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REVIEW ARTICLE

Cognitive appraisals of disability in persons with traumatic spinal cord injury: a scoping review

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STUDY DESIGN: Scoping review.
OBJECTIVES: To describe the meaning of cognitive appraisals, their relation with outcome. measures, and adapted appraisal scales after Spinal Cord Injury (SCI) in the existing literature.
METHODS: This review was performed according to the Arksey and O'Malley (2005) framework that consisted of five steps: setting the review question, searching the literature, selecting and classifying the studies, charting the data, and summarizing the results. Published articles from 1990 to 16 May 2020 related to cognitive appraisal, persons with traumatic SCI (TSCI), and persons older than 18 years were identified by searching by key terms in four databases (PubMed, Web of Science, Scopus, and Embase).
RESULTS: The included studies ($n = 26$) were categorized into three categories. Categories focused on the meanings of cognitive appraisals following TSCI (i.e., appraisals being complex and context-related, or in general definition how persons with TSCI interpret their disability and how they evaluate the resources available to respond to it), the relationship between cognitive appraisals and physical/psychological/social/ outcomes, and appraisals of disability (including the use of appraisals as a predictor of subsequent positive or negative consequences).
CONCLUSIONS: The results demonstrated that a cognitive appraisal of TSCI is critical to longer-term rehabilitation outcomes. A combination of physical and psychological-based interventions can help to modify negative or dysfunctional appraisals. Cognitive appraisal in TSCI seems to vary from person to person. To predict it and develop a rehabilitation plan, future research needs to focus on the relationship between cognitive appraisal and person-related factors, including demographic characteristics.

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INTRODUCTION

Traumatic spinal cord injury (TSCI) resulting from motor vehicle and road accidents, falls, sports, violence (gunshot, stab wound), and other traumatic events is one of the most severe injuries in the central nervous system [1, 2]. The prevalence of TSCI is higher than non-traumatic SCI [3]. Moreover, there are distinct differences in psychological functioning between the two. Perceptions of SCI that are measurable with an appraisal scale differ between the two groups, and people with non-TSCI may have more sense of loss [4], and poorer mental health outcomes such as stress, anxiety, and depression compared to persons with TSCI in the chronic phase [5].

TSCI is typically a sudden and unexpected event that impacts physical and psychosocial functioning in addition to having long lasting economic impacts [6]. It affects various aspects of life, and it is a major challenge to the wellbeing of the affected person [7]. In fact, SCI initiates a process of lifelong psychological adjustment by affecting the body's functions and causing immobility and dependence on others. Therefore, knowing how people with TSCI respond to the health threat can be essential for improving various dimensions of health (e.g., physical, psychological, social) and quality of life [7, 8].

Disabilities due to TSCI vary from one person to another. Some persons are anxious and depressed in response to these challenges, while others adjust well to their condition. As such, appraisal following SCI impacts physical health outcomes [9, 10]. Cognitive appraisal is the mental interpretation that the person makes in response to environmental stimuli and is the process by which stressful events such as TSCI are evaluated for meaning [10, 11]. People may interpret a stressful event as a threat, challenge, and loss and analyze whether the available resources

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are sufficient or insufficient to respond. Finally, they get an overview of their situation. Cognitive appraisal includes two forms: primary and secondary [11]. In the primary form, persons evaluate the potentially stressful situation with respect to their wellbeing and decide if this incident is unimportant, positive (e.g., stimulating to growth), or stressful outcomes (e.g., terrifying, losing and depressing). Secondary appraisal refers to what a person can do and what is expected to make that person self-sufficient and adaptable to a new situation. (e.g., whether personal agency such as family and friends can help) [5, 11, 12].

Previous studies showed that cognitive appraisal scores in people with TSCI were related to functional independence measure scores (motor subscale), anxiety symptoms, and depression symptoms. On the other hand, when persons with TSCI have a challenging or positive appraisal of disability, it can help improve their mood and functional independence significantly [13–15]. However, persons with TSCI may have low cognitive appraisals scores because of their negative interpretation of limited social integration and increased medical complications, which ultimately decrease participation in rehabilitation and quality of life [16]. Despite the importance of this subject there is little research on the cognitive appraisal of TSCI [17].

We performed a scoping review because it is useful for summarizing and disseminating research findings to policy-makers, practitioners, and consumers [18]. In scoping reviews, researchers can use various studies, including original studies, systematic reviews, meta-analyses, meta-syntheses, narrative reviews, rapid reviews, reviews and gray literature [19]. There is little research about definitions, variables and cognitive appraisal in TSCI and the present scoping review aims to describe the meaning of cognitive appraisals in TSCI, their relation to outcome measures, and adapted appraisal scales after SCI in existing literature.

