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Original Article

Long-lasting effects of post-traumatic stress disorder in Yazidi women living in Northern Iraqi camps

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الملخص

أهداف البحث: لم يتم بعد التحقيق في شدة اضطراب ما بعد الصدمة وآثاره طويلة الأمد بين السكان الايزيديين. قيمت هذه الدراسة تأثير شدة اضطراب ما بعد الصدمة وإزمانه على المعايير الفسيولوجية والجسمية لدى النساء الناجيات من الأحداث المتعلقة بالإبادة الجماعية بعد هجوم ما يسمى بتنظيم الدولة الإسلامية في العراق وسوريا (داعش) في عام 2014.

طريقة البحث: تم تشخيص اضطراب ما بعد الصدمة تم تقييمها باستخدام قائمة مراجعة اضطراب ما بعد الصدمة لـ (بي سي إل 5 –) "دي إم سي -5. تم تقسيم المشاركين إلى: السيطرة الخارجية (الأفراد الأصحاء الذين يعيشون خارج المخيمات)، والرقابة الداخلية (الأفراد الأصحاء الذين يعيشون في المخيمات)، ومجموعة اضطراب ما بعد الصدمة (الأفراد الذين تم تشخيص إصابتهم باضطراب ما بعد الصدمة). تم تقسيم مجموعة اضطراب ما بعد الصدمة وفقا لزمن الإصابة >2 سنة، و2-5 سنوات، و>5 سنوات، وتم تقسيمها وفقا لشدة اضطراب ما بعد الصدمة إلى "معتدل" و"شديد" و"أقصى شدة". تم تقييم ضغط الدم الانقباضي، وضغط الدم الانبساطي، وتشبع الأكسجين في الدم ومعدل ضربات القلب. وتم قياس الوزن والطول ومحيط الخصر. تم حساب مؤشر كتلة الجسم ونسبة الخصر إلى الطول.

النتائج: أظهرت مجموعة اضطراب ما بعد الصدمة زيادة في قيم ضغط الدم الانقباضي (9.51، 7.63%)، ضغط الدم الانقباضي (5.57، 4.01%)، معدل ضربات القلب (12.04، 5.57%)، مؤشر كتلة الجسم (6.91، 6.19%)، وزن الجسم (7.14، 6.27%)، الوزن (11.27، 10.62٪)، ونسبة الخصر إلى الطول (11.90، 6.82٪)، مقارنة بالضوابط الخارجية والداخلية، على التوالي. انخفضت قيم تشبع الأكسجين في الدم في مجموعة اضطراب ما بعد الصدمة مقارنة بكلا التحكمين. مع تطور المرض من "أقل من سنتين" إلى "> 5 سنوات" ضغط الدم الانقباضي (2.49%)، ضغط الدم الانقباضي (7.83%)، معدل ضربات القلب (14.93%)، مؤشر كتلة الجسم (33.14%)، وزن الجسم (19.17%)، زادت نسبة الخصر إلى الطول (13.95٪)، والوزن (26.39٪) في مجموعة اضطراب ما بعد الصدمة. وبالمثل، مع تقدم شدة المرض من "معتدل" إلى "أقصى شدة"، معدل ضربات القلب (22.53%)، ضغط الدم الانقباضي (9.31%)، ضغط الدم الانقباضي (11.79%)، مؤشر كتلة الجسم (17.3%)، وزن الجسم (12.77%)، نسبة الخصر إلى الطول (13.95%) والوزن (21.06%) زادت في مجموعة اضطراب ما بعد الصدمة.

الاستنتاجات: هناك تأثير طويل المدى على العوامل الفسيولوجية والقياسات البشرية لدى النساء المصابات باضطراب ما بعد الصدمة والذي قد يتفاقم بسبب شدة المرض وإزمانه.

الكلمات المفتاحية: اضطراب ما بعد الصدمة؛ الآثار البيئية؛ على المدى الطويل؛ مضاعفات المرض؛ الإبادة الجماعية؛ الشعب الايزيدي

Abstract

The severity of post-traumatic stress disorder and its long-lasting effects among the Yazidi population has not yet been investigated.

Objectives: This study evaluated the impact of PTSD severity and chronicity on physiological and anthropometric parameters in women survivors of the genocide-related events after the so-called Islamic State of Iraq and Syria (ISIS) attack in 2014.

Methods: The diagnosis PTSD was assessed using PTSD Checklist for DSM-5 (PCL-5). Participants were divided into: External control (healthy individuals living outside the camps), Internal control (healthy individuals living in the camps), and PTSD group (individuals diagnosed with PTSD). The PTSD group was subdivided according to chronicity <2 years, 2–5 years, and >5 years and subdivided according to PTSD severity into "Moderate", "Severe" and "Extreme". Systolic blood pressure (SBP), diastolic blood pressure (DBP), blood oxygen saturation

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(SPO_2) and heart rate (HR) were evaluated. Weight, height and waist circumference were measured. Body mass index (BMI) and waist-to-height ratio (WHtR) were calculated.

Results: The PTSD group showed significant increases in SBP, DBP, heart rate, BMI, WC, weight, and WHtR compared to the control groups. SPO_2 values decreased in the PTSD group. As the disease progressed, there were further increases in SBP, DBP, heart rate, BMI, WC, WHtR, and weight. Similar increases were observed with the severity of the disease.

Conclusion: Our data indicates that a long-term impact on physiological and anthropometric parameters is present in women diagnosed with PTSD which might be aggravated by the severity and chronicity of the disease.

Keywords: Disease complications; Environmental implications; Genocide; Long-term; Post-traumatic stress disorder; Yazidi people

Introduction

The Yazidis, an ethnoreligious group living in the Kurdistan Region of Iraq, Syria, Turkey, Azerbaijan, and Armenia, have faced ongoing marginalization and oppression, primarily because of their minority status.[1] This mistreatment dates to the time of the Ottoman Empire and has continued into very recent times. One of the most notable events occurred in August 2014, when the Yazidi community in Sinjar, Northern Iraq, was targeted by ISIS.[2] The assault by ISIS specifically targeted individuals by gender: men were executed; boys were recruited as child soldiers; and women and girls were subjected to sexual slavery.[3–5] PTSD, the most frequently documented mental health condition among Yazidis, affects an estimated 70%–90% of the population.[5] Given their prolonged exposure to numerous traumatic events, many Yazidis are believed to experience complex PTSD.[6] The rates of suicide and attempted suicide are alarmingly high within this community.[1] However, importantly, these figures are likely to be substantially underestimated because of stigma surrounding mental health.[7] In some instances, self-immolation has been reported as a response to the overwhelming feelings of shame associated with sexual violence.[8] According to Mann and Marwaha (2020), symptoms of PTSD include flashbacks, nightmares, intrusive thoughts, avoidance of reminders of trauma, and hypervigilance.[6,9] The pathophysiology of PTSD is believed to be associated with changes in the brain leading to alterations in the cerebral spinal fluid. PTSD has been shown to alter the coordination of activities such as metabolism, immune response, and stress management by the hypothalamus–pituitary–adrenal (HPA) axis.[5] The HPA axis detects stress, releases hormones such as cortisol, and regulates the activities described above.[4] In PTSD, the HPA axis may function abnormally, thereby affecting metabolism, the immune response, and stress management, and contributing to PTSD symptoms and health problems. The HPA axis is responsible for the body's stress response, and PTSD is believed to increase HPA axis reactivity.[4,7] Several physical symptoms may result, such as headaches, fatigue, and difficulty in concentrating and sleeping.[8,9] PTSD can disrupt the brain's regulation of emotions, often because of imbalances in key neurotransmitters such as serotonin and dopamine.[9,10] These neurotransmitters play crucial roles in mood and emotion control, and their imbalance can lead to symptoms such as anxiety and depression in individuals with PTSD.[4] PTSD exerts profound effects on various physiological and anthropometric parameters.[2,6] Anthropometric parameters are frequently used as research tools to assess noncommunicable disease risk factors in populations.[11] These parameters include body weight, height, waist circumference (WC), body mass index (BMI), and waist-to-height ratio (WHtR). PTSD is associated with alterations in both physiological and anthropometric measures, thus reflecting the effects of the disorder on the body's stress response system.[3,5] Alterations in blood oxygen saturation, heart rate, blood pressure, body weight, height, WC, BMI, and WHtR have been reported to reflect the effects of PTSD on the body's stress response system.[5,6]

Importance of the study

This study analyzed physiological and anthropometric parameters in participants with PTSD living in IDP camps, and associations of these parameters with disease severity and chronicity. To date, no prior study has addressed the physiological and anthropomorphic changes associated with PTSD in relation to the severity and chronicity of the disease. This study is expected to contribute to broadening approaches to PTSD by providing new perspectives on the long-term physiological aspects of the disease.

