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Cortisol Dysregulation Linking Metabolic and Psychological Disorders: A Cross-Sectional Study in Tripoli, Libya

Ayiman Khalleefah Alfeetouri Almabrouk [1], Mohammed A. Murshid[2*], kamal Alhadi Mawloud Alshaybani[3], Tarak abu Al-kasem Zahmoul[4], Abdulwahid Mohammed Almahdi Sirtiyah[5], Asem Ramadan Amar Mohamed[6], Said Ezawia[7].

[1,3,7] Department of Health Sciences Al-ajeelat, Faculty of Health Science, Zawia University, Libya

[2,4,5,6] Department of Veterinary Medicine, Faculty of Veterinary Medicine and Agriculture, Zawia University, Libya

*Corresponding author. Email: m.morshed@zu.edu.ly

اختلال تنظيم الكورتيزول وعلاقته بالاضطرابات الأيضية والنفسية: دراسة مقطعية في طرابلس، ليبيا

أيمان خليفة الفيتوري المبروك[1], محمد السيد مرشد*[2], كمال الهادي مولود الشيباني[3], طارق ابوالقاسم زهمول[4], عبد الواحد محمد المهدي سرتية[5], عاصم رمضان عمار محمد[6], سعيد الزاوية[7].

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Abstract:

Cortisol is a glucocorticoid hormone that regulates metabolism and psychological balance through activation of the stress response. This study aimed to explore the association between elevated cortisol levels and selected biochemical disorders including insulin resistance, Cushing's syndrome, Addison's disease, congenital adrenal hyperplasia, as well as psychological disorders such as depression and bipolar disorder. A total of 50 patients (aged 7–30 years, both sexes) were recruited from Al-Razi Psychiatric Hospital in Tripoli, Libya, between May 15 and July 30, 2025. Data were collected using a structured clinical questionnaire and analyzed using descriptive statistical methods in Microsoft Excel. The results showed that the highest prevalence was in the 21–30 age group (46%). Females were more affected by metabolic disorders (66%) compared to males (34%), while psychological disorders were also higher in females (58% vs. 42%). A clear association was observed between elevated cortisol and clinical symptoms such as obesity, anxiety, and depression. The study recommends adopting a healthy lifestyle, regular checkups, and cautious use of corticosteroids under medical supervision to reduce cortisol-related health risks.

Keywords: Cortisol, Metabolic disorders, Psychological disorders, Insulin resistance, Depression, Bipolar disorder, Obesity, Stress, Libya.

الملخص:

يُعدّ الكورتيزول أحد الهرمونات الجلوكوكورتيكويدية الرئيسة التي تؤدي دورًا محوريًا في تنظيم عمليات الأيض والحفاظ على التوازن النفسي من خلال تنشيط استجابة الجسم للإجهاد. هدفت هذه الدراسة إلى استقصاء العلاقة بين ارتفاع مستويات الكورتيزول وبعض الاضطرابات البيوكيميائية المختارة، بما في ذلك مقاومة الإنسولين، ومتلازمة كوشينغ، ومرض أديسون، وتضخم الغدة الكظرية الخلقي، إضافةً إلى بعض الاضطرابات النفسية مثل الاكتئاب واضطراب ثنائي القطب. شملت الدراسة خمسين مريضًا من كلا الجنسين، تتراوح أعمارهم بين 7 و30 عامًا، تم اختيارهم من مستشفى الرازي للأمراض النفسية بمدينة طرابلس، ليبيا، خلال الفترة من 15 مايو إلى 30 يوليو 2025. جُمعت البيانات باستخدام استبيان سريري مُنظَّم، وتم تحليلها باستخدام الأساليب الإحصائية الوصفية من خلال برنامج.Microsoft Excel أظهرت النتائج أن أعلى نسبة انتشار للحالات كانت ضمن الفئة العمرية 21–30 سنة (46%). كما تبين أن الإناث كنّ أكثر تأثرًا بالاضطرابات الأيضية مقارنة بالذكور (66% مقابل 34%)، في حين سُجِّلت نسبة أعلى من الاضطرابات النفسية بين الإناث أيضًا (58% مقابل 42%). ولوحظ ارتباط واضح بين ارتفاع مستويات الكورتيزول وظهور أعراض سريرية مثل السمنة والقلق والاكتئاب. وتوصي الدراسة باعتماد نمط حياة صحي، وإجراء فحوصات طبية دورية، والاستخدام الحذر لمشتقات الكورتيكوستيرويدات تحت إشراف طبي، للحد من المخاطر الصحية المرتبطة بارتفاع مستويات الكورتيزول.