METHODOLOGY

The present study is a scoping review describing cognitive appraisals in persons with TSCI. Because this is a scoping review, we used all types of articles published in scientific journals that referred to our subject. This review was performed according to the Arksey and O'Malley framework [18, 20]. We followed Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) with the following steps:

To set the review question

First, we determined the review questions, including**:**

1. What is the meaning of cognitive appraisal (primary and secondary appraisal) in persons with TSCI?
2. What are the outcomes that are related to cognitive appraisal following TSCI?
3. What are the dimensions or subscales of cognitive appraisal questionnaires used for persons with TSCI?

Literature search

The search strategy was designed by a specialist in library sciences and medical research. In order to identify the relevant papers, an online systematic search of the literature was performed in PubMed, Web of Science, Scopus, and Embase from 1990 to 16 May 2020, without any language limitation. Search was limited to the past 30 years in order to concentrate on most recent literature. The search syntax was performed by combined medical subject headings (MeSH), Emtree terms, and free text words. Detailed PubMed search syntax is presented in Appendix 1. The results were entered into Endnote X8 (Company Clarivate, Philadelphia, PA, USA). Duplicate documents were removed. Then, the documents were sent to four reviewers in two independent groups.

Study selection and classification

At first, four reviewers (SSh, PM, NY, and MSh) independently scrutinized the titles and abstracts of the documents. After that, two reviewers (SSh, PM) independently reviewed the full text of articles based on inclusion and exclusion criteria.

Inclusion criteria were: publication after 1990, no limits to study design, human TSCI studies related to cognitive appraisal, and adult populations older than 18 years. Exclusion criteria were: animal studies, non-TSCI, pediatric SCI, adolescent persons and samples that had acquired their SCI as a child/adolescent but assessed as adults. Any discrepancy regarding the eligibility of studies was resolved by a third party (MSh).

To chart the data

Two reviewers independently excluded unrelated data from related studies in the predesigned data collection chart, which included the title, author(s), year of publication, journal, aims/purpose of study, type of study, study duration, study location (where the study was conducted), measuring tools, total study duration, study population (sample size, the setting of injury, cause of injury, level of injury, age, sex), outcome measures (if applicable), outcomes (if applicable), related key findings to the scoping review questions, key conclusion, and other comments from the study authors.

To summarize the results

To provide a narrative summary using the framework, two independent persons summarized the results and key conclusions of the articles and categorized the data. The definitions, relationships between variables, and evaluation scales were each placed in separate categories. The main categories were based on the answers to the research questions. Furthermore, the third person read all results, eliminated duplicates, and reread all included articles and main categories.

RESULTS

There were 26 studies meeting inclusion criteria that were included in the review. The PRISMA 2009 flow diagram, used to display the process of the literature search and study selection (Fig. 1). There were two articles regarding the meaning of cognitive appraisal in persons with TSCI, 20 articles regarding appraisals and outcome measures/coping, and 4 articles regarding the appraisal of disability questionnaire (Table 1A, B, C).

MEANING OF APPRAISALS FOR PERSONS WITH TSCI

Two studies explored the meaning and interpretation of cognitive appraisals from the point of view of persons with TSCI (Table 1A).

Byra described that people with TSCI were trying to make sense of what had happened to them and understand. Affected persons evaluated SCI as an effective factor in prolonging the loss of potential benefits, loss of hope, and fear of the future. They noted that SCI impacted the ability to perform roles and maintain satisfying relationships with other people. In general, it was found that the meaning of appraisals in TSCI depended on the context and stage of a person's life [21].

DeRoon-Cassini et al. in their study showed that seven meaning-making themes emerged from interviews with people with TSCI. These themes were positive growth (including learning to value life more after the SCI), degree of life change, identity integration (i.e., that the injury and the person's personality have been unified with self-identity), restricts other people (burden on other people), no sense (no rational or spiritual description), injury stagnation (sense of being blocked by the injury and unable to