Materials and Methods

Study design

This observational cross-sectional study was conducted from November 2021 to June 2022 at the IDP camps located in the Duhok Governorate, Kurdistan Regional Government of Iraq. Because of local governmental and international security laws, access to the survivors is highly restricted. The BCF, the establishment in charge of the IDP camps in Duhok, granted us access to 5 of the 15 IDP camps in Duhok: Sharia, Khanke, Qadia, Kabarto, and Bajet Kandala. We were guided by the BCF to the tents in which survivors that could be visited were residing. An estimated 595 Yazidi women who were survivors of the ISIS attack on Sinjar in 2014 were living in the five camps (data from BCF). The present study included exclusively Yazidi women who were survivors newly diagnosed with PTSD. The diagnosis of PTSD was performed as part of this study. Only newly diagnosed PTSD cases were

included, to avoid any interference due to medications used to address PTSD symptoms.

Sampling technique

In the estimated population of 595 Yazidi women, 202 had already been diagnosed with PTSD, whereas 62 were newly diagnosed (our target population). After the exclusion of ten women according to the exclusion criteria, 52 women were enrolled in this study. The internal control group, selected from healthy people in the same camps as the PTSD group, was carefully screened and matched to the PTSD group according to demographic criteria. Similarly, the external control group, representing the unaffected population outside the camps, was identified through community networks and healthcare institutions. A total of 156 apparently healthy women who had not been diagnosed with PTSD were interviewed. Because 52 newly diagnosed cases of PTSD remained after application of the exclusion criteria, each control group included 52 women, to match the number in the PTSD group. The participants were classified into the following three groups (n = 52 per group): 1, an external control, comprising apparently healthy individuals living outside the camps; 2, an internal control, comprising apparently healthy individuals living inside the camps; and 3, a PTSD group, comprising individuals newly diagnosed with PTSD, living inside the camps, and not receiving any psychiatric medication. The PTSD group was subdivided into groups with moderate, severe, or extreme illness severity, and into groups with <2, 2−5, or >5 years' chronicity (time after symptom occurrence). On the basis of the interview, the control groups consisted of people who were not diagnosed with PTSD.

Inclusion criteria

1) PTSD group: this group comprised only individuals diagnosed with PTSD during our research (newly diagnosed). Only Yazidi women who had experienced persecution and violence under the regime of ISIS in 2014 and remained living with their families in IDP camps after displacement from their homes were included in this group.
2) Internal control group: this group comprised only apparently healthy women residing in the same IDP camps as the women with PTSD in the study.
3) External control group: this group comprised only apparently healthy women selected from outside the IDP camps, who had never lived inside any IDP camp. The women in this group were selected from the working staff at the University of Duhok and their relatives living in Duhok City.

Exclusion criteria

Women who were excluded had a family history of neuropsychiatric disorders before the genocide, or a lifetime history of bipolar or any psychiatric disorder; a history of alcohol or drug use/dependence; a history of neurological disorder; current systemic illness affecting central nervous system function; or a history of chronic diseases, such as diabetes, cancer, liver, heart, kidney, and/or endocrine disfunction. The study further excluded individuals undergoing any form of psychotherapy, pharmacotherapy, or psychosocial treatment. Additionally, pregnant women were excluded. These criteria were chosen to minimize confounding variables and to ensure that the studied population accurately represented the targeted population.

Assessment instruments

A pre-validated questionnaire was designed by the researchers according to the study requirements. Data were collected on age, alcohol consumption, smoking habits, and previous medical history (including heart, liver, kidney, and other conditions) for all eligible participants meeting the inclusion criteria.

A psychiatrist used the validated Kurdish version of the PTSD diagnostic criteria of the DSM-5 (PCL-5) checklist[12] to diagnose PTSD. The PCL-5, a self-assessment questionnaire consisting of 20 items, is used to measure symptoms of PTSD as defined in the DSM-5. The questionnaire uses a rating scale of 0−4, wherein a score of 2 or higher is considered clinically significant for each item. A PCL-5 score of 33 is suggested as the threshold for diagnosing PTSD.

Data collection methods

The measurements of physiological and anthropometric parameters were performed at the clinics of the IDP camps for the participants in the PTSD and internal control groups. The external control group was accessed at the College of Science, University of Duhok. Height was measured in centimeters, without shoes, with a standard height measuring rod. Weight was measured in kilograms (kg), without shoes, with digital scales, and was recorded with an accuracy of 0.1 kg. The BMI was calculated as weight in kilograms divided by height in meters squared. A BMI <25 kg/m^2 was considered normal. A BMI of 25.0−29.9 kg/m^2 was classified as overweight, whereas a BMI ≥30 kg/m^2 was defined as obese. WC was measured with a measuring tape for each participant wearing minimal clothing, and with the feet approximately 25−30 cm apart. The measurements were taken in a plane perpendicular to the long axis of the body at the level of the umbilicus without compression of the skin. WHtR was derived from the ratio of WC/height.[13] The measurement of physiological parameters was performed according to World Health Organization guidelines. Oxygen saturation was measured with a BMC M130 fingertip pulse oximeter. Blood pressure and heart rate were assessed with an aneroid sphygmomanometer in participants who had been sitting for at least 5 min.

Statistical analysis

Power analysis, with alpha level of 0.05, aiming for >80% power, was used for sample size determination. This approach helped detect meaningful differences in physiological and anthropometric parameters between the PTSD

and control groups, thus enhancing the study's reliability and generalizability. The power of the sample size for several parameters was tested, including for the independent samples t-test and one-way ANOVA. The normality of the values for physiological and anthropometric parameters was verified before comparisons were made between groups. All data were analyzed in Statistical Package for Social Science (SPSS) software version 26.0. Data are reported as mean and standard deviation (SD). For all analyses, a p-value ≤ 0.05 was considered statistically significant. The mean values between groups were compared with one-way ANOVA. To compare the percentage differences between the PTSD group and the control groups, we used an independent samples t-test. The correlation between physiological and anthropometric parameters in participants with PTSD according to PTSD severity was analyzed with Pearson's correlation coefficient.

Results

The power of the sample size for the independent samples t-test and one-way ANOVA was >80%. Accordingly, the sample size was considered statistically valid.

Participants with confirmed PTSD were categorized according to disease severity, as shown in Figure 1-A. The participants with PTSD were also categorized according to the time after PTSD symptom onset, as depicted in Figure 1-B, as follows: <2 years, 2−5 years, or >5 years.

In Table 1 most participants were 25 years of age or older (>67%). Marriage was common, particularly in the external control group (50%). A substantial proportion of participants with PTSD had no formal education (34.6%). Employment status varied: most of the external control group was employed (57.7%), whereas the internal and PTSD groups were primarily non-employed (90.4% and 100%, respectively).

Effects of PTSD on anthropometric and physiological parameters

The mean values in Table 2 indicated that most of the studied parameters, except SPO_2, were significantly higher in the PTSD group than in the external and internal control groups.

Effects of time after PTSD symptom onset on anthropometric and physiological parameters

Table 3 illustrates the effects of the time after PTSD symptom onset on anthropometric and physiological parameters. Significantly higher values were observed in all anthropometric parameters, and highly significant values

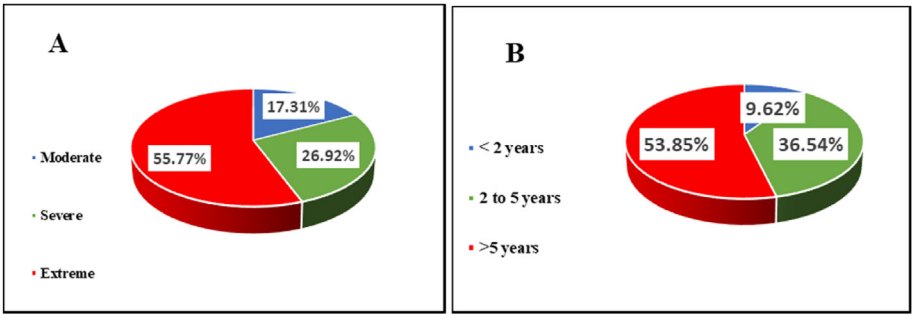


Figure 1: Distribution of participants with PTSD according to (A) disease severity and (B) time after PTSD symptom onset.