الكلمات المفتاحية:

الكورتيزول، الاضطرابات الأيضية، الاضطرابات النفسية، مقاومة الإنسولين، الاكتئاب، اضطراب ثنائي القطب، السمنة، الإجهاد، ليبيا.

Introduction:

Cortisol plays a central role in regulating the body's stress response, metabolism of proteins, carbohydrates, and fats, as well as blood pressure and immune function. Dysregulation of cortisol may lead to clinical disorders ranging from hypercortisolism (Cushing's syndrome) to hypocortisolism (Addison's disease), and has also been strongly linked to psychiatric conditions such as depression and bipolar disorder (Thau *et al.,* 2021; Newell-Price *et al.,* 2006).

Accumulating evidence from both local and international studies highlights a strong relationship between cortisol imbalance and adverse health outcomes. Modern evidence supports the importance of cortisol measurement in different biological matrices including blood, saliva, urine, and hair, to understand the impact of chronic stress and hormonal dysregulation (Levine *et al.,* 2007). Notably, hair cortisol levels were found to reflect long-term stress exposure in Libyan populations, serving as a biomarker for trauma-related research (Etwel *et al.,* 2014).

With regard to metabolic disorders, Libyan data from Tobruk demonstrated significant variations in homeostatic model assessment of insulin resistance (HOMA-IR) levels across different age groups and between sexes, emphasizing the role of hormonal and genetic factors (El-Megrabi *et al.,* 2023). International research further indicates that hyperactivation of the hypothalamic-pituitary-adrenal (HPA) axis is particularly associated with severe depressive disorders (Nandam *et al.,* 2020), while experimental models suggest that prolonged cortisol secretion may underlie stress-induced depressive behavior (Qin *et al.,* 2016).

Despite growing evidence linking cortisol dysregulation to both metabolic and psychological disorders, data from Libyan clinical populations remain limited. Therefore, the present study aims to investigate the association between elevated cortisol levels and selected biochemical disorders, including insulin resistance, Cushing's syndrome, Addison's disease, and congenital adrenal hyperplasia, as well as psychological disorders such as depression and bipolar disorder. Additionally, this study seeks to determine the prevalence of these conditions according to age and gender and to explore the relationship between cortisol levels, clinical symptoms, and associated complications among patients in a Libyan clinical setting.

Methodology:

Study setting: This study was conducted at Al-Razi Psychiatric Hospital in Tripoli, Libya, a specialized tertiary care center that provides comprehensive mental health services and inpatient psychiatric care. The hospital serves a diverse population, which makes it an appropriate setting for investigating the biochemical and psychological correlates of cortisol levels among different patient groups.

Study period: The research was carried out over a six-week period, from May 15 to July 30, 2025. This timeframe was chosen to ensure adequate data collection and consistency in laboratory and clinical procedures.

Sample: The study sample consisted of 50 patients of both sexes, ranging in age from 7 to 30 years. Participants were recruited from among individuals admitted or attending outpatient clinics during the study period. Inclusion criteria encompassed patients diagnosed with metabolic or psychological disorders potentially related to cortisol imbalance, while exclusion criteria involved those with acute infections, endocrine disorders unrelated to cortisol, or

incomplete medical records. All participants, or their guardians in the case of minors, provided informed consent prior to enrollment.

Data collection tool: Data were collected using a structured questionnaire designed specifically for this study. The questionnaire included sections on demographic information (age and gender), disease type, clinical symptoms, complications, prescribed medications, and treatment response. All data were collected under the supervision of qualified medical personnel to ensure accuracy and confidentiality.

Statistical analysis: Collected data were analyzed using Microsoft Excel. Descriptive statistical methods were employed to calculate percentages, means, and frequency distributions. Results were further categorized and compared based on age groups and gender to identify potential patterns and associations between cortisol-related disorders and demographic variables.

Result:

The study analyzes the prevalence of metabolic and mental illnesses, their relationship with cortisol, distribution by age and severity, descriptive blood measures, differences in mean values, and the impact of cortisol on patients' psychological and social status.