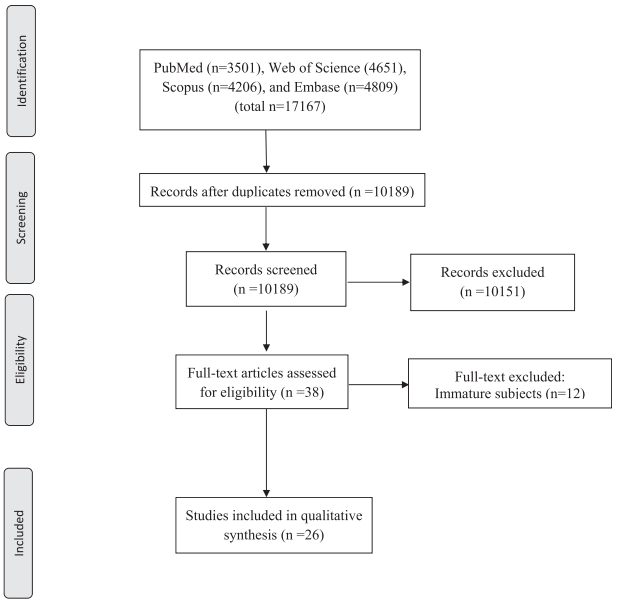

Fig. 1 Flow diagram of the literature search and article screening.

progress in life), and injury acceptance (conciliation with one's situation) [22].

COGNITIVE APPRAISALS AND OUTCOME MEASURES

Twenty-one studies described the relationship between cognitive appraisal (primary and secondary appraisals) and outcome measures including: mood, adjustment and coping, post-traumatic stress disorder (PTSD), psychological distress, quality of life and life satisfaction, self-efficacy and wellbeing, environmental and societal participation, resilience, purpose in life, sense of coherence, functional outcome, and chronic pain (Table 1B).

Mood

Kennedy et al. found that depression positively correlated with the Appraisals of Disability Primary and Secondary Scale (ADAPSS) variables. The subscales of this questionnaire are fearful despondency, overwhelming disbelief, determined resolve, negative perceptions of disability, and personal agency [16]. A study by Bonanno et al. suggested that participants with stable, low depression used more challenge appraisal. Participants in the delayed depression group used more challenge appraisal compared with the depression-improved group. Additionally, the stable low anxiety group had less appraisal of threat [23].

Kennedy et al. in part of another study cited that there was a relationship between threat appraisals and depression [24]. The same authors with different person populations reported that at 12 weeks post injury, the ALE (appraisal of life-events) subscales "threat" and "loss" had strong correlations with 1-year post-injury outcome measures such as mood (Stress related growth, depression, and anxiety) [25, 26].

Adjustment and coping

Kennedy et al. cited that Coping approaches at the beginning of rehabilitation were a main predictor of long-term appraisal. There was a significant relationship between the ADAPSS subscales and coping strategies [16]. In another study, Kennedy et al. stated that there was a relationship between threat appraisals and coping [24]. They found that a coping check list for stressful events was related to enhanced threat and loss appraisals, and task-focused coping was positively linked to challenge appraisals [27].

The results of a literature review by Galvin and Godfrey showed that psychological adjustment in persons with SCI is largely predictable after appraisal. Thus, specific appraisals and coping strategies following SCI may lead to poorer or stronger emotional adjustment in the long term. Persons who understood a higher degree of threat and reported poor emotional adjustment appraised the situation as uncontrollable [28].

Barone and Waters stated that reappraisal coping strategies are an important cognitive strategy and that less educated, less person, and recently injured persons with SCI were less likely to use positive reappraisal coping behaviors. Younger persons who were more likely to have psychosocial adaptation and had more positive reappraisal coping behaviors. Positive reappraisal coping strategies were linked with creating positive meaning by focusing on personal growth [29].

Lequerica et al. found that the use of coping strategies was dependent on the context of stress appraisals. Threat/loss appraisals were more related to emotion-focused coping than problem-focused coping, whereas problem-focused coping was more associated with challenging appraisals. Threat appraisals are positively correlated with problem-focused and emotion-focused coping. Challenge appraisals tend to arouse problem-focused coping reactions, whereas in the case of loss, the damage has already been done, so emotional regulation strategies must be relied upon more heavily [30].

Lequerica et al. explained that three factors of Ways of Coping Questionnaire (WOCQ) including positive reappraisal, escape avoidance, and seeking social support appear to be most related to understanding stressful situations. The nature of the situation is of key importance in understanding stress and coping [31] Scholten et al. found that appraisals of threat and loss were related to passive coping (maladaptive) and that both of them were associated with lower resilience and higher psychological distress [32].

PTSD

Agar et al. showed that cognitive appraisals were important predictors of persistent PTSD in persons with SCI. The three cognition subscales were "negative cognitions about the self," "negative cognitions about the world," and "self-blame." There were positive relationships between total negative cognitions and two of the subscales ("negative cognitions about the self" and "negative cognitions about the world") in relation to PTSD symptoms and diagnosis. Self-blame had a higher relationship with PTSD symptoms. The results showed the importance of negative appraisals more than other non-cognitive variables in predicting chronic PTSD [33].

