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ORIGINAL ARTICLE

Evaluation of the relationship between theory of mind relating to cognitive performance and post-traumatic stress disorder in Syrian refugee amputees living in Turkey

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Abstract

Background According to the available literature, studies examining the relationship between theory of mind (ToM) and post-traumatic stress disorder (PTSD) have a small sample size and are few in number.

Aims This study aims to investigate the relationship between the potential presence of PTSD in Syrian refugee amputees living in Turkey, ToM skills measured by Reading the Mind in the Eyes Test (RMET), and variables related to amputation.

Method Our 69 follow-up amputee patients answered a socio-demographic and amputation data form, and the RMET, PTSD checklist for DSM-5 (PCL-5), and Beck Depression Inventory-II (BDI-II) completed a ToM task.

Results Those with potential PTSD were significantly less educated than those without ($p = .017$). Prosthesis usage time ($p = .002$) and duration of post-amputation ($p = .033$) were significantly shorter in those with potential PTSD compared to those without. The RMET neutral valence ($p = .035$) and RMET total ($p = .017$) accuracy scores were significantly lower in patients with potential PTSD. Those with potential PTSD were higher significantly more depressed ($p < .001$). In our regression analyses, lower education level ($p < .05$), shorter prosthesis usage time ($p = .008$), and lower RMET neutral valence ($p = .006$) / RMET total ($p = .032$) accuracy scores predicted the presence of potential PTSD.

Conclusions Lower education level, prosthesis use for a shorter period, and poor mind-reading skills from neutral and total eye expressions were predictive of the potential presence of PTSD in amputees, even though they were largely exposed to similar traumas. Our findings suggest that treatment and follow-up of PTSD should also target deficits in cognitive and emotional abilities.

Keywords Amputee · PTSD · Refugee · Theory of mind · Trauma

Introduction

Theory of mind (ToM) refers to the ability to comprehend the mental states, beliefs, intentions, desires, and knowledge of others. Because ToM skills involve being aware of the emotional and cognitive states of others, they have a pivotal role in social interaction and communication [1, 2]. Woodruff and Primack introduced the concept of ToM in 1978, and since then, a wide range of tasks, methods, and theories have accumulated in the literature [3].

ToM development begins in early infancy and continues through adolescence [4, 5]. As the child gets older, the ToM's function becomes more complex. Children become aware of the intentions of others as their ToM develops and learn that people can manipulate their own behavior to achieve their goals. ToM ability is essential for empathy and social interaction [6]. Social cognition can therefore be said to be a result of ToM skills.

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There is no consensus on what tests should be used to measure ToM. Reading the Mind the Eyes Test (RMET) and Strange Stories are more sensitive tests that have been developed to measure specific social-cognitive deficits [7, 8].

Post-traumatic stress disorder (PTSD) is a mental health issue that some people develop as a result of experiencing or witnessing a life-threatening event such as war, natural disaster, car accident, or sexual violence. PTSD is a disorder that may have a negative effect on many aspects of daily life, particularly interpersonal relationships [9]. Previous research has found that people with PTSD have lower family cohesion and functioning, lower life satisfaction, lower intimacy within romantic ties, and a lower likelihood of establishing and maintaining close relationships [10–13].

In people with PTSD, broad social cognitive deficits and differences have been recognized, including difficulties accurately attributing emotions and inferring the mental states of other people and oneself [14, 15]. A recent meta-analysis of these crucial areas of social cognition, which included 19 research involving 565 individuals with PTSD and 641 individuals without, discovered that people with PTSD lower scores in overall social cognitive performance, especially mentalizing, with a moderate effect size for overall social cognition deficits in the PTSD group [16].

Despite strong evidence that trauma survivors have disruptions in interpersonal functioning, few studies have conducted systematic investigations of particular difficulties with social cognition, such as ToM deficits, that may mediate these negative outcomes.