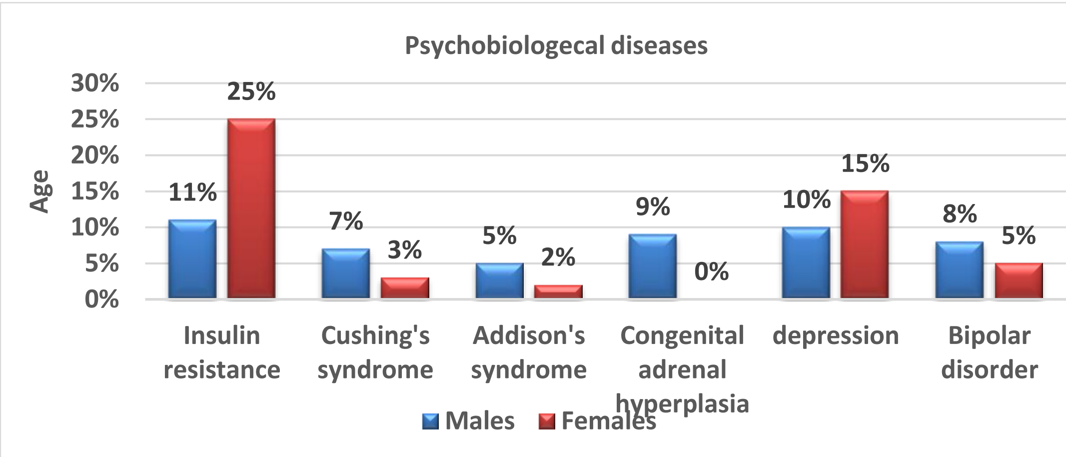

Figure (6): Distribution of patients by age group.

The results showed that the highest prevalence was in the age group 21–30 years (46%), while the lowest was in the group 7–20 years(18%). This may be attributed to the fact that young adults are more exposed to psychological stress and hormonal changes compared to children.

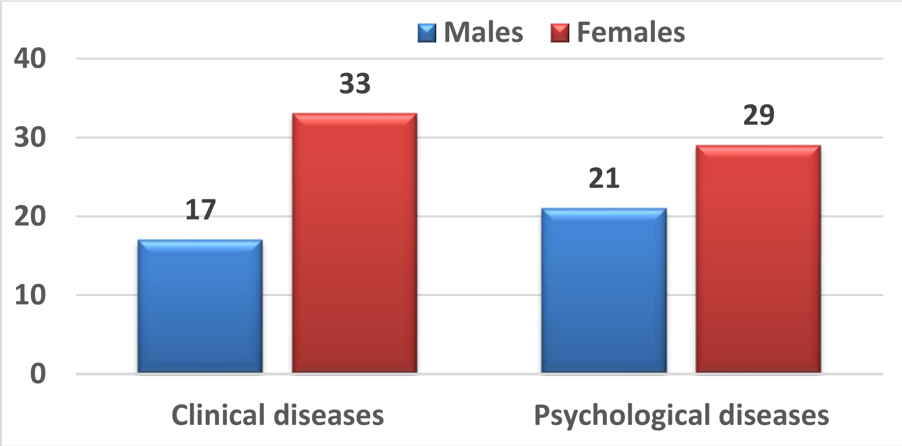

Figure (7): Distribution of patients by gender

Females represented the majority of cases (62%) compared to males (38%). This can be explained by hormonal fluctuations in women and their greater susceptibility to both metabolic and psychological disorders.

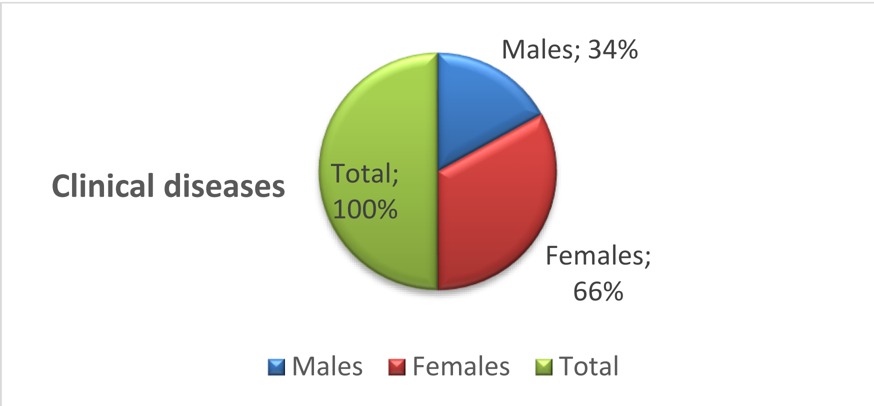

Figure (8): Types of biochemical (metabolic) disorders.