Psychological distress

Griffiths and Kennedy found that challenge-focused appraisals were identified by persons with SCI who did not report psychological distress. The primary appraisal style of participants was either challenge or benign. Threat appraisals were present only in the acute stage of SCI. All participants thought they could overcome their problems and that they could access the resources to accomplish this. Secondary appraisal style is therefore useful for coping. Participants identified that appraisal style was an important factor in achieving a positive outcome. The threat and loss appraisal style may be linked to persons with SCI who experience higher levels of distress [34]. Scholten et al. showed that appraisals of threat and loss were one of the important psychological factors in the explanation of psychological distress [32].

The results of the study of Kennedy et al. showed that there is an important difference between the mean scores of various countries for the challenge and loss subscales. For the loss subscale, clear differences were found between the mean scores of UK respondents, who represented a higher loss than

Table 1. Meaning of appraisals in TSCI (A), appraisals and outcome measures (B), and factor structure of the ADAPSS (C).

A				
No.	**Author Ref.**	**Country**	**Type of Study**	**Aim Of study/variables for B**
1	Byra [21]	Poland	Review	Conceptualizations, providing previous methods of defining and appraising disability, point to the complex nature of this phenomenon.
2	DeRoon-Cassini et al. [22]	USA	Mixed method (cross-sectional and semi structured, face-to-face interviews)	Meaning-making appraisals from SCI survivors' narratives of their injury experience
B				
3	Bonanno et al. [23]	British, Swiss, Swedish, German, Austrian, and Irish	longitudinal	To assess longitudinal trajectories of depression and anxiety symptoms after SCI as well as the predictors of those paths/mood, resilience
4	Duggan et al. [38]	USA	Mixed method (qualitative and survey)	To explain the use of the World Health Organization's (WHO) International Classification of Functioning, Disability and Health (ICF) as a conceptual framework for processing and analyzing the narratives of 50 community-dwelling women with SCI/ environmental effects
5	Galvin and Godfrey [28]	New Zealand	Reviews literature	To examine the psychological adjustment to SCI and illustrate the applicability of a SAC for rehabilitation of this population/adjustment and coping
6	Griffiths and Kennedy [34]	UK	Mixed method (Qualitative+ survey)	To describe the positive psychological outcomes experienced by people reporting low levels of psychological distress, to understand how these persons explain their positive outcomes/psychological distress
7	Agar et al. [33]	UK	Cross-sectional	To examine factors associated with persistent PTSD in persons with SCI/PTSD
8	Barone and Waters [29]	UK	Mixed method (a descriptive explanatory design)	To assess the extent to which socio-demographic characteristics and hardiness describe coping in adults living with SCI/adjustment and coping
9	Kennedy et al. [16]	UK	Longitudinal	To investigate mortality, psychological impact, coping strategies, and cognitive appraisals in a cohort of persons with spinal cord injury from 12 weeks post injury to 21 years post-hospital discharge/mood, adjustment, and coping
10	Kennedy et al. [25]	UK	Longitudinal	To examine the contribution of sense of coherence (SOC), appraisals, and behavioral responses when predicting psychological outcomes after SCI/mood, quality of life and life satisfaction, sense of coherence
11	Kennedy et al. [27]	UK	Cross-sectional	To describe the community needs of persons with SCI among four European countries/psychological distress
12	Kennedy et al. [24]	UK	Cross-sectional	To explore the relationships of appraisals, coping strategies, and support with mood and QOL in persons with SCI/mood, adjustment and coping, quality of life, and life satisfaction
13	Kennedy et al. [35]	UK	Cohort	To assess the relationship between cognitive appraisals in persons with SCI living in the community, and to test how these factors affect functional outcomes, social participation, and life satisfaction/quality of life and life satisfaction
14	Lequerica et al. [30]	USA	Mixed-methods (cross-sectional and semi structured, face-to-face interviews)	To investigate how women with SCI perceive the stressors they encounter, and how cognitive appraisal is associated with coping and life satisfaction/adjustment and coping, quality of life, and life satisfaction
15	Lequerica et al. [31]	USA	Cross-sectional	To examine depicting coping with a three factor model of positive reappraisal, escape avoidance, and seeking social support based on the way of coping questionnaire in women with SCI/adjustment and coping

B				
No.	**Author and ref.**	**Country**	**Type of study**	**Aim of study/variables for B**
16	Kennedy et al. [13]	UK	Longitudinal	To assess the contribution of pre-rehabilitation appraisals of SCI and coping strategies with score variance functional independence post discharge/functional outcomes
17	Peter et al. [37]	Swiss	Cross-sectional	To investigate the SCI Adjustment Model (SCIAM) and gain a better understanding about whether and how the psychological resources GSE and PIL, appraisals, and coping influence participation in persons SCI/purpose in life, general self-efficacy
18	Kennedy et al. [26]	UK	Longitudinal	To explore the relationships between appraisals and coping with mood, functioning and QOL pre- and post-rehabilitation for acute SCI/ mood