In one research, 16 Bosnian refugees with war-related PTSD performed significantly worse on the RMET than 16 other refugees without PTSD and 50 Danes without PTSD [17]. In a study with individuals with PTSD as a result of attacks, work accidents, natural disasters, the empathic skills of PTSD patients ($n=16$) were assessed using various tasks such as RMET, empathic resonance test and faux pas test compared to healthy controls ($n=16$) [18]. RMET scores were lower in the PTSD group; however, the differences were not statistically significant ($p=0.14$). On the other hand, in a study of police officers who were participated in the mission in Iraq, police officers with PTSD who were attacked ($n=20$) exhibited significantly impaired RMET performance compared to officers without PTSD who were not attacked ($n=15$) [19].

In a 2014 study, no significant difference was observed in RMET performance between combat veterans with traumatic brain injury (TBI) and PTSD who served in Iraq ($n=16$) and combat veterans with only TBI ($n=16$) [20]. Nazarov et al. in a 2014 study and Altunbaş et al. in a 2019 study compared PTSD individuals with childhood traumas and healthy individuals [21, 22]. They investigated the relationships between the ToM performances of the groups with RMET and other cognitive tests. Nazarov et al. reported no difference in RMET duration and accuracy values between 20 healthy volunteers compared to 31 PTSD patients [21]. Altunbas et al. found that 30 PTSD patients had significantly lower RMET score accuracy and significantly longer RMET response time compared to 30 healthy volunteers [22]. In contrast, emotionally abused and neglected adolescents did not perform poorly on the RMET in a research by van Schie et al. [23]. According to the literature, PTSD that is currently present or has a history of traumatic experiences throughout childhood may cause impaired ToM skills, which may cause issues with social interaction. In a current cohort study, researchers looked at the effect of social cognition on the treatment response of PTSD patients, as a result, three themes were identified to explain the relationship between PTSD and social cognition: (1) Individuals' social cognition varies over time and context. (2) PTSD risk may be increased by impaired social cognitive ability. (3) Trauma and PTSD can have an impact on social cognition [24]. It has been proposed that those with poor or abnormal social cognition may be more susceptible to PTSD after experiencing trauma. Social cognitive abilities have been hypothesized to mediate the association between childhood attachment and PTSD risk and resilience [25]. Social cognitive impairment may raise the likelihood of developing PTSD. Indeed, we know that similar traumas have clinically different outcomes in different individuals.

In this regard, we aimed to investigate the relationship between the presence of potential PTSD in Syrian refugee amputees living in Turkey, who were exposed to very similar traumas, and the level of amputation, cause and other descriptive variables, especially RMET skills. We hypothesized that low RMET performance is associated with the presence of potential PTSD within the ToM framework.

We believe that our study in this specific population provides a significant contribution to the literature as it has a larger sample size compared to previous studies and emphasizes the predictive aspect of low RMET performance in terms of the possible presence of PTSD.

Methods

Selection of participants and formation of groups

In this cross-sectional study, an online questionnaire was sent to 120 Syrian war victims refugees who lived in various regions of Turkey, were amputated for different reasons, and underwent prosthesis application and rehabilitation in Alliance of International Doctors (AID) Prosthesis Centers (Istanbul and Hatay/Reyhanlı). Amputee Syrian refugees living in camps were excluded from the study. The study was carried out in June–August 2022. The study included 69 amputees who were refugees after the Syrian war, between

the ages of 18 and 65, who could read Arabic, did not have organic brain damage, had not used drugs that could affect their brain functions in the last month, and were not diagnosed with substance abuse.

In our PCL-5 scale, the cut-off was set as 23 as in the study we referenced [26]. Those scoring 23 and above were considered as potential presence of PTSD and those scoring below 23 were considered as potential absence of PTSD and the participants were divided into two groups. The groups were compared in terms of psychometric properties.

Survey instruments

The questionnaire we prepared online was delivered to the participants. RMET, PTSD checklist for DSM-5 (PCL-5), BDI-II scales were used. In addition to socio-demographic characteristics, other data such as the cause of amputation, amputated limbs, duration of post-amputation, duration of prosthesis use, and degree of mobilization of the amputee were collected.