Table 1: Sociodemographic characteristics of the participants.

Variable		Groups		
		External (n = 52)	Internal (n = 52)	PTSD (n = 52)
		n (%)	n (%)	n (%)
Age	<25 years	10 (19.2%)	14 (26.9%)	17 (32.7%)
	≥25 years	42 (80.8%)	38 (73.1%)	35 (67.3%)
Civil status	Single	23 (44.2%)	31 (59.6%)	36 (69.2%)
	Married	26 (50.0%)	20 (38.5%)	14 (26.9%)
	Divorced	3 (5.8%)	1 (1.9%)	2 (3.8%)
Education level	Not educated	0 (0%)	10 (19.2%)	18 (34.6%)
	Primary	1 (1.9%)	11 (21.2%)	14 (26.9%)
	Middle school	4 (7.7%)	16 (30.8%)	8 (15.4%)
	High school	12 (23.1%)	8 (15.4%)	9 (17.3%)
	University	35 (67.3%)	7 (13.5%)	3 (5.8%)
Work status	Employed	30 (57.7%)	5 (9.6%)	0 (0%)
	Not employed	22 (42.3%)	47 (90.4%)	52 (100%)

Table 2: Comparison of anthropometric and physiological parameters among study groups. The comparison was performed with one-way ANOVA. Values denoted as *p < 0.05 were considered significant, and those denoted as **p < 0.001 were considered highly significant.

Characteristic	Study groups			p value
	External N = 52	Internal N = 52	PTSD N = 52	
	Mean ± SD	Mean ± SD	Mean ± SD	
Anthropometric parameters				
Age (years)	28.08 ± 4.84	28.19 ± 5.71	30.21 ± 10.25	0.251
Weight (kg)	54.21 ± 6.36	54.53 ± 6.61	60.32 ± 1.27	<0.001**
BMI (kg/m^2)	22.14 ± 2.33	22.29 ± 2.03	23.67 ± 3.48	0.007*
WC (cm)	68.02 ± 5.76	68.58 ± 5.99	72.88 ± 8.34	0.001*
WHtR	0.42 ± 0.04	0.44 ± 0.03	0.47 ± 0.06	<0.001**
Physiological parameters				
Systolic BP (mmHg)	107.77 ± 7.50	109.65 ± 9.79	118.02 ± 10.56	<0.001**
Diastolic BP (mmHg)	73.79 ± 4.53	74.90 ± 7.15	77.90 ± 7.83	0.006*
SPO_2 (%)	97.62 ± 1.19	97.48 ± 1.69	97.02 ± 2.05	0.169
Heart rate (bpm)	77.02 ± 8.53	81.64 ± 9.75	86.29 ± 12.76	<0.001**

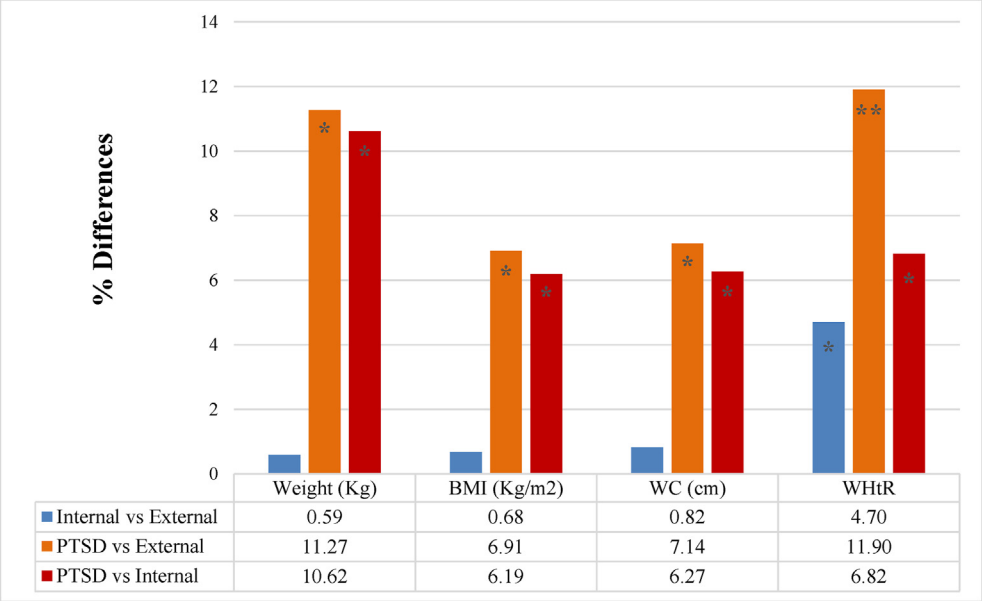
External, apparently healthy women living outside the camps; internal, apparently healthy women living inside the camps; PTSD, participants with PTSD diagnosed according to the DSM-5 (PCL-5) scale.

Table 3: Comparison of anthropometric and physiological parameters among PTSD groups according to time after PTSD symptom onset. The comparison was performed with one-way ANOVA. Values denoted as *p < 0.05 were considered significant, and those denoted as **p < 0.001 were considered highly significant.

Characteristic	PTSD group/chronicity			p value
	<2 years N = 5	2–5 years N = 19	>5 years N = 28	
	Mean ± SD	Mean ± SD	Mean ± SD	
Anthropometric parameters				
Weight (kg)	51.54 ± 7.14	55.53 ± 9.65	65.14 ± 10.75	0.002*
BMI (kg/m^2)	19.01 ± 2.46	22.49 ± 3.01	25.31 ± 2.85	<0.001**
WC (cm)	63.60 ± 3.29	71.05 ± 8.55	75.79 ± 7.64	0.004*
WHtR	0.43 ± 0.05	0.46 ± 0.06	0.49 ± 0.05	0.043*
Physiological parameters				
Systolic BP (mmHg)	115.00 ± 5.00	119.05 ± 9.37	117.86 ± 12.08	0.749
Diastolic BP (mmHg)	73.20 ± 4.55	77.63 ± 8.21	78.93 ± 7.90	0.321
SPO_2 (%)	98.00 ± 0.71	96.89 ± 2.31	96.93 ± 2.04	0.540
Heart rate (bpm)	75.60 ± 8.91	88.21 ± 16.01	86.89 ± 10.05	0.135

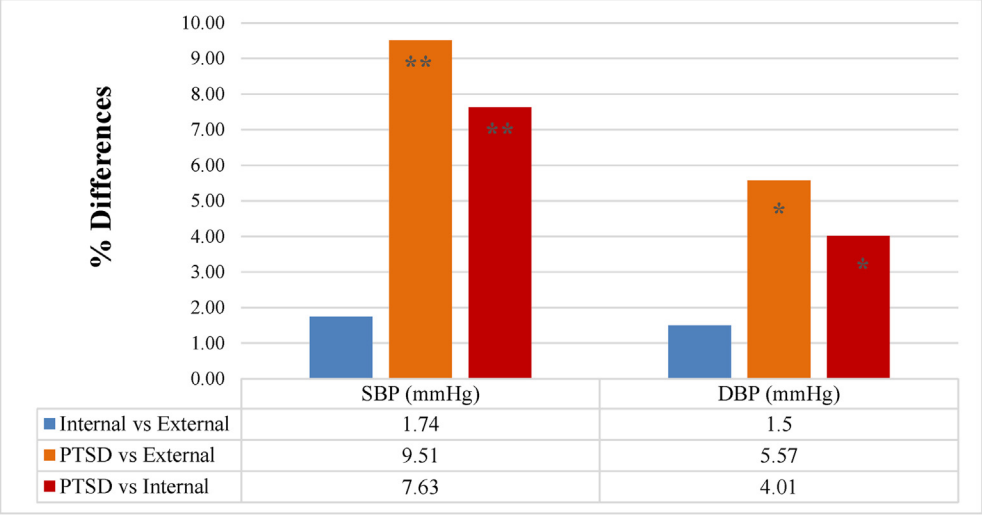
Table 4: Anthropometric and physiological parameters in the PTSD groups, categorized by PTSD severity. The comparison between participants was performed with one-way ANOVA. Values denoted as *p < 0.05 were considered significant, and those denoted as *p < 0.001 were considered highly significant.