Table 1. continued

19	Kennedy et al. [7]	UK	Longitudinal	To assess the degree to which current thinking in terms of early appraisals and coping predicts adjustment and QOL outcomes after SCI, and to investigate degree of involving social and demographic variables in QOL and adjustment/psychological wellbeing
20	Peter et al. [36]	Swiss	Cross-sectional	To examine the associations between the psychological resource GSE and PIL, appraisals, coping and life satisfaction; to examine whether the effects of psychological resources on life satisfaction are mediated by appraisals and coping, as proposed by the SCIAM/ quality of life and life satisfaction, purpose in life, general self-efficacy, wellbeing
21	Raichle et al. [39]	USA	Cross-sectional	To explore the use of a bio-psychosocial model to perceive and treat pain in persons with SCI/pain
22	Scholten et al. [32]	Netherland	Cohort	To explore the relationship between personal resource resilience and psychological distress, and whether appraisals of threat and loss and passive coping mediate this relationship/adjustment and coping, resilience, psychological distress
C				
23	Dean and Kennedy [15]	UK	Cross-sectional	To develop a reliable and valid appraisal scale; ADAPSS for adult with SCI
24	Russell et al. [40]	USA	Cross-sectional	To evaluate the clinical utility and discriminant validity of the ADAPSS-sf The ADAPSS-sf was evaluated on identification of persons experiencing poor psychological adjustment and prediction of life satisfaction beyond measures of emotional distress
25	McDonald et al. [41]	USA	Cross-sectional	To investigate the psychometric properties of a measure of SCI-specific appraisals, the ADAPSS-sf
26	Mignogna et al. [42]	USA	Cross-sectional	To examine the psychometric properties and clinical utility of a short form of the ADAPSS-sf, a 6-item measure adapted from the original 33-item ADAPSS questionnaire

participants from other countries. The participants had evidence of positive psychological reactions and therefore represented high appraisal scores for the challenge appraisal. The relationship between less psychological distress and utilization of positive primary appraisals and effective coping strategies has been shown in this population [27].

Quality of life and life satisfaction

Kennedy et al. stated that persons with complete paraplegia scored higher in the "threat" subscale of the ALE questionnaire than those with incomplete paraplegia. There was a relationship between threat appraisals and quality of life, depression, and coping [24]. In a related study, Kennedy et al. showed that appraisals at 3 months after injury were related to quality of life (QOL) scores at 2 years post-SCI. These results emphasized the importance of fostering persons' self-efficacy and positive appraisals within this time to help long-term psychological wellbeing and adjustment [26]. They cited appraisal processes which had an important role in rehabilitation and level of life satisfaction in persons with SCI. The most important appraisal process that this study disclosed was negative perceptions of disability [35].

Lequerica et al. found Life satisfaction was positively correlated with challenge appraisals and negatively correlated with loss appraisals. More recently injured women appraised the situation as "loss," and this appraisal may have a direct impact on life satisfaction apart from any coping strategies [30]. Peter et al. found loss appraisals had a moderate effect and was the only variable that had a direct association with life satisfaction [36].

Self-efficacy and wellbeing

Peter et al. reported that general self-efficacy (GSE) had a moderate direct impact and mediated effects by threat appraisal and by challenge appraisal on participation. This finding suggests a partial mediation effect [37]. In another study, they stated that the impact of GSE on life satisfaction and wellbeing was indirect and mediated via loss appraisals [35].

Kennedy et al. cited that challenging appraisals and the appraisals made at the beginning of injury may be important when defining how an person copes with their SCI, their psychological wellbeing, and how they are involved in the rehabilitation process [7].

Environmental effects and social participation

Duggan et al. in assessing the text coded at stress appraisal, showed that features of the physical and social world were difficult for women following their return home to the community. Almost all women reported stressors in connection with environmental effects, especially technology, and less so with the natural environment and human-made changes [38].

Peter et al. showed that there was a relationship between participation with threat appraisal directly and challenge/loss appraisal indirectly. The results support both direct and indirect effects on participation as suggested in the SCIAM (Spinal cord injury adjustment model; an appraisal and coping process) [36].

Peter et al. in their study about whether the psychological resources influence participation found that the Participation was positively related with challenge appraisal [36].

Resilience

Bonanno et al. reported that resilient persons with SCI perceived main stressors as challenges and used active coping efforts [23]. Scholten et al. reported that appraisals of threat, loss, and passive coping, had mediating effects in the association between resilience and psychological distress [32].