Reading mind eyes test (RMET)

The RMET is a computer-based behavioral task that is widely used in ToM research to assess the capacity to attribute mental states to others through their eyes [7, 18, 27]. It was developed by Baron-Cohen et al. (2001). In this task, participants are shown cropped photographs of people that only show the eye region. They are then given four adjectives and asked to select the one that best describes what the person in the photograph is thinking or feeling. There are 36 photographs in total. Using a method previously established by Lee et al., the photos were also categorized by emotional value (positive, neutral, and negative) [27]. The test is scored by adding the number of correctly identified photos by the participant; thus, the maximum total score is 36. Permission to use the Arabic version of the test was obtained from the Autism Research Center (ARC) [28]. Kittel et al. found that the internal consistency of the test was acceptable in their meta-analysis ($\alpha = 0.73$). In our sample, the internal consistency coefficient of the RMET scale was 0.67 [29].

PTSD checklist for DSM-5 (PCL-5)

This symptom checklist inquires about the occurrence of four clusters of PTSD symptoms according to the DSM-5 (intrusion, avoidance, negative alterations in cognition and mood, and hyperarousal) within the preceding month [30]. The measurement is made on a 20-item Likert-type scale between 0 (not at all) and 4 (very much). They can be added together to produce a final score (range 0–80). This test has been demonstrated to have high reliability and validity and to suit the DSM-5 four-factor model for PTSD [31]. Ibrahim et al. carried out the validity research of the Arabic version [26]. The PCL-5 had adequate convergent validity and had a high internal consistency (alpha = 0.85). For the intrusion, avoidance, negative alterations in cognition and mood, and hyperarousal symptom clusters, respectively, Cronbach's alpha values of the PCL-5 subscales were 0.76, 0.88, 0.74, and 0.71. The PCL-5 achieved an optimum balance of sensitivity and specificity with a cut-off score of 23 (sensitivity = 0.82, specificity = 0.70) [26]. In our sample, the internal consistency coefficients of the PCL-5 scale were 0.93, 0.85, 0.76, 0.87, and 0.80 for total, intrusion, avoidance, negative alterations in cognition and mood, and hyperarousal symptom clusters, respectively. Permission to use this scale in this study was obtained from Ibrahim [26].

Beck depression inventory-II (BDI-II)

Beck et al. developed it in 1996 to assess the intensity and severity of depression symptoms [32]. The scale consists of 21 self-report items. Each item uses a 4-point Likert scale scored from 0 to 3. The patient must choose the statement that best describes how they felt in the previous week, including the day of the survey [33]. Depression levels are categorized as minimal (0–13), mild (14–19), moderate (20–28), and severe (29–63) based on the total score acquired from the answers to all questions [34]. Ghareeb conducted a validity study on the Arabic version of the inventory [35]. He found the internal consistency coefficient to be 0.83. In our study, we found the internal consistency coefficient to be 0.93. The permission of Ghareeb was obtained for its use in this study [34].

Approval number E-10840098–604.01.01.01–3973 was obtained from our university, the Ethics Committee for Non-Interventional Clinical Research, and the participants were informed about the study's purpose and content. The research was carried out in accordance with the Helsinki Declaration's principles.

Statistical analysis

The significance level in this study was set at $p \leq 0.05$ for all evaluations. IBM SPSS Statistics for Windows was used for statistical analysis (Version 20.0). To determine whether the continuous variables were normally distributed or not, the Kolmogorov–Smirnov test was used.

Descriptive statistical techniques were used to define the groups. The Mann–Whitney *U* test, qi-square test, and Fisher's Freeman exact test were used for paired comparisons of the absence/presence of potential PTSD and other factors. Factors showing statistical significance in these analyses were included in the regression analysis as independent variables. We then performed binary logistic regression analysis to determine the contribution of the relevant predictors

to our categorical dependent variable of absence/presence of potential PTSD. Since duration of post-amputation and duration of prosthesis use showed multicollinearity, we included duration of prosthesis use in our regression analyses, which had stronger significance in paired comparisons. Since RMET neutral valence was domain of RMET total, it was included in separate regression analyses. In addition, the BDI-II cut off-2 item could not be included in the regression analysis because there were no participants with both moderate-severely depressed and non-PTSD in our chi-square analysis.