Characteristic	PTSD severity			p value
	Moderate N = 9	Severe N = 14	Extreme N = 29	
	Mean ± SD	Mean ± SD	Mean ± SD	
Anthropometric parameters				
Weight (kg)	52.52 ± 9.98	58.58 ± 9.62	63.58 ± 11.30	0.026*
BMI (kg/m^2)	21.04 ± 3.92	23.28 ± 2.96	24.68 ± 3.20	0.017*
WC (cm)	67.33 ± 7.81	70.14 ± 8.20	75.93 ± 7.68	0.008*
WHtR	0.43 ± 0.05	0.45 ± 0.06	0.49 ± 0.05	0.006*
Physiological parameters				
Systolic BP (mmHg)	111.67 ± 6.12	113.71 ± 8.82	122.07 ± 10.82	0.005*
Diastolic BP (mmHg)	72.67 ± 3.61	74.36 ± 5.51	81.24 ± 8.19	0.001*
SPO_2 (%)	98.44 ± 0.73	98.36 ± 0. 50	95.93 ± 2.15	<0.001**
Heart rate (bpm)	75.11 ± 6.45	81.57 ± 8.28	92.03 ± 12.94	<0.001**



	Weight (Kg)	BMI (Kg/m2)	WC (cm)	WHtR
Internal vs External	0.59	0.68	0.82	4.70
PTSD vs External	11.27	6.91	7.14	11.90
PTSD vs Internal	10.62	6.19	6.27	6.82

Figure 2: Percentage differences in weight, BMI, WC, and WHtR among study groups. The comparison was performed with independent samples t-test. Values denoted as *p < 0.05 were considered significant, and those denoted as **p < 0.001 were considered highly significant. Abbreviations: body mass index (BMI), waist circumference (WC), and waist-to-height ratio (WHtR).



	SBP (mmHg)	DBP (mmHg)
Internal vs External	1.74	1.5
PTSD vs External	9.51	5.57
PTSD vs Internal	7.63	4.01

Figure 3: Percentage differences in systolic blood pressure (SBP) and diastolic blood pressure (DBP) among study groups. The comparison was performed with independent samples t-test. Values denoted as *p < 0.05 were considered significant, and those denoted as **p < 0.001 were considered highly significant. Abbreviations: systolic blood pressure (SBP) and diastolic blood pressure (DBP).

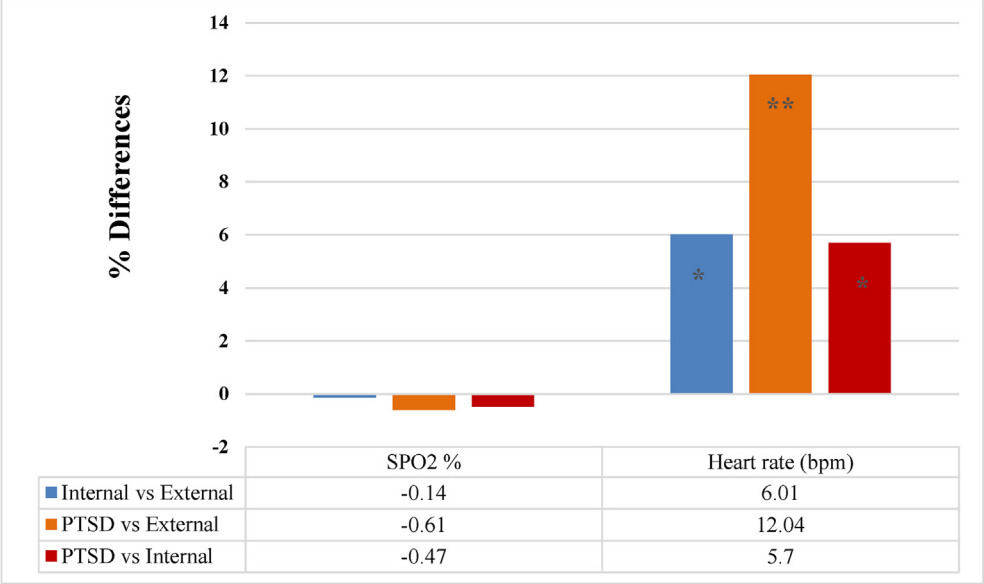
were observed for BMI, with an increase in the time after symptom onset from <2 years to >5 years. However, no significant differences in physiological parameters were observed among study groups.

Effects of disease severity on anthropometric and physiological parameters

As the severity of PTSD increased from moderate to severe or extreme, all studied parameters increased except SPO_2, which significantly decreased. The heart rate highly significantly increased with increasing disease severity (Table 4).

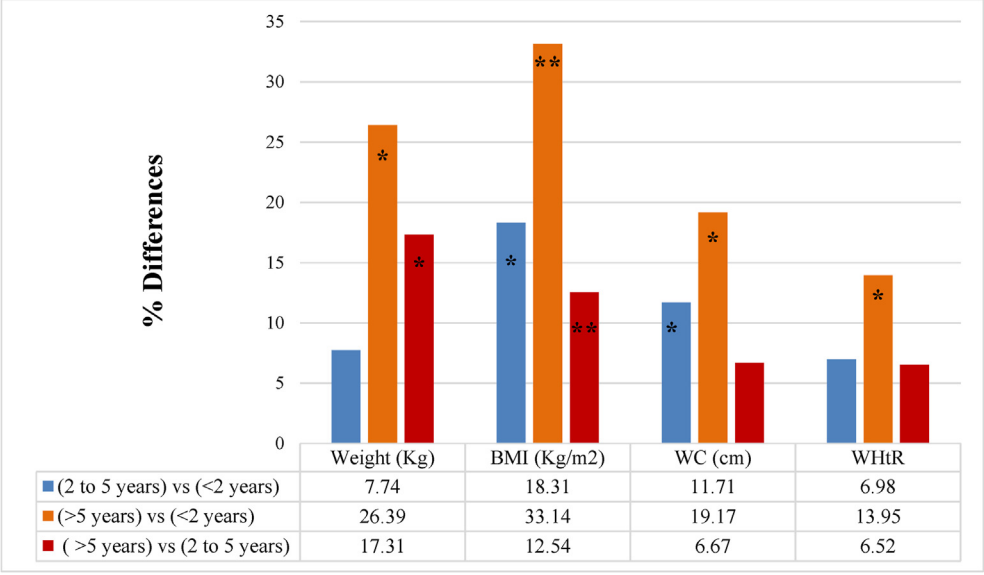
Percentage differences in anthropometric and physiological parameters among groups

The PTSD group had higher systolic blood pressure (SBP; 9.51%), diastolic blood pressure (DBP; 5.57%), heart rate (12.04%), BMI (6.91%), WC (7.14%), WHtR (11.90%), and weight (11.27%) than the external control group ($p < 0.05$), whereas SPO_2 was 0.61% lower in the PTSD group (Figures 2–



	SPO2 %	Heart rate (bpm)
Internal vs External	-0.14	6.01
PTSD vs External	-0.61	12.04
PTSD vs Internal	-0.47	5.7

Figure 4: Percentage differences in blood oxygen saturation (SPO_2) and heart rate (HR) among study groups. The comparison was performed with independent samples t-test. Values denoted as *$p < 0.05$ were considered significant, and those denoted as **$p < 0.001$ were considered highly significant. Abbreviation: oxygen saturation (SPO_2).