Purpose in life

Peter et al. cited that PIL is also indirectly linked to life satisfaction through two pathways: (1) challenge appraisal and humor (including PIL-challenge), and (2) challenge-humor and humor-life satisfaction [36]. Peter et al. in their study found that Challenge appraisal and humor were used as mediators in the relationship between purposes in life (PIL) [37].

Sense of coherence

Kennedy et al. reported that sense of coherence (SOC) had a significant correlation with threat, challenge, and loss subscales of ALE [25].

Functional outcomes and pain

Kennedy et al. showed that subscales of ALE (threat, challenge and loss)were related to the motor subscale of the FIM (Functional Independence Measure) [14]. They found that functional independence measures had a correlation with ADAPSS (variables of fearful despondency, overwhelming disbelief, negative perceptions of disability) [35].

Raichle et al. showed that knowing coping strategies, beliefs/appraisals, and other psychosocial variables may affect persons with SCI and chronic pain [39].

THE APPRAISALS OF DISABILITY: PRIMARY AND SECONDARY SCALE

Four studies described the Appraisals of Disability: Primary and Secondary Scale (ADAPSS) (Table 1C). In a study by Dean and Kennedy, with the purpose of determining the validity and reliability of the appraisal scale, revealed that the ADAPSS has a six-factor construction with the following subscales: fearful despondency, overwhelming disbelief, determined resolve, growth and resilience, negative perceptions of disability, and personal agency [15]. In addition, Rusell et al. found that the ADAPSS-short form (sf) is effective in the identification of poor psychological adjustment. Their results showed that SCI/disability-specific appraisals measure emotional distress. Furthermore, these appraisals simultaneously predict both poor psychological adjustment and insight into life satisfaction [40].

Furthermore, McDonald et al. found that the ADAPSS-sf's two-factor structure of "catastrophic negativity" and "determined resilience" SCI appraisals were related to mental disorders, mental health concerns, life satisfaction, ethnic minority status, age, SCI severity according to the American Spinal Injury Association (ASIA) Impairment Scale, and cause of SCI (traumatic or non-traumatic). The ADAPSS-sf showed that this scale has some characteristics including brevity, convergent validity, face validity, and content validity. The ADAPSS-sf is a potentially valuable tool for clinicians and researchers to determine SCI appraisals and personize treatment [41]. Mignogna et al. obtained the short form items (six-item measure) from the original 33-item ADAPSS questionnaire, and after factor analysis, found two important factors in the scale. One factor involved appraisals implicating fear and loss, and the second factor reflected resilience. Mignogna presented the reliability and validity study findings from their application of the short form in a veteran population. Veterans' disability-related appraisals were strongly related with life satisfaction. Study results support internal validity, and the questionnaire is a logical and relevant two-factor structure of the ADAPSS-sf that is useful in outperson veterans with chronic SCI and related disorders. The ADAPSS-sf total score was negatively associated with life satisfaction after controlling for depressive symptoms and level of injury. The ADAPSS-sf factor 1 and 2 scores were also negatively associated with life satisfaction, after controlling for depressive symptoms and level of injury [42].

DISCUSSION

In this paper, we provided an overview of articles focusing on cognitive appraisal of disability in persons with TSCI. The studies showed that cognitive appraisal of disability following TSCI can be important to help rehabilitation phase, psychological and functional outcomes, and various aspects of life that we discuss below. In the present study, two studies delineated the meaning of appraisals in TSCI. These studies showed that meaning of cognitive appraisals in TSCI may depend on life context and prior experiences [21]. Furthermore, the person's personality, unique learning needs following SCI, degree of life changes and restrictions, and injury acceptance can all affect the meaning of appraisal in persons with TSCI [22, 23]. Kaiser and Kennedy examined cognitive appraisals of disability that people make following TSCI and non-TSCI. They explained that when persons with SCI perceive something to be wrong, they try to understand the situation and the cognitive process begins. Cognitive appraisals following SCI were related to circumstances prior to SCI, traumatic experiences, coping and managing difficult situations, and the impact of SCI on relationships, persons, and changes of view of self and life. In this research, there was no clear difference between the statements of the people with TSCI and non-TSCI [43]. The results of this study were alike to the present study.

In the present research, some studies described the relationship between appraisals with outcome measures, and identified eleven distinct subcategories. In "Mood" subcategory, the relationship between anxiety/depression and cognitive appraisal was demonstrated.

