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Review Article

Systematic Review of Literature on Stress Assessment and Evaluation: Methods, Instruments, and Applications in Current Biopsychosocial Sciences

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Abstract

Introduction: Stress has become an inevitable component of postmodern era extending its shade from inner world of mind to intercontinental and global issues. Every deliberate planning especially policy making for public health needs to evaluate the level of stress at first (implicitly affected by diathesis-stress model). The present study is devoted to systematically review of the psychosocial stress-related literature.
Materials and Methods: With the keywords of this systematic review 9 scientific search engines sere searched for Persian and English relevant literature. According to relation to study parts, academic publishing, date of publication and Jadad system, relevant sources were selected. The manuscript then, finalized by evaluation of six experts in psychosocial stress domain via Delphi method.
Results: The final structure of the results encompassed six autoclitic inventories, two method of raters' ratings, seven biological and physiological methods, three neurological methods, and seven executive functioning inspections.
Conclusion: It appears that there are several methodological issues in order to improve the process of stress assessment. Authors' opinion about the optimum methodology, incorporation of biopsychosocial approach, currents limits, obstacle, feature directions and foresighting has been discussed.

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1. Introduction

Stress is an undeniable fact of everyday life which all people in all societies and socioeconomic stages have experienced it throughout human-life history. Stress is in fact an essential and important part of life so that art and literature of all eras registered and recorded it in so many various ways (1). The underlying reasons of inclusion and spread of stress in human societies are considered to be complexity of individual, social, and ecological environments of human, multiple-level simultaneous interactions of human with surrounding factors, as well as diversity on stress expression among people (2). Without stress life would fall into stagnation and inertia, while high levels of stress would exhaust and assimilate people. Our everyday life is brimful of time limits, obstacles, challenges, and life/job demands. In some, stress is ordinary to the degree which they consider and accept it as a constant and usual component of their lives. Nonetheless, it shall be known that stress changes our sensation, perception, cognitive processing, interactions and acts/behaviors and even have the power to influence basic structures of executive functioning, especially learning and memory (3).

In biopsychological sciences, stress is a psychophysiological feeling of tension and strain. Low levels of stress might be desirable, beneficial, and even constructive for biopsychosocial health. Stress in its optimum level and positive from improves physical and functional capabilities as well as psychological wellbeing. In addition, positive optimum stress is found to be an important factor to motivation, adaptation, adjustment, and interaction with environments. However, even high levels of positive stress can result in problems of biopsychosocial health and serious harms (4). In a distinctive definition, stress is considered as any change in external/internal environment of any given organism which disturbs homeostasis (balance of internal body environment) and that given organism shall consume energy in order to reach the balanced state (5).

Studies have revealed that stress is a key factor in etiology and formation of most physical and mental disorders. Evidence have not determined the accurate degree and influence mechanisms of stress on onset of biopsychosocial disorders, yet. Therefore, a few authors refuse the role of stress on health and disorder issues. On the contrary, most of the health professional believe that such differences in the results of various studies is a result of using diverse methods of stress assessment (6).

The important point of psychophysiological assessments of stress, is measurement of degree, intensity, and quality of stress in the given situation and individual. Assessment of stress and its levels in different people and even in a given individual from time to time, without consideration of individual differences in personality and psychological characteristics, appears to be a tough action. Some people can process and deal with multiple stressors, while some others solely can cope with a few limited stressors simultaneously. Because sometimes the amount of stressors is correlated with the amount of experience stress in individuals' life, some authors have tried to combine the

results of stress tests with burnout tests. Stress assessment tests help to find the stressors in individual's life, while burnout tests indicate the degree to which individual is close to the state of exhaustion. The combination of these two would help authors identify how much excessive stress can trigger feelings of exhaustion and burnout in people (7-10). Human stress assessment has a history with parallel simultaneous progresses which are different according to the domain of science of analysis. Polygraph system, a comprehensive and coordinated system to assess stress indices and its psychological outputs in physiological forms, was invented in 1921 in University of California at Berkley by Larson. Physiological indices of stress have been assessed in medical and physiological majors of universities from 1930's after the works of Selye. In 1967 with announcement of *Social Readjustment Rating Scale (SRRS)*, stress was acknowledged as a distinctive construct in psychology and psychiatry. From 1970's gradually various instruments/methods have been developed to assess stress as a distinctive and influential factor on therapeutic process. This trend became formal by incorporation of PTSD class into Anxiety Disorders of DSM-III. Today, many instruments claim to assess various aspects of stress in a wide range of occasions and DSM-5 has a distinct classification form disorders cause by stress (11-14).

In spite of such great history and a large body of evidence/researches on human biopsychosocial stress, there is a lack of comparative and review studies on effectiveness, limits, and concurrent validity of varied and different stress assessment methods/instruments, so that there it is not clear which method/instrument feats the given situation/condition/population. Moreover, according to several distinctive definitions of stress and the wide range of related theoretical concepts (5, 6), the choice of suited method/instrument of stress assessment is appeared to be difficult. Therefore, the present preliminary study tries to gather information via systematic review of literature in order to make a theoretical ground in the domain of biopsychosocial systems of stress assessment. Authors have aimed to provide authors with a basis point in which characteristics, domains, capabilities, limits, and psychometric features of popular stress assessment methods/instruments are classified, so that other authors/researchers can benefit from such information to calibrate more their future studies and/or develop more efficient methods/instruments.

2. Method

2.1. Design

This study administered in the form of systematic review. Systematic review is a type of literature review which focuses on research questions. In such type of study, authors try to gather all worth-full research evidence related to the research question together, so that the result would be a synthesized combination of acknowledged, evaluated and selected evidence (15). Applicable steps of a given systematic review would be formulating research questions, setting eligibility criteria, the use of conceptual models to communicate between research questions and eligibility criteria, gathering related evidence, screening of studies and literature, the process of selection, and summarizing the findings (16). Such method helps especially in the case of inspection of concepts with a large body of literature/research and as such, systematic review could be assumed as a basis for future meta-analytic studies.

