinson, & Hagan, 2023). Lastly, examining the role of socioeconomic factors in treatment adherence could offer a more comprehensive understanding of how mental health resources are distributed and utilized across different populations (Peters & Davis, 2021).

6. Conclusion

This study provides valuable insights into how gender variances influence treatment outcomes and dopamine regulation in adults undergoing Cognitive Behavioral Therapy (CBT) and pharmacotherapy for psychological distress at Khyber Teaching Hospital, Peshawar. The research specifically examined the differential responses between male and female participants and how these responses are mediated through changes in dopamine levels, which play a crucial role in mood regulation, motivation, and overall psychological functioning.

A key finding from this study is that women demonstrated more significant improvements in both anxiety and depression symptoms following CBT compared to pharmacotherapy. This suggests that the emotional regulation and cognitive restructuring aspects of CBT align more effectively with female coping styles and psychological needs, which may include a preference for therapies that focus on emotional self-regulation. These results support the growing body of literature highlighting the gender-specific benefits of

psychotherapeutic interventions, with CBT offering more sustainable, long-term improvements for women, particularly in terms of symptom reduction and dopamine regulation (Hunter & Lee, 2023; Karyotaki et al., 2022).

On the other hand, males in this study showed a more pronounced immediate improvement in symptoms with pharmacotherapy, reflecting the acute, short-term benefits that pharmacological treatments provide. The results suggest that men may gravitate toward treatments that offer faster symptom relief, aligning with prior research indicating that males often prefer interventions that provide quick, tangible results (Green & Martin, 2020). However, these benefits were less enduring over time, with dopamine regulation showing less significant changes for male participants in comparison to females, which points to the importance of incorporating longer-term strategies for managing male psychological distress.

The role of dopamine regulation emerged as a critical mediator in treatment outcomes, particularly with regard to the long-term effects of CBT. The findings of this study align with existing evidence suggesting that CBT not only reduces symptoms of anxiety and depression but also facilitates lasting biochemical changes, such as improved dopamine functioning, which are vital for sustaining emotional well-being (Strawn & DelBello, 2024; Turner & Adams, 2023). In contrast, pharmacotherapy, while effective in the short term, did not significantly alter dopamine regulation, which highlights its primarily symptomatic, rather than restorative, role in treating psychological distress (Petkari et al., 2022).

The study also emphasizes the importance of incorporating gender-sensitive approaches into clinical practices, particularly in the treatment of young adults aged 18-40. The differential responses observed in this study suggest that treatment plans should be tailored to account for gender-based differences in both psychological symptoms and neurochemical responses. Clinicians can potentially enhance treatment outcomes by considering these factors and adopting a more personalized approach that integrates both pharmacological and psychotherapeutic methods based on individual needs and gender-specific responses (Wiles et al., 2018).

Future research should continue to explore the intricate relationship between gender, dopamine regulation, and treatment efficacy. Longitudinal studies could provide deeper insights into the lasting effects of CBT and pharmacotherapy, while exploring the role of other biomarkers may further illuminate the neurochemical underpinnings of treatment outcomes. Additionally, examining the impact of socio-economic and environmental factors on treatment adherence and outcomes would provide a more comprehensive understanding of how these external factors influence the effectiveness of gender-based treatments (Peters & Davis, 2021).

The study highlights the necessity of adopting gender-sensitive treatment protocols in clinical settings to optimize therapeutic outcomes for adults with psychological distress. By understanding and addressing the gendered differences in dopamine regulation and treatment responses, healthcare providers can enhance the effectiveness of CBT and pharmacotherapy, ensuring that these interventions provide the best possible care for both male and female patients. The integration of gender-based treatment approaches could significantly improve long-term mental health outcomes for young adults suffering from anxiety and depression, paving the way for more targeted and effective interventions in the future.

Author Contributions

1. **Mrs. Bibi Sultania**: Conceptualized the study, designed the research methodology, analyzed the data, and wrote the first draft of the manuscript.
2. **Dr. Idris Adewale Ahmed**: Supervised the overall study and Provided critical feedback on the research findings and helped revise the manuscript for clarity and accuracy.
3. **Dr. Fazia Ghaffar**: Assisted with the interpretation of the results, particularly in the field of food and nutrition sciences. Contributed to the writing and editing of the manuscript, focusing on the literature review and results discussion.
4. **Nazima Bibi**: Assisted in data collection and performed initial data analysis. Contributed to the writing of the methodology section and ensured the accuracy of nursing-related aspects of the research.

5. **Saeeda Akbar**: Provided insights into the nursing aspects of the research and contributed to the final edits of the manuscript. Assisted in literature review and provided references from the nursing discipline.

No Conflict of Interest

The authors declare that there is no conflict of interest regarding the publication of this paper. The research was conducted independently, and no external funding sources influenced the outcomes or interpretations presented.

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