	Weight (Kg)	BMI (Kg/m2)	WC (cm)	WHtR
(2 to 5 years) vs (<2 years)	7.74	18.31	11.71	6.98
(>5 years) vs (<2 years)	26.39	33.14	19.17	13.95
(>5 years) vs (2 to 5 years)	17.31	12.54	6.67	6.52

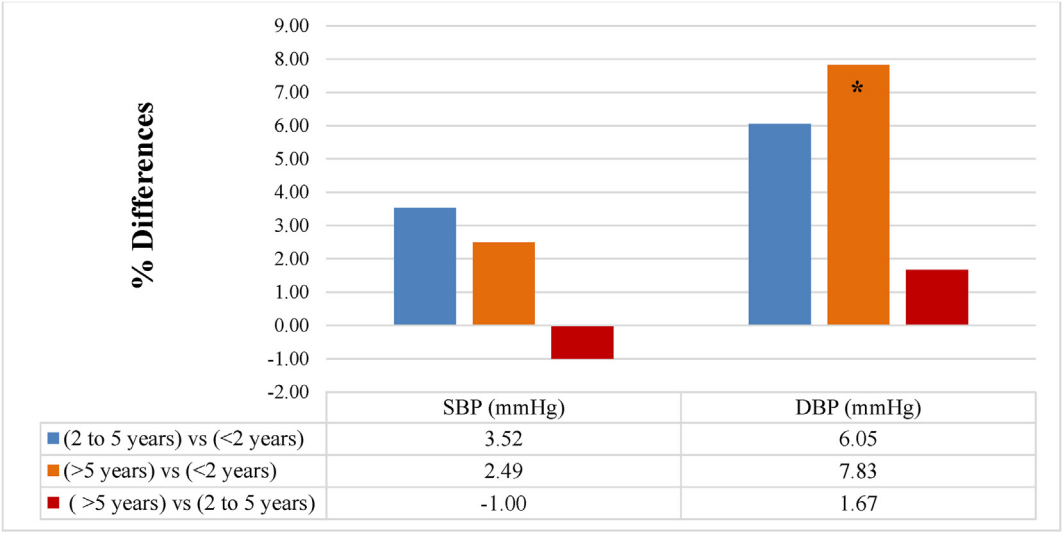
Figure 5: Percentage differences in weight, body mass index (BMI), waist circumference (WC), and WHtR according to time after PTSD symptom onset. The comparison was performed with independent samples t-test. Values denoted as *$p < 0.05$ were considered significant, and those denoted as **$p < 0.001$ were considered highly significant. Abbreviations: body mass index (BMI), waist circumference (WC), and waist-to-height ratio (WHtR).

4). SBP (7.63%), DBP (4.01%), heart rate (5.7%), BMI (6.19%), WC (6.27%), and weight (10.62%) were higher in the PTSD group than the internal control group ($p < 0.05$), whereas SPO_2 was 0.47% lower (Figures 2–4).

Comparison of the external and internal control groups indicated no significant differences in weight, BMI, WC, and blood pressure (SBP or DBP) (Figures 2 and 3). However, the internal control group exhibited higher WHtR (4.76%) and heart rate (6%), and lower SPO_2 (0.14%), than the external control group (Figures 2 and 4).

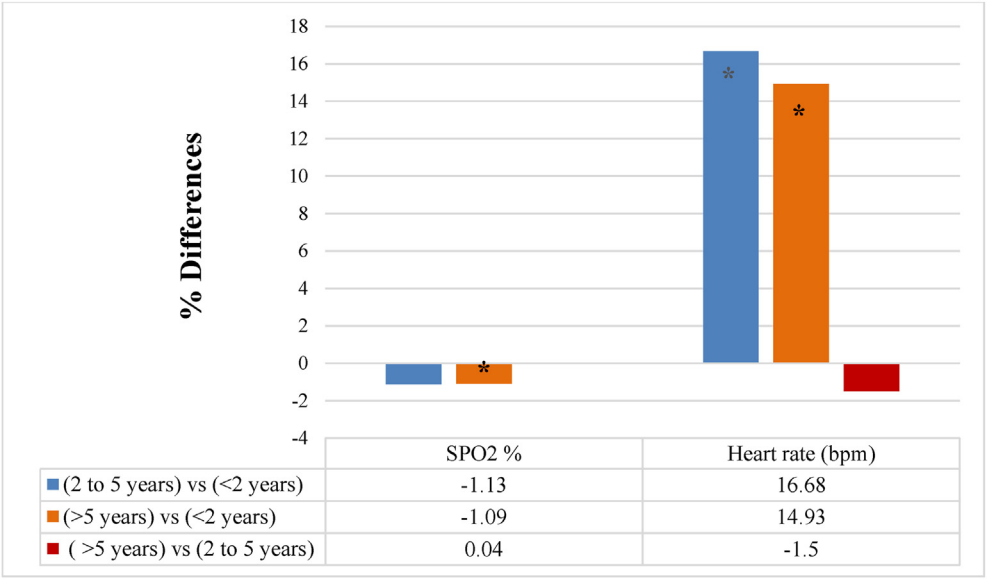
Percentage differences in anthropometric and physiological parameters according to time after PTSD symptom onset

As the time after PTSD symptom onset increased, we observed a marked rise in all anthropometric parameters,



	SBP (mmHg)	DBP (mmHg)
(2 to 5 years) vs (<2 years)	3.52	6.05
(>5 years) vs (<2 years)	2.49	7.83
(>5 years) vs (2 to 5 years)	-1.00	1.67

Figure 6: Percentage differences in systolic blood pressure (SBP) and diastolic blood pressure (DBP) according to time after PTSD symptom onset. The comparison was performed with independent samples t-test. Values denoted as *p < 0.05 were considered significant, and those denoted as **p < 0.001 were considered highly significant. Abbreviations: systolic blood pressure (SBP) and diastolic blood pressure (DBP).



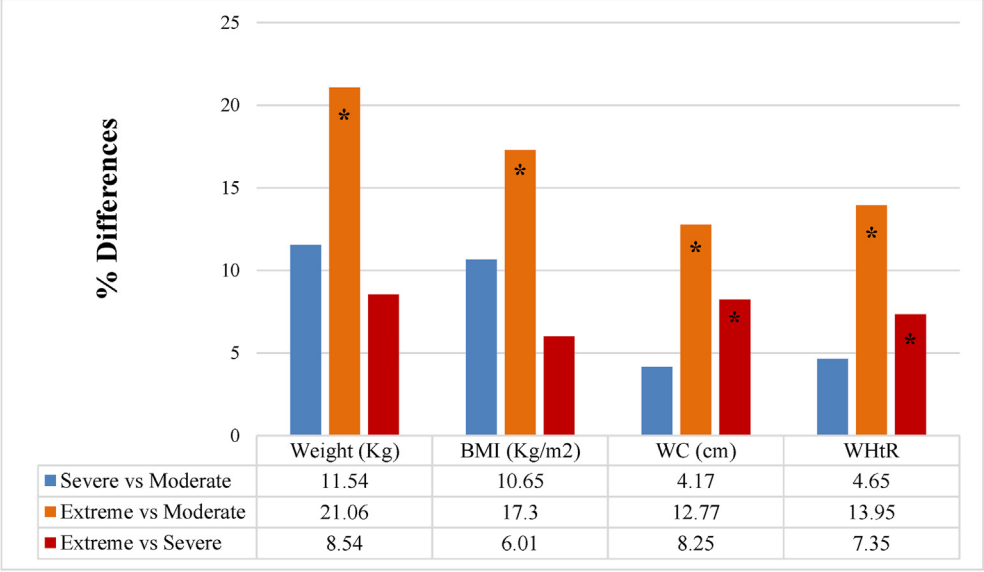
	SPO2 %	Heart rate (bpm)
(2 to 5 years) vs (<2 years)	-1.13	16.68
(>5 years) vs (<2 years)	-1.09	14.93
(>5 years) vs (2 to 5 years)	0.04	-1.5

Figure 7: Percentage differences in blood oxygen saturation (SPO_2) and heart rate (HR) according to time after PTSD symptom onset. The comparison was performed with independent samples t-test. Values denoted as *p < 0.05 were considered significant, and those denoted as **p < 0.001 were considered highly significant. Abbreviation: oxygen saturation (SPO_2).

particularly BMI (highly significant). The most significant difference was observed in the comparison of individuals with <2 years versus >5 years of PTSD symptoms. Higher SBP (2.49%), DBP (7.83%), heart rate (14.93%), BMI (33.14%), WC (19.17%), and weight (26.39%) were observed with an increase in PTSD duration from <2 years to >5 years, whereas a less significant difference in SPO_2 (−1.09%) was observed in the same comparison (Figures 5–7).