2.2. Sample and procedure

The Population of the present study comprised published English and Persian studies about stress assessment before November, 1, 2016. The keywords of the research included "stress, stress assessment, stress evaluation, tension, tension assessment, tension evaluation" which were searched in scientific search engines include PubMed, Science Direct, Google Scholar, MagIran, Google Patent, SID, Kolwer, Springer, and IranDoc, and most related papers were selected. Inclusion criteria were date of publication (on site/hardcopy/ corrected proof in press; before 11/1/2016), subjective relevance, Academic source of publication, and the relevance rate to keywords according to search engines. Jadad scoring criterion was an additional issue for experimental papers. Jadad scale which is also known as Jadad scoring method, or Oxford quality scoring system, is an independent assessment process of methodological quality of research (17).

2.3. Analysis

After data collection regarding inclusion/exclusion criteria of the study, with the use of Jadad method, the most suitable resources for the study were determined and put to the dedicated part of the work. Results were collected, derived, and classified with use of librarian study design and analyzed by content analysis as well as citation rates.

Moreover, in order to improve the validity of the results and reducing biases in final analyses, Delphi method was administered. Delphi method helps to increase the level of novelty and creativity in the phase of exploration of new ideas and mostly is addressed as a novel inspiring method. Using dialectical logic, Delphi method is to some extent alike grounded theory research design and tries to collect, classify, and manage the existing knowledge of experts (18, 19). In the present study, to find the best methods of stress assessment, the question was sent to six social/health psychologists (PhD of clinical psychologist with specialized work legislation) which were specialized in stress assessment and research, and asked for providing the well-known, most applicable, and most suitable methods of stress assessment. Their initial answers were summarized and unified and in the second round sent back to all experts and asked to modify if there is a need. The second round answers were integrated together and sent back to them for the third run. For the third time, experts were modified the list. These modifications were implemented in the synthetic form and was sent to the experts for the fourth time. In this phase, all the experts accepted the list and therefore, this consensual list shaped the final structure of the results structure of the study (Table 1).

2.4. Ethics

The most important ethical issue of the study, was respecting the copyrights of the authors of resources include papers, books, book chapters, manuscripts, dissertations, etc., which is directly done in the present study. The other issue was anonymity of the participants of Delphi method.

The identity of all these experts kept anonymous. All the procedure and aims of the study were fully described to all them and they filled out written consent in which they fully understand the terms of participation. The results of Delphi method administration and the study were sent to the aforementioned experts as part of mutual partnership.

Table 1. Delphi method procedure to find the most suitable framework of the study

Stages of the procedure	Desirable structure of the frame work of the study
First run	Stress tests, stress questionnaires, stress inventories, stress evaluation, stress induction, stress rating, stress interview, brain regions of stress, neuromodulators of stress, blood test of stress, hormone test of stress, respiratory stress, oxidative stress, heat stress, cold presser technique, tension evaluation and assessment, analgesia evaluation, stress hormones, stress neurotransmitters, neurological stress evaluation, psychodynamic stress assessment, projective stress tests, incomplete sentences stress tasks, computerized stress tasks, cognitive stress tasks, stroop test, PASAT, PVSAT, unconscious stress, moral tension, decision-making stress, perceptive stress tasks.
Second run	Subjective stress assessment techniques, objective stress assessment techniques, biophysiological methods of stress assessment, stress assessment at work, acute vs. chronic stress assessment, computerized stress assessment, neuropsychological stress assessment, cognitive stress assessment techniques, crises assessments.
Third run	autoclitic inventories, raters' ratings, biological and physiological methods, neurological methods, and executive functioning (EF) assessments.

3. Findings

According to authors' the review of literature, it appears that there are many effective methods/instruments to assess stress from which applying the "the best method/instrument" completely related to the research question and its specific methodology. Some biological methods are suited for assessment of acute and short-term stress, while questionnaire methods are desirable for measurement of chronic and long-term stress. It might appear that the best preferred method would be the combination of physiological as well as questionnaire measurements to concurrently understand various dimensions of stress in given individuals (if applicable). It shall be noticed that implementation of physiological methods requires elimination of somatic intervening variables, especially elimination of musculoskeletal ones, from results. In addition, not only a general level of a given physiological index is unable solely determine the level of stress, but also the profile of such index through the time and in comparison with the reference population should be taken to account.

In order to study methods of stress assessment, 851 research papers and 131 book/book chapters were considered from which 419 papers and 63 book/book chapters were chosen according to inclusion criteria of the study. After abstract review 301 full-text papers as well as 14 book/book chapters were selected. Finally, 84 papers were chosen as the main body of inspection (diagram 1).

With respect to the criteria of the systematic review, 20 papers were considered as forming the conceptual framework of the study (table 2).

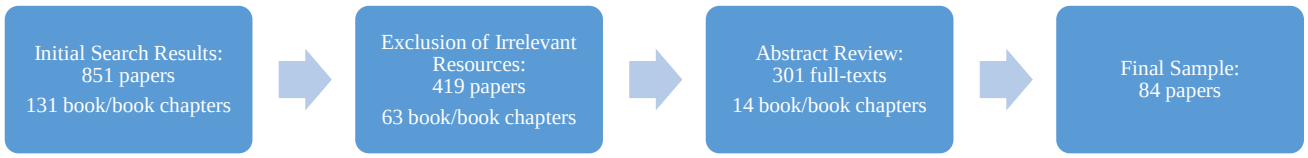

Diagram 1. Sampling process of the study

According to the literature review, there are several methods