Results

Socio-demographic and amputation-related characteristics

The majority of Syrian refugee amputees living in Turkey were male ($n=59$; 85.5%). The oldest amputee was 67 years old, and the mean age was 33.88 ± 11.88 years. Two-thirds of the volunteers were married ($n=46$; 66.7%), one third were single ($n=23$; 33.3%) and about three quarters were either only literate or had primary education. Most amputees were unemployed (69.6%) and had been amputated due to war injuries (81.2%). All participants were prosthesis users, with a mean duration of prosthesis use and post-amputation of 7.33 ± 8.39 and 8.46 ± 8.42 years, respectively. There were no significant differences in sex ($p=0.81$), age ($p=0.675$), marital status ($p=0.479$), employment status ($p=0.193$), cause of amputation ($p=1.000$), amputated limb(s) ($p=0.571$), and amputee mobilization degree ($p=0.411$), between those with and without potential PTSD. Those with potential PTSD were significantly less educated than those without ($p=0.017$).

Prosthesis usage time and duration of post-amputation were significantly shorter in those with potential PTSD than in those without (10.92 ± 11.72 vs 5.28 ± 4.79, $p=0.002$; 11.42 ± 12.10 vs 6.78 ± 4.72, $p=0.033$, respectively). Socio-demographic and amputation-related characteristics of the refugees are shown in Table 1.

Features related to RMET and BDI-II

There was no significant difference in RMET negative valence ($p=0.086$) and RMET positive valence ($p=0.534$) scores between those with and without potential PTSD. RMET neutral valence (9.48 ± 2.29 vs 8.09 ± 2.59, $p=0.035$) and RMET total (19.04 ± 4.51 vs 16.48 ± 4.82, $p=0.017$) accuracy scores were significantly lower in those with potential PTSD. Approximately three-quarters of the amputees had minimal to mild depression (73.9%) and one-quarter had moderate to severe depression (26.1%). Those with potential PTSD were higher significantly more depressed ($p<0.001$). The characteristics of amputees on the RMET and BDI-II are shown in Table 1.

Predictive factors for the presence of potential PTSD

Educational status, prosthesis usage time, RMET neutral valence, and RMET total factors, which were significant in the paired comparison of potential PTSD absence/presence and other factors, were included in the regression analyses as independent variables. Since our dependent variable potential PTSD absence/presence was a binary categorical variable, binary logistic regression analysis (enter mode) was used. In our first analysis, being a high school graduate negatively predicted the presence of potential PTSD compared to being literate ($p=0.015$). Moreover, shorter prosthesis usage time ($p=0.008$) and lower RMET neutral valence accuracy scores ($p=0.006$) predicted the presence of potential PTSD. In our second analysis, being a graduate of high school ($p=0.034$) and university and above ($p=0.047$) negatively predicted the presence of potential PTSD compared to being illiterate. Moreover, shorter prosthesis usage time ($p=0.038$) and lower RMET total accuracy scores ($p=0.032$) predicted the presence of potential PTSD. Regression analyses are shown in Tables 2 and 3.

Discussion

This research examined into the relation between the presence of potential PTSD, ToM skills measured by RMET, socio-demographic, and amputation-related characteristics in Syrian refugee amputees living in Turkey. Our groups were largely homogeneous in terms of sociodemographic and amputation-related characteristics. Those with potential PTSD performed lower on the ToM task (RMET neutral valence and RMET_total accuracy) than those without. In addition, lower eye-to-mind reading neutral valence and total accuracy values in this ToM task (RMET) predicted the presence of potential PTSD. Those with potential PTSD were significantly less educated, had shorter prosthesis usage time and duration of post-amputation, and were more depressed than those without. High school, university and above graduation and longer prosthesis usage time negatively predicted the presence of potential PTSD. Our findings contribute to the existing literature by showing that low ToM performance is associated with and even predicts the presence of potential PTSD.