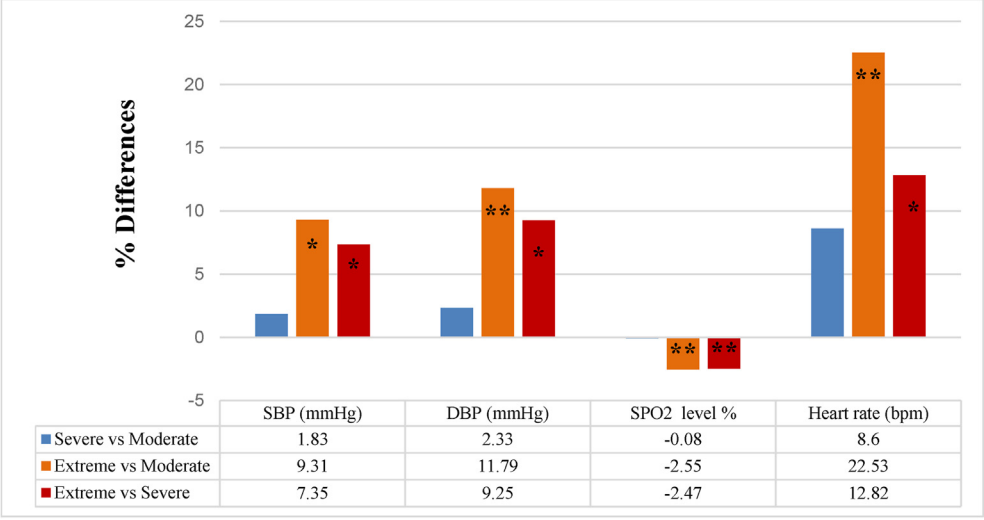
Percentage differences in anthropometric and physiological parameters according to PTSD severity

Participants with moderate or extreme PTSD showed the most significant differences in anthropometric and physiological parameters among severity groups (Figure 8). Participants with extreme PTSD showed higher heart rate (22.53%), SBP (9.31%), DPB (11.79%) (p < 0.05), BMI



	Weight (Kg)	BMI (Kg/m2)	WC (cm)	WHtR
Severe vs Moderate	11.54	10.65	4.17	4.65
Extreme vs Moderate	21.06	17.3	12.77	13.95
Extreme vs Severe	8.54	6.01	8.25	7.35

Figure 8: Percentage differences in anthropometric parameters according to the severity of PTSD. The comparison was performed with independent samples t-test. Values denoted as *p < 0.05 were considered significant, and those denoted as **p < 0.001 were considered highly significant. Abbreviations: body mass index (BMI), waist circumference (WC), and waist-to-height ratio (WHtR).



	SBP (mmHg)	DBP (mmHg)	SPO2 level %	Heart rate (bpm)
Severe vs Moderate	1.83	2.33	-0.08	8.6
Extreme vs Moderate	9.31	11.79	-2.55	22.53
Extreme vs Severe	7.35	9.25	-2.47	12.82

Figure 9: Percentage differences in physiological parameters according to the severity of PTSD. The comparison was performed with independent samples t-test. Values denoted as *p < 0.05 were considered significant, and those denoted as **p < 0.001 were considered highly significant. Abbreviations: systolic blood pressure (SBP), diastolic blood pressure (DBP), and oxygen saturation (SPO_2).

(17.3%), WC (12.77%), WHtR (13.95%), and weight (21.06%) than those with moderate PTSD. However, participants in the extreme group had lower SPO_2 (2.55%) than those in the moderate group (Figures 8 and 9). Higher WC (8.25%), WHtR (7.35%), and weight (8.53%) were observed in the extreme group than in the severe group (Figure 8). Higher SBP (7.35%), DBP (9.25%), and heart rate (12.82%), but lower SPO_2 (−2.47%), were observed in the extreme group than in the severe group (Figure 9).

Anthropometric and physiological characteristics of participants

Significant variations were observed among individuals facing health concerns within the PTSD group: nearly 28% were overweight, 7.7% had high WC (>88 cm), 19% had elevated SBP (>130 mmHg), 23% had elevated DBP (>85 mmHg), and approximately 7.7% exhibited tachycardia (heart rate > 100 bpm) (Table 5). Notably, the

Table 5: Percentage distribution of participants according to anthropometric and physiological parameters. The evaluation was performed by comparison of participants with PTSD with healthy participants not diagnosed with PTSD. The comparison was performed with Pearson chi-squared tests. *Significant at p < 0.05; ** highly significant at p < 0.001; p > 0.05 was considered non-significant (NS).

Characteristic	External N = 52 N (%)	p value	Internal N = 52 N (%)	p value	PTSD N = 52 N (%)	p value
Anthropometric parameters						
Age						
<25 years	10 (19.2%)	<0.001**	14 (26.9%)	<0.001**	17 (32.7%)	<0.001**
≥25 years	42 (80.8%)		38 (73.1%)		35 (67.3%)	
Body mass index (kg/m^2)						
Normal	52 (100%)	NS	52 (100%)	NS	37 (71.2%)	0.053
Overweight	0		0		15 (28.8%)	
Obese	0		0		0	
Waist circumference (cm)						
<88 cm	52 (100%)	NS	52 (100%)	NS	48 (92.3%)	0.001*
≥88 cm	0		0		4 (7.7%)	
Physiological parameters						
Systolic blood pressure (mmHg)						
<130 mmHg	52 (100%)	NS	49 (94.2%)	0.002*	42 (80.8%)	<0.001**
≥130 mmHg	0		3 (5.8%)		10 (19.2%)	
Diastolic blood pressure (mmHg)						
<85 mmHg	52 (100%)	NS	48 (92.3%)	0.001*	40 (76.9%)	<0.001**
≥85 mmHg	0		4 (7.7%)		12 (23.1%)	
Oxygen saturation (%)						
<95	0	NS	3 (5.8%)	0.001*	8 (15.4%)	<0.001**
≥95	52 (100%)		49 (94.2%)		44 (84.6%)	
Heart rate (bpm)						
Tachycardia > 100	0	NS	0	NS	4 (7.7%)	0.005*
Normal 60−100	52 (100%)		52 (100%)		48 (92.3%)	
Bradycardia < 60	0		0		0	

Table 6: Percentages of participants with PTSD, categorized into moderate, severe, or extreme by disease severity. The comparison was performed with Pearson chi-squared tests. *Significant at p < 0.05; **significant at p < 0.001; p > 0.05 was considered non-significant (NS). Abbreviations: body mass index (BMI), waist circumference (WC), waist-to-height ratio (WHtR), systolic blood pressure (SBP), diastolic blood pressure (DBP), and oxygen saturation (SPO_2).

Characteristic	Moderate N = 9 N (%)	Severe N = 14 N (%)	Extreme N = 29 N (%)	p value
Anthropometric parameters				
Age				
<25 years	3 (33.3%)	7 (50%)	7 (24.1%)	0.238
≥25 years	6 (66.7%)	7 (50%)	22 (75.9%)	
Body mass index (kg/m^2)				
Normal	8 (88.9%)	12 (85.7%)	17 (58.6%)	0.080
Overweight	1 (11.1%)	2 (14.3%)	12 (41.4%)	
Obese	0	0	0	
Waist circumference (cm)				
<88 cm	9 (100%)	14 (100%)	25 (86.2%)	0.179
≥88 cm	0	0	4 (13.8%)	
Physiological parameters				
Systolic blood pressure (mmHg)				
<130 mmHg	9 (100%)	14 (100%)	19 (65.5%)	0.007*
≥130 mmHg	0	0	10 (34.5%)	
Diastolic blood pressure (mmHg)				
<85 mmHg	9 (100%)	13 (92.8%)	18 (62.1%)	0.016*
≥85 mmHg	0	1 (7.1%)	11 (37.9%)	
Oxygen saturation (%)				
<95	0	0	8 (27.6%)	0.024*
≥95	9 (100%)	14 (100%)	21 (72.4%)	
Heart rate (bpm)				
Tachycardia > 100	0	0	4 (13.8%)	0.179
Normal 60−100	9 (100%)	14 (100%)	25 (86.2%)	
Bradycardia < 60	0	0	0	

Table 7: Percentages of participants with PTSD, categorized into times of <2 years, 2–5 years, or >5 years after PTSD symptom onset. The comparison was performed with Pearson chi-squared tests. *Significant at $p < 0.05$; **significant at $p < 0.001$; $p > 0.05$ was considered non-significant (NS). Abbreviations: body mass index (BMI), waist circumference (WC), waist-to-height ratio (WHtR), systolic blood pressure (SBP), diastolic blood pressure (DBP), and oxygen saturation (SPO_2).