Insulin resistance was the most common disorder, followed by Cushing's syndrome and Addison's disease, while congenital adrenal hyperplasia was the least reported. This reflects the global prevalence of insulin resistance and its strong link with cortisol dysregulation.

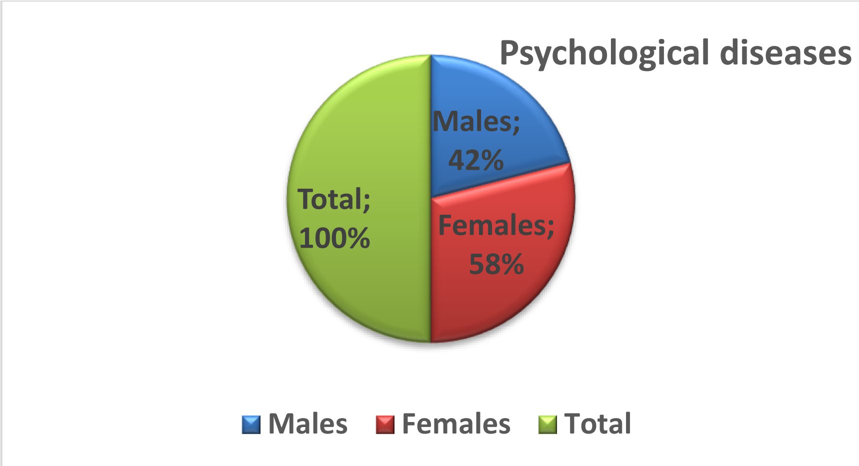

Figure (9): Types of psychological disorders

Depression was the most prevalent, followed by bipolar disorder. This aligns with previous studies linking elevated cortisol levels to major depression and mood disorders.

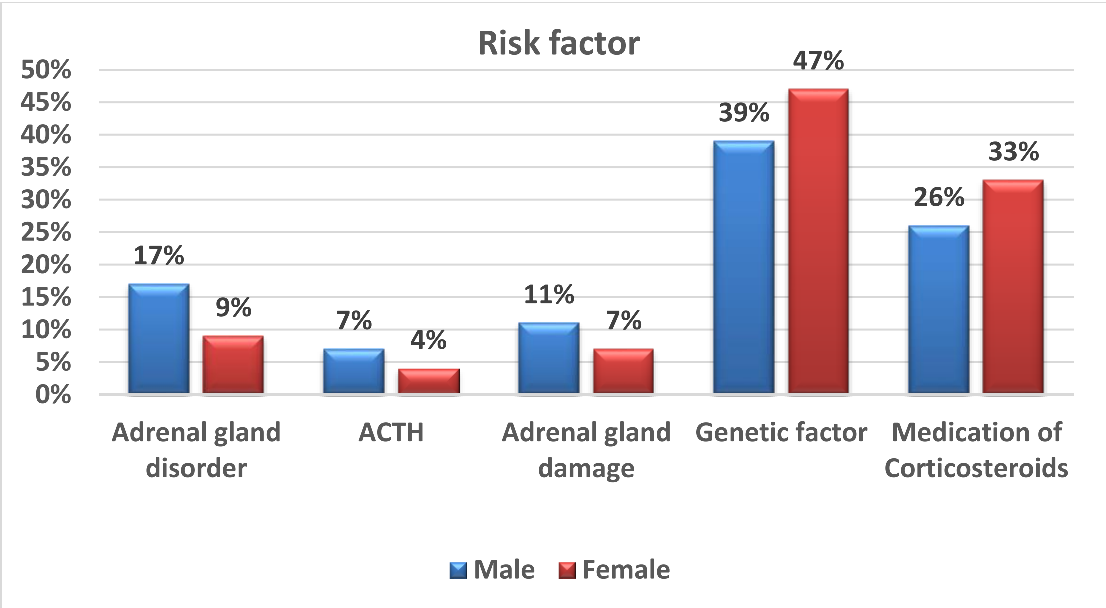

Figure (10): Causes of cortisol-related disorders

Genetic and hormonal factors were the most common causes, followed by chronic psychological stress.This highlights the interaction between genetic predisposition and environmental stressors in the development of these conditions. In this study, type 2 diabetes emerged as the most prevalent health complication among the studied patients, whereas muscle atrophy was the least frequently observed. This pattern can be attributed to the direct association between cortisol dysregulation and impaired glucose metabolism. Elevated cortisol levels are known to enhance hepatic gluconeogenesis and reduce peripheral insulin sensitivity,

thereby increasing the risk of developing insulin resistance and subsequent type 2 diabetes. In contrast, the lower incidence of muscle atrophy may reflect the relatively shorter duration of hypercortisolemic exposure among participants or effective therapeutic interventions mitigating muscle catabolism.