Some studies found appraisal scales such as ADAPSS [16], ALE [26] and stress appraisal scale [30] to be related to mood (i.e., depression, anxiety) in persons with SCI. Moreover, persons with SCI who negatively appraised their disability were more likely to report lower mood [40]. In another study performed by Geyh et al. most persons with SCI experienced little negative effect and few depressed feelings because they did not evaluate difficult life situations as a loss or threat and they had a positive challenge from the event. Those who were older and suffered from their SCI more recently experienced a more depressed mood, less positive affect, and fewer challenge appraisals. Persons with traumatic, rather than non-traumatic, SCI used fewer loss appraisals [4]. On the other hand, Eaton et al. reported cognitive appraisals in people with SCI in the primary stage of rehabilitation had a meaningful relationship with depression and the stable low anxiety group used fewer threat appraisals than the anxiety recovery and delayed anxiety group [44]. These studies showed that people with TSCI and non-TSCI with negative appraisal had lower mood. These findings were similar to the present research.

Threat, loss, and challenge appraisals were related to coping and poorer emotional adjustment in the long term. Several prospective studies have assessed the predictive power of Stress Appraisal and Coping (SAC) model variables on long-term outcomes. For example, some of the studies cited that coping strategies in the early phases of rehabilitation predict long-term appraisal approach [16, 24, 28, 34]. Stress appraisal plans have been emphasized given that participants in therapy groups experience recovered mood during and after therapy [28].

One study showed the relationship between positive primary appraisals and effective coping strategies [27]. Younger persons tended to have more positive reappraisal coping behaviors [29]. The use of coping strategies differs depending on the context of stress appraisals [30]. Appraisals were significantly related to passive or active coping post injury [26, 32, 36, 37]. Ramirez-Maestre et al. conducted a study on persons with musculoskeletal chronic pain who had functional impairment. They reported that high levels of challenge appraisal were related to high levels of active coping strategies and the harm, loss, or threat appraisal is

associated with a high level of passive coping strategies [45]. Whitty studied on a healthy population and showed that there was no difference in scores of coping strategies in young, middle age and old participants and that the Ways of Coping Questionnaire was more likely to support a "contextual" view [46]. This study was different from our findings, which may be due to the small number of samples.

Kennedy et al. in several studies showed that educational intervention such as "cope effectiveness training", which teaches appraisal and coping skills, may change participants' negative appraisals of the implications of SCI and ultimately improve mood and help persons with SCI cope with their disabilities [13, 47–49].

Furthermore, cognitive appraisals were important predictors of chronic PTSD in persons with SCI. These findings have highlighted the importance of negative appraisals in the prediction of chronic PTSD [22, 33]. Herta et al. in their study on traumatic people with or without disability cited that the severity of PTSD symptoms affect cognition negatively after exposure to accidental trauma [50]. This result was similar to the present study.

Some studies found that there is a relationship between psychological distress syndrome and cognitive appraisals in persons with TSCI [27, 32, 34]. Mullins et al. in their study on multiple sclerosis persons with physical disability reported that the unpleasant feelings such as sadness, anxiousness, and irritability were related to threat or loss appraisals [51]. These findings were similar to the present study.

There was also a relationship between threat appraisals and QOL [24, 26]. Furthermore, appraisal processes had an important role in the level of life satisfaction in persons living with SCI [35]. Increased life satisfaction is correlated with challenge appraisals, while decreased life satisfaction is correlated with loss appraisals as well as no coping strategy [30, 36]. Moreover, the appraisal disability scale had a significant relationship with life satisfaction in persons with SCI [40–42]. Morris et al.'s study showed that able-bodied persons' appraisals of disability after supposed SCI are much more negative than appraisals of disability in persons with true SCI. These findings supported the claim that living successfully and satisfactorily with SCI may be more attainable than persons might have supposed prior to their injury [52].

Another important outcomes measure in the present study was relationship between appraisals and general self-efficacy with wellbeing in persons with TSCI [7, 37] However, better psychological wellbeing was related to less concern about "limiting other people" as a result of TSCI and SCI [22]. These findings showed the importance of positive appraisals in achieving long-term psychological wellbeing [7, 26]. On the other hand, Marceron and Rohrbeck in their study found that there was a relationship between low self-efficacy and high perceived threat in persons with physical disabilities in natural and human-made disasters [53]. This finding was similar to present research.

In the present study, women with SCI appraised that features of the physical and social world were difficult for their return to the community [27]. Furthermore, it was found that there is an inverse relationship between social participation and threat appraisal [36, 38]. Recent evidence by Noreau and Boschen showed an environmental impact on participation, focusing on "person fit with the environment" and showed that the level of participation of people with disabilities is low. Although despite the apparent theoretical impact of the environment, there is still scientific evidence to limit or facilitate participation [54]. It was similar to our study.