Characteristic	<2 years N = 5 N (%)	2–5 years N = 19 N (%)	>5 years N = 28 N (%)	p value
Anthropometric parameters				
Age				
<25 years	1 (1.9%)	9 (47.4%)	7 (25%)	0.226
≥25 years	4 (7.7%)	10 (52.6%)	21 (75%)	
Body mass index (kg/m^2)				
Normal	5 (100%)	18 (34.6%)	14 (50%)	0.001*
Overweight	0	1 (1.9%)	14 (50%)	
Obese	0	0	0	
Waist circumference (cm)				
<88 cm	5 (100%)	19 (100%)	24 (85.7%)	0.156
≥88 cm	0	0	4 (14.3%)	
Physiological parameters				
Systolic blood pressure (mmHg)				
<130 mmHg	5 (100%)	15 (78.9%)	22 (78.6%)	0.517
≥130 mmHg	0	4 (21.1%)	6 (21.4%)	
Diastolic blood pressure (mmHg)				
<85 mmHg	5 (100%)	15 (78.9%)	20 (71.4%)	0.364
≥85 mmHg	0	4 (21.1%)	8 (28.6%)	
Oxygen saturation (%)				
<95	0	4 (21.1%)	4 (14.3%)	0.496
≥95	5 (100%)	15 (78.9%)	24 (85.7%)	
Heart rate (bpm)				
Tachycardia > 100	0	3 (15.9%)	1 (1.9%)	0.242
Normal 60–100	5 (100%)	16 (84.1%)	27 (51.9%0	
Bradycardia < 60	0	0	0	

prevalence of PTSD was higher in individuals ≥25 years of age within the PTSD group (Table 5, $p < 0.001$).

Anthropometric and physiological characteristics of participants with PTSD by disease severity

The association of PTSD severity with anthropometric and physiological parameters is shown in Table 6. According to the results, 75% of participants with extreme PTSD were older than 25 years, 41.4% were overweight, 13.8% had WC > 88 cm, 34.5% had hypertension, 37.9% had high DBP, 27.6% had SPO_2 <95%, and 13.8% had tachycardia.

Anthropometric and physiological characteristics of participants with PTSD, by time after PTSD symptom onset

Individuals with PTSD symptoms for 2–5 years had a significantly higher rate of obesity (50%) than those with symptoms for <2 years. Interestingly, no significant differences were observed in age, WC, SBP, DBP, SPO_2, or heart rate among groups (Table 7).

Discussion

The Duhok Governorate has borne the brunt of the displaced population, including both refugees (mostly Syrian, since the beginning of the Syrian crisis in 2014) and IDPs. According to 2016 data, the Duhok Governorate hosted a total population of 1.47 million people, including a staggering 718,000 displaced individuals (including IDPs and refugees). From the IDP population, an estimated 85% were Kurds (Sunni or Yazidi), whereas 8% were Arabs, 5% were Christians, and the remaining people were members of other minority groups, such as Turkmen and Shabaks.[14]

The total number of IDPs hosted in Duhok was estimated to be approximately 400,000 by the United Nations and Kurdish officials, of whom approximately 199,000 people living in the camps were either Sunni or Yazidi.[15] According to data from the BCF, in 2024, 1774 Yazidi women who had survived the ISIS attack on Sinjar were distributed across 15 IDP camps in Duhok.[16] The BCF, a non-governmental, non-political, non-profit organization, was founded in 2005 in Erbil, the capital city of the Kurdistan Region of Iraq. According to data from the BCF, the prevalence of PTSD varies across the camps in Duhok, from approximately 32.8% to 39.5%.

Displaced people, whether refugees or IDPs, are particularly challenging patient groups often traumatized by prolonged civil wars, torture, and ethnic cleansing.[6,17] Many Yazidi women have experienced severe physical and sexual violence and the loss of loved ones because of the atrocities committed by ISIS.[2] The traumatic effects of the ISIS attacks are likely to have lasting effects on the mental and

emotional well-being of these women, and to contribute to prolonged psychological distress and potential neurocognitive anomalies.[5,18] Trauma is likely to be long-lasting for Yazidi women who survived the ISIS attack.[2] The medical assistance is inadequate in the conditions under which most of these women are living,[5] and previous studies have shown that blood pressure problems and diabetes, for example, are common in this population.[6] Second, most of the Yazidi women remain living in inadequate conditions inside the camps for displaced people, which were planned to be temporary since 2014, thus aggravating their health status.[17] According to several previous studies, Yazidi women have various mental health disorders including PTSD.[18–20]

Effects of PTSD on anthropometric and physiological parameters

The HPA axis links the CNS with peripheral tissues through the involvement of the hypothalamus, and pituitary and adrenal glands.[4,5] This system of neuroendocrine pathways and feedback loops regulates a broad range of physiological processes, particularly those mediating the stress response, and hence has consistently been implicated in trauma-related conditions.[21,22] Traumatized Yazidi women who are survivors should undergo a complete medical assessment including blood pressure and diabetes testing, because many studies have shown that these problems and mental health concerns are common in this population.[20,23]

In the present study, we observed substantial percentage differences in physiological and anthropometric parameters between the PTSD group and both the external and internal control groups. The PTSD group experienced more significant alterations, including higher body weight, BMI, WC, and waist-to-height ratios, than the control groups. PTSD is associated with intricate physiological and psychological mechanisms that influence various anthropometric measurements.[5] Neuroendocrine dysregulation, characterized by disruptions in the HPA axis and cortisol secretion, contribute to alterations in weight, BMI, and WC, and often lead to elevated visceral adiposity.[4,6] Sleep disturbances and disrupted appetite regulation, which are common among individuals with PTSD, further exacerbate these changes.[7] Sedentary lifestyles resulting from PTSD symptoms, together with stress-related eating behaviors, contribute to weight gain and alterations in BMI and WC.[8] Moreover, the chronic psychological stress inherent in PTSD triggers inflammatory responses, thereby affecting cytokine and metabolic health, and influencing these anthropometric measurements.[4] Integrating comprehensive interventions addressing both the psychological and physiological aspects of the disorder are imperative to mitigate the adverse effects on weight, BMI, WC, and overall metabolic health.[11,24] Individuals with PTSD often experience heightened stress, which may lead to changes in eating habits and physical activity patterns, and potentially result in weight gain and elevated obesity incidence.[9] These changes reflect the complex interplay between psychological stress and physical health,[17] which is commonly observed in individuals with PTSD.[23]

In the current study, women diagnosed with PTSD had elevated blood pressure (SBP and DBP) and heart rate. According to previous studies, PTSD can lead to elevated blood pressure, thus reflecting an overactive stress response.[23,25] Higher central and peripheral noradrenergic activity has been observed in both children and adults with PTSD in cross-sectional studies of sympathetic nervous system (SNS) activity in PTSD.[26] The relationship between PTSD and blood pressure control mechanisms is attributable to the intricate involvement of the HPA axis and the SNS, which play critical roles in modulating various physiological processes, including cardiovascular function.[26] The dysregulation of these neuroendocrine pathways and feedback loops, as frequently observed in individuals with PTSD, may contribute to the elevations in blood pressure and heart rate.[25,26]

Sleep patterns and immune function are disrupted in people with PTSD, thus increasing the risk of physical health problems, including cardiovascular disease, diabetes, and gastrointestinal disorders.[23] Abnormal heart rate patterns, such as elevated resting heart rate and heart rate variability, are consistently observed in individuals with PTSD and are associated with a heightened risk of cardiovascular issues.[25,28] In this regard, the results of the current study align with those from previous studies.[24,25,29]

Interestingly, comparison of people living outside the IDP camps with people living inside the camps indicated no significant differences in weight, BMI, WC, and blood pressure; however, those living inside the camps had higher WHtR and heart rate, as well as lower SPO_2. Living with a person diagnosed with PTSD is known to significantly affect the mental, emotional, and physical health of family members or caregivers. Although these individuals might not have directly experienced the traumatic events themselves (and are likely to be similar to our internal control group), they can nonetheless be profoundly affected by the ongoing stress and challenges of caring for someone with PTSD.[24]