This study showed that higher education level predicted lower risk of PTSD in amputees. Some researchers have underlined a potential relationship between educational level and PTSD [36, 37]. Accordingly, epidemiologic data from the ESEMeD study in Italy reported significantly higher

Table 1 Socio-demographic and amputation-related characteristics of the amputee Syrian refugees (*: Mann Witney *U* test; ":qi-square test; ': Fisher's Freeman Exact test)

-	**PCL-5 < 23 probably not PTSD (*n* = 25)**	**PCL-5 ≥ 23 probably PTSD (*n* = 44)**	**Statistic value**	**All of sample (*n* = 69)**
Sex	-	-	.81"	-
Male	24 (96.0)	35 (79.5)		59 (85.5)
Female	1 (4.0)	9 (20.5)		10 (14.5)
Age	35.08 ± 12.50	33.20 ± 11.60	.675*	33.88 ± 11.88
Marital status	-	-	.479"	-
Married	18 (72.0)	28 (63.6)		46 (66.7)
Single	7 (28.0)	16 (36.4)		23 (33.3)
Education status	-	-	**.017'**	-
Literate	2 (8.0)	15 (34.1)		17 (24.6)
Primary education	13 (52.0)	23 (52.3)		36 (52.2)
High school	5 (20.0)	4 (9.1)		9 (13.0)
University and above	5 (20.0)	2 (4.5)		7 (10.1)
Unemployed	15 (60.0)	33 (75.0)	.193"	48 (69.6)
Employment	10 (40.0)	11 (25.0)		21 (30.4)
Cause of amputation	-	-	1.000"	-
Other	5 (20.0)	8 (18.2)		13 (18.8)
War	20 (80.0)	36 (81.8)		56 (81.2)
If war	-	-	.866'	-
Land mine	4 (20.0)	9 (25.0)		13 (23.2)
Bomb	6 (30.0)	7 (19.4)		13 (23.2)
Weapon	5 (25.0)	9 (25.0)		14 (25.0)
Other	5 (25.5)	11 (30.6)		16 (28.6)
Amputated limb(s)	-	-	.571'	-
Right upper limb	0 (0)	1 (2.3)		1 (1.4)
Right lower limb	11 (44.0)	15 (34.1)		26 (37.7)
Left lower limb	9 (36.0)	21 (47.7)		30 (43.5)
Left upper limb—left lower limb	1 (4.0)	0(0)		1 (1.4)
Right lower limb—left lower limb	4 (16.0)	7 (15.9)		11 (15.9)
Prosthesis usage time, years	10.92 ± 11.72	5.28 ± 4.79	**.002***	7.33 ± 8.39
Duration of post-amputation, years	11.42 ± 12.10	6.78 ± 4.72	**.033***	8.46 ± 8.42
Amputee mobilization degree	2.24 ± 0.66	2.07 ± 0.51	.411*	2.13 ± 0.57
		There is one (1) missing data		*There is one (1) missing data*
RMET negative valence	5.84 ± 2.15	4.93 ± 2.10	.086*	5.26 ± 2.15
RMET positive valence	3.72 ± 1.67	3.46 ± 1.90	.534*	3.55 ± 1.81
RMET notr valence	9.48 ± 2.29	8.09 ± 2.59	**.035***	8.59 ± 2.56
RMET_total	19.04 ± 4.51	16.48 ± 4.82	**.017***	17.41 ± 4.84
BDI-cut off-2 item	-	-	**.000"**	-
Minimal—mild	25 (100)	26 (59.1)		51 (73.9)
Moderate—severe	0 (0)	18 (40.9)		18 (26.1)

p values below <0.05 are written in bold because they show statistical significance

rates of PTSD in subjects with lower levels of education [38]. Although conflicting results have been reported on the potential association between education level and PTSD, the strongest evidence suggests lower education levels to put subjects at higher risk for PTSD [39–41].