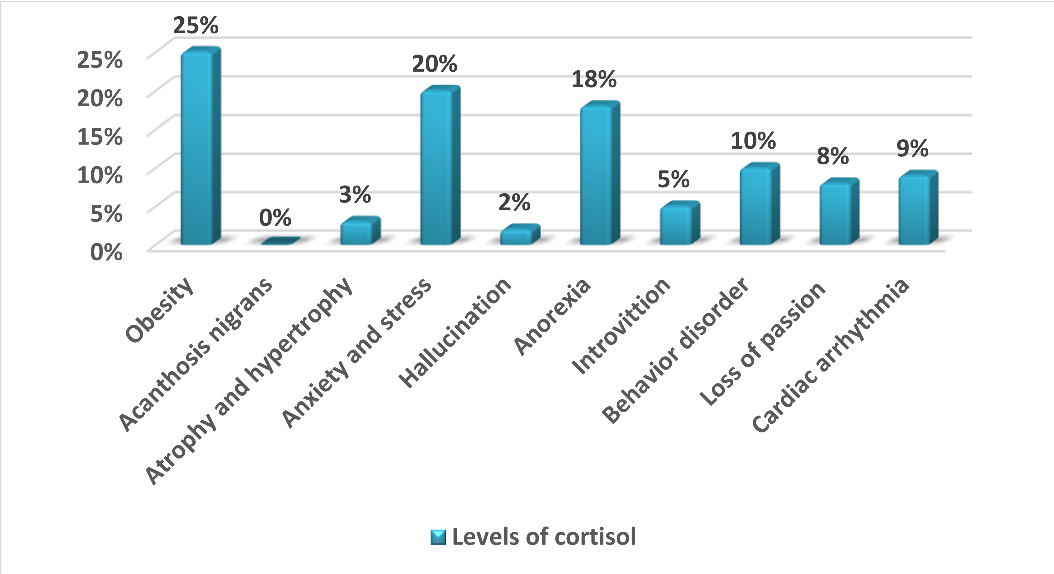

Figure (13): Distribution of metabolic and psychological disorders by gender

Discussion:

The findings of this study are consistent with previous national and international research, which has demonstrated a strong association between elevated cortisol levels and both metabolic and psychological imbalances. Etwel *et al*. (2014) in Libya reported that increased hair cortisol concentrations reflected chronic stress exposure during periods of conflict, supporting cortisol's role as a biological marker of psychological stress. A local study from Tobruk revealed that insulin resistance (HOMA-IR) varied by age and gender, with higher rates observed among males (Mahboba Aldareh, 2024), which partially contrasts with the present study where females exhibited higher rates of metabolic disorders. Internationally, Sahu *et al*. (2022) found through a systematic review and meta-analysis that patients with depression generally have higher serum and plasma cortisol levels than healthy controls, aligning with our findings linking cortisol elevation to depressive symptoms. Similarly, Ortiz *et al*. (2022) reported that dysregulation of the hypothalamic–pituitary–adrenal (HPA) axis and disrupted diurnal cortisol rhythms are associated with increased risks of obesity and insulin resistance. Moreover, Murphy and Loria (2017) indicated that women may be more susceptible to the

metabolic effects of chronic stress due to hormonal factors, which may explain the higher prevalence of metabolic disturbances among females in this study. Also, the results are consistent with previous research indicating that females are more susceptible to cortisol-related metabolic disorders (Aghil, 2023), whereas males are relatively more exposed to psychological conditions (Nandam *et al.,* 2020). Children were found to be more vulnerable to psychological than metabolic disorders. These findings underscore cortisol's pivotal role in chronic disease development and psychiatric comorbidities, highlighting its value as a diagnostic and therapeutic biomarker.

Conclusion and Recommendations: Cortisol plays a pivotal role as a predictor of both metabolic and psychological disorders. Maintaining a healthy lifestyle with regular exercise, limiting unnecessary corticosteroid use, and undergoing periodic medical screening especially for high-risk individuals are essential. Additionally, reducing stimulants and ensuring sufficient sleep can help regulate cortisol levels and support overall well-being.

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