Our findings indicating no statistically significant age differences between the external and internal control groups are consistent with those from previous studies suggesting that age is not a factor contributing to these observed anthropometric parameters.[27,30] Therefore, the chronic stress and emotional burden of caregiving may contribute to disruptions in lifestyle habits, such as altered eating patterns, decreased physical activity, and increased sedentary behavior.[3,9] Shared environmental factors and coping strategies within the household further contribute to similar changes in these anthropometric parameters.[18,20] Prolonged exposure to caregiving-related stress can lead to persistent activation of the SNS, HPA axis dysregulation, and chronic inflammation, thus resulting in elevated blood pressure and heart rate.[22,26] Additionally, because of the demands of their role, caregivers often adopt unhealthy lifestyle behaviors, such as poor dietary choices and decreased physical activity, which in turn contribute to cardiovascular strain.[25,30] According to Pisaruk et al. (2023), the duration of PTSD significantly influences various anthropometric parameters in people with PTSD.[5] Our study showed altered anthropometric and physiological parameters in individuals with PTSD, which was aggravated by the duration of the disease. Individuals exhibiting PTSD

symptoms for more than 5 years had substantially higher weight, BMI, WC, and waist-to-height ratios than those with a PTSD duration <2 years. This finding highlights the association between prolonged PTSD and significant differences in BMI reported previously.[8] Moreover, our study showed that individuals with PTSD symptoms for ≥5 years had higher blood pressure and heart rate, and significantly lower oxygen saturation. The chronic nature of PTSD contributes to persistent neuroendocrine dysregulation, particularly involving the overactivation of the HPA axis and prolonged elevation of stress hormones such as cortisol.[5,6] This dysregulation disrupts energy metabolism and leads to differences in weight, BMI, and WC over time.[31]

In contrast, some articles have discussed the possibility of physiological adaptation to chronic stress over time, called allostasis, thus leading to a new physiological equilibrium that prevents further significant alterations in physiological parameters.[32] This adaptation may involve the establishment of new homeostatic mechanisms that help maintain stability in blood pressure, oxygen saturation, and heart rate despite the presence of chronic PTSD.[11,20]

Qian et al. (2022) have discussed how the effects of PTSD on physiological variables depend on factors such as trauma type, severity, coping skills, support system, and co-existing conditions. For example, individuals with combat-related trauma exhibit distinct cardiovascular responses from those with non-combat-related trauma.[1] The unique stressors associated with combat, including prolonged exposure to life-threatening situations and hypervigilance, contribute to an exaggerated sympathetic nervous system response leading to both higher heart rate and blood pressure.[2] These physiological differences are further intensified by the severity of PTSD symptoms, thus reflecting the profound psychological distress experienced by individuals with severe combat-related PTSD.[26] The chronic activation of the stress response system, alterations in neurotransmitters, and the influence of psychosocial and behavioral factors associated with combat-related trauma collectively contribute to the intricate relationship between distinct cardiovascular responses and the severity of PTSD symptoms in these individuals.[29]

The present study revealed differences in various physiological and anthropometric parameters between the moderate and extreme PTSD groups. In terms of anthropometric parameters, the group with extreme severity had significantly higher weight, BMI, WC, and WHtR than the group with moderate severity. Severe and chronic stress can lead to dysregulated cortisol, which in turn can influence glucose metabolism and appetite regulation.[32] Dysregulated cortisol can lead to increased cravings for high-calorie foods, particularly those high in sugar and fat, to temporarily alleviate stress.[26] These dietary habits can contribute to changes in anthropometric parameters over time.[31,32] Herein, the group with extreme PTSD severity had higher SBP, DBP, and heart rate, and lower SPO_2, than the moderate group. These results suggest potential cardiovascular and respiratory changes associated with severe PTSD. Extreme PTSD is often associated with persistent activation of the sympathetic nervous system, thus leading to elevated release of catecholamines.[11] This heightened sympathetic activity results in vasoconstriction and consequently elevated SBP, DBP, and heart rate, as the body prepares for a fight-or-flight response.[8]

Severe PTSD is often associated with chronic low-grade inflammation and endothelial dysfunction. Elevated inflammatory markers such as CRP contribute to alterations in cardiovascular function, including higher vascular resistance and changes in blood pressure.[30] Endothelial dysfunction also influences anthropometric parameters, such as BMI and WC, through its effects on metabolic and vascular health.[27] Chronic activation of these systems in response to PTSD-related stress may contribute to cardiovascular changes, higher value in heart rate leading to the observed variations in blood pressure.[27,28]

The percentage distributions among the participants provided insights into the physiological implications of PTSD in cardiovascular and respiratory health in the study groups. Notably, we observed a relatively high prevalence of PTSD in individuals ≥25 years of age, thus suggesting a potential vulnerability of older individuals to PTSD in IDP settings. Furthermore, the elevated WC and BMI observed in individuals with PTSD suggested the potential effects of chronic stress on metabolic parameters.[33] An imbalance in energy metabolism could cause this alteration and explain the observed changes in body weight.[32] The observed significant differences in SBP and DBP, together with diminished SPO_2, indicated potential cardiovascular and respiratory implications of PTSD, as previously described. Chronic stress can lead to overactivation of the autonomic nervous system, particularly the sympathetic branch, and sustained elevations in blood pressure.[33] Disruption of normal breathing patterns may contribute to decreased SPO_2. Additionally, chronic stress influences autonomic nervous system dysregulation, breathing pattern alterations, and neuroendocrine disturbances, all of which might have contributed to the observed physiological disparities among the study groups.[33,34]

A total of 34% of participants with extreme PTSD had significantly elevated DBP and SBP, whereas no participants with moderate or severe PTSD had high blood pressure. These findings suggested an association between PTSD severity and elevated blood pressure, thus potentially reflecting the physiological stress response.[34] The persistent and chronic nature of stress in severe PTSD includes a heightened state of physiological arousal, which may exert a continuous burden on the cardiovascular system.[10] This prolonged physiological arousal may induce maladaptive changes in blood vessel structure, thereby contributing to the development of atherosclerosis and vascular rigidity.[31] Furthermore, the lower SPO_2 in the extreme PTSD group might have been indicative of altered breathing patterns associated with this extreme severity.[31]

A higher percentage of overweight individuals was observed in the group with PTSD for >5 years. This finding suggested a potential link between prolonged PTSD and changes in weight.[28] Individuals with longstanding PTSD may experience prolonged stress and emotional distress, and potentially alterations in eating habits and physical activity patterns that contribute to obesity.[4] Moreover, metabolic changes may be influenced by alterations in stress-related neuroendocrine and inflammatory pathways,

as well as the disrupted sleep patterns often observed in individuals with PTSD.[29,32] From our current results, we conclude that PTSD significantly affects physiological and anthropometric parameters. These physiological changes are likely to be a manifestation of the complex interplay between psychological trauma and the body's physiological responses. The study highlights the importance of considering both psychological and physiological aspects in understanding and managing PTSD.

Conclusion

According to the present study, the 2014 terrorist assault perpetrated by the so-called ISIS in Iraq continues to inflict severe suffering on Yazidi women, and has led to long-lasting physiological and anthropomorphic alterations associated with PTSD. These alterations might be understood as complications of chronic PTSD. The urgent need for appropriate healthcare for Yazidi women who are survivors of the genocide in Northern Iraq is evident. In this context, early PTSD diagnosis and intervention are crucial to prevent additional health problems due to the physiological and anthropometric alterations associated with PTSD. How generations raised by people with PTSD might be affected by the disease is unclear. Research is urgently needed to enhance understanding of PTSD, and to identify specific biomarkers for accurate diagnosis and effective treatment of the disease.

Study limitations

This study's observational cross-sectional design prevented the determination of causation. However, a cross-sectional design can help establish preliminary evidence of a causal relationship. Here in, the cross-sectional design was useful in examining the association of PTSD with alterations in physiological and anthropometric parameters, particularly in the setting of a lack of information regarding the time of disease onset. In the same manner, the cross-sectional design aided in examination of the association of PTSD chronicity and severity with alterations in physiological and anthropometric parameters. We additionally collected data from a random sample of displaced Yazidi households from Sinjar living in Duhok camps in the Kurdistan Region of Iraq; this aspect also could be considered a study limitation.

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Conflict of interest

The author(s) have no conflict of interest to declare.

Ethical approval

Ethical clearance was obtained from the Directorate of Health of Duhok Governorate and the Scientific Committee of the College of Science/University of Duhok (reference number: 22062021-6-7).

Consent

Before data collection, the participants were fully informed of the importance and objectives of this study, and each participant provided written consent.

Authors contributions

Conceptualization, SYA and DSP; methodology, KHJ; formal analysis, KHJ; investigation, KHJ; resources, KHJ; writing—original draft preparation, KHJ; writing review and editing, KHJ, SYA, and DSP; supervision, SYA and DSP; project administration, KHJ. All authors have critically reviewed and approved the final draft and are responsible for the content and similarity index of the manuscript.

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