In our study, increased duration of post-amputation was associated with lower PTSD. This may be related to the time elapsed since the trauma (injury) and PTSD symptoms may be alleviated over time. In addition, duration of prosthesis use predicted a lower risk of PTSD. Prosthesis treatment

Table 2 Binary logistic regression analysis of factors affecting potentional PTSD absence/ presence of amputee Syrian refugees (Nagelkerke R Square: .453; Hosmer and Lemeshow test: .731)

-	B	S.E	Wald	df	Sig	Exp(B)	95% C.I.for EXP(B)	
-							Lower	Upper
Education status								
Literate (Ref.)	-	-	6.903	3	.075	-	-	-
Primary education	−1.689	.930	3.298	1	.069	.185	.030	1.143
High school	−3.019	1.242	5.905	1	**.015**	.049	.004	.558
University and above	−2.332	1.220	3.652	1	.056	.097	.009	1.062
Prosthesis usage time, years	−.174	.065	7.120	1	**.008**	.840	.739	.955
RMET notr valence	−.488	.177	7.628	1	**.006**	.614	.434	.868

p values below <0.05 are written in bold because they show statistical significance

may be effective as a rehabilitative factor for PTSD over time, with improvement in physical functioning. The cause of amputation (war or other), the degree of amputee mobilization and the type of amputated limbs had no significant effect on the presence of potential PTSD.

In one of our authors Tatar's study, the prevalence of moderate to severe depression in Syrian refugee amputees living in Turkey was 15.1% [42]. In our study, amputees were more depressed (26.1%). The increase in depression level was strongly associated with the presence of PTSD.

People suffering from PTSD may experience psychosocial difficulties due to deficits in social cognition. People who have PTSD may experience neurocognitive issues such as mental defeat, negative emotion appraisal, perceived negative reactions of others, or cognitive distortions [43, 44]. According to a meta-analysis of social cognition performance in posttraumatic stress disorder, social phobia, and anxiety disorders discovered that PTSD patients had problems with mentalizing and emotion recognition [45]. However, this study only included 6 PTSD studies.

In addition, there are a limited number of studies evaluating the relationship between PTSD and mind reading with more sensitive tests such as RMET. If we look at these studies: in a study of Bosnian war migrants, those with PTSD ($n=16$) had lower RMET accuracy than migrants without PTSD ($n=16$) and the presence of PTSD predicted poorer RMET performance [17]. In 2012, Mazza et al. studied 20 police officers who were exposed to a attack and subsequently diagnosed with PTSD and 15 healthy police officers serving in Iraq who were not exposed to the attack. The PTSD group performed worse on the mind reading (RMET) task than the healthy group and low RMET performance predicted high "avoidance and numbing" scores of trauma [19]. Our findings agreed with the findings of these studies, but in our study, low RMET neutral valence and total performance predicted the presence of potential PTSD. On the contrary, there was no difference in mind reading (RMET) performance between veterans who developed traumatic brain injury (TBI) due to the war in Iraq and had PTSD ($n=16$) and veterans who developed TBI but did not have PTSD ($n=16$) [20].

In a study 2014, conducted by Nazarov et al., women with PTSD with childhood trauma ($n=31$) had more difficulty recognizing familial relationships than healthy women ($n=20$). Furthermore, when compared to neutral mental states, healthy women had faster RMET response time to emotionally valanced mental states (positive and negative valence), whereas the PTSD group had close response time across all values [21]. However, in contrast to our study, there was no distinction among the groups in terms of mind reading (RMET) accuracy scores and reading times for neutral, positive, and negative expressions. According to our findings, the conflicting results may be due to the low sample size of these studies, unlike our study. In a recent study, Altunbaş et al. showed that the PTSD group ($n=30$) also showed lower performance (from RMET total accuracy) in the ToM (RMET) task compared to the healthy control group ($n=30$) [22]. This result was consistent with our findings. They also showed in their study that exposure to childhood traumas (physical neglect, emotional neglect, sexual abuse, and emotional abuse) negatively affected ToM performance. This could imply that adversity in childhood has caused long-term damage to social cognition. On the other hand, it could imply that PTSD is linked to deficits in social cognitive functioning. Furthermore, as the severity of PTSD increases, so may the impairment in ToM performance. People suffering from PTSD may have poor academic performance, social interaction issues, and communication difficulties as a result of ToM impairment.