The present study reported that highly resilient persons with TSCI related to low appraisals of threat and loss [23, 34]. McDonald et al. cited that resilience is one of the components of the ADAPSS and this indicates that this component has a decisive role in the positive or negative appraisal of SCI. For example, negative appraisal had a correlation with less resilience [42]. The results of the mentioned studies about resilience were consistent with each other.

Some studies showed that challenge appraisal and humor were used as mediators in the relationship between PIL [37, 38]. The study of Geyh et al. showed that both persons with SCI and TSCI who were more recently injury experienced less challenge appraisal and lower PIL [4]. This finding was similar to the present study. Furthermore, SOC had a significant correlation with threat, challenge of cognitive appraisals [25]. In a review study with a similar result to the present study that was done by Ceallaigh, it was found that cognitive appraisals were a potential target for interventions seeking to improve SOC [55].

In some recent studies, it was shown that threat, challenge, and loss appraisal is related to the motor subscale of the FIM in persons with TSCI [13, 36]. ALE threat and physical/social functioning also had a significant positive correlation [26]. Furthermore, cognitive appraisals may be related with pain [40]. Sullivan et al.'s study on traumatic people showed that injustice perception as a type of cognitive appraisal can play an important role in health outcomes such as physical function, pain, and prolonged disability [56]. Finally, Summers et al. in their study showed that chronic pain was related to appraisals, and that negative cognition was associated with greater pain severity [57]. The results of the studies of the named researchers were similar to the present study, despite the differences in the type of sample studied (trauma and non-trauma persons).

The last category was about factor structure of the ADAPSS. This scale has a 6-factor structure [15]. The ADAPSS-sf, however, can better help clinicians to recognize the risk of developing more negative interpretation of their situation [44]. The ADAPSS-sf has a two-factor structure including "catastrophic negativity" and "determined resilience" and is a six-item measure adapted from the original 33-item ADAPSS questionnaire [42]. The ADAPSS-sf is effective in identifying poor psychological adjustment and provides insight into satisfaction with life beyond measures of emotional distress [40]. The ADAPSS-sf is a potentially valuable tool for clinicians and researchers to assess SCI appraisals [41]. Carpenter in a systematic review study found that cognitive appraisal of stress instruments had a limited number and included the Cognitive Appraisal of Health Scale, the Meaning of Illness Questionnaire, the Appraisal of Illness Scale, the Stress Appraisal Measure, and the Primary Appraisal/Secondary Appraisal scale. These scales were not a special instrument for persons with SCI. This study suggests the need for other tools to investigate the role of cognitive appraisal in the mental and physical health of people who have experienced stress [58].

CONCLUSION

Primary and secondary appraisals in persons with TSCI are complex and related to context. Additionally, there is a relationship between cognitive appraisals and physical and psychological outcome measures. Interpretation of the traumatic event was related to maladjustment and wellbeing, PTSD, depression, anxiety, one's ability to cope, and taking advantage of the situation. Interpretation of the entire traumatic event affects QOL, life satisfaction, self-efficacy, and physical function. As such, measures of cognitive appraisal scale may be used as predictors of outcomes following TSCI; for example, the ADAPSS-sf reflects fear/loss and resilience. As such, cognitive appraisal of TSCI is critical to long-term outcomes and rehabilitation in persons with SCI following road accidents and other trauma. Physical/psychological training programs can help improve initial appraisal. Appraisals can ultimately improve response to the traumatic event, help persons grow after the event, and increase resilience and quality of life. Further work should clarify the relationship between context and primary and secondary appraisals in TSCI. The future research work should focus on the relationship between cognitive appraisals and clinical/demographic characteristics in people with TSCI.

DATA AVAILABILITY

All data generated or analyzed during this study are included in this published article (and its Supplementary Information files).

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AUTHOR CONTRIBUTIONS

MSh suggested the title of article and contributed to designing the review protocol. VRM and SMGh contributed to designing the review protocol. They supervised the work and managed the research team to do the job accurately. MGh screened potentially eligible studies, extracted data, and entered data into EndNote. RHA and FR extracted and interpreted results. In addition, SSh, PMS, ZGh, and MSh completed the database search and created the "Summary of findings" tables. ARV revised the article critically and did English editing several times. All authors wrote the article and help to critically review.

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COMPETING INTERESTS

The authors declare that they have no competing interests except ARV (Appendix 2).

ETHICS APPROVAL

The Ethics Committee of Sina Trauma and Surgery Research Center, Tehran University of Medical Sciences, approved the study, and the reference number is 98-02-38-374. We certify that all applicable institutional and governmental regulations were followed during the course of this research.

ADDITIONAL INFORMATION

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