In this case, a reciprocal cause and effect interaction between social cognition and PTSD can be assumed. In one aspect, impairment in social cognition may raise the likelihood of PTSD. In this context, similar traumas cause clinically different clinical outcomes in different individuals. In this respect, our study predicts different clinical outcomes such as the absence/presence of potential PSTD in individuals who have been exposed to remarkably similar traumas such as amputation, war itself and migration, and provides

Table 3 Binary logistic regression analysis of factors affecting potentional PTSD absence/presence of amputee Syrian refugees (Nagelkerke R Square: .377; Hosmer and Lemeshow test: .690)

-	B	S.E	Wald	df	Sig	Exp(B)	95% C.I.for EXP(B)	
-							Lower	Upper
Education status								
Literate (Ref.)	-	-	5.801	3	.122	-	-	-
Primary education	−.1.486	.895	2.760	1	.097	.226	.039	1.306
High school	−.2.309	1.089	4.497	1	**.034**	.099	.012	.839
University and above	−.2.406	1.209	3.958	1	**.047**	.090	.008	.965
Prosthesis usage time, years	−..142	.069	4.308	1	**.038**	.867	.758	.992
RMET total	−..152	.071	4.573	1	**.032**	.859	.747	.987

p values below <0.05 are written in bold because they show statistical significance

a clue that these differences are caused by the deficits in the theory of mind, which is a developmental process. In other aspects, it also supports the hypothesis that PTSD impairs social cognition.

Recommendations for further research

This research suggests that certain cognitive practices and ToM tasks can be incorporated into the treatment process for PTSD clients in order to improve their ToM skills. In addition, prosthetic equipment and other physical therapy approaches offered to amputees may contribute to PTSD rehabilitation. Theory of mind skills may be damaged because of PTSD, and this may lead to problems in social interaction to help these patients overcome this, "mind reading" practices may be recommended. Therapy disciplines aimed at improving one's ability to express oneself and understand the moods of other people will be beneficial. Cognitive restructuring psychotherapy and cognitive rehabilitation techniques could be beneficial in the treatment of PTSD patients [46]. A treatment priority should also be specific simulation techniques and technological tools for emotion identification practice that increase emotional awareness.

Although the participants were patients followed up in our clinic, the fact that we administered psychometric measurements online was one of the limitations of our study. Unlike the limited number of studies investigating the relationship between PTSD and mind reading, we had a larger sample size. Participants were examined and evaluated only once. Prospective studies in which participants are assessed at different points are needed to better evaluate the hypothesized disruptive effect of PTSD on ToM skills. On the other hand, the hypothesis that subclinical neurodegenerative deficit in the neurodevelopmental process may cause inadequate ToM skills, making the individual vulnerable to stress and leading to the development of PTSD has much weaker evidence. Although studies in PTSD patients with childhood traumas are a start, we think that genetic studies and prospective studies that can be designed before trauma are needed in this context [21, 22].

Conclusion

Lower education level, prosthesis use for a shorter period, and poor neutral and total mind reading skills were predictive for the presence of potential PTSD in some amputees, despite being exposed to largely similar traumas. In addition, the short duration of post-amputation indicates the potential presence of PTSD. This study may help researchers better understand the pathogenesis of PTSD. It will also aid in the development of new PTSD treatment options. Our findings suggest that PTSD treatment and follow-up should address cognitive and emotional deficits as well.

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Declarations

Ethics approval and consent to participate All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. The study protocol was approved by the ethics committee of our university (number: E-10840098–604.01.01.01–3973). Written informed consent was obtained from all individual participants included in the study.

Conflict of interest The authors declare no competing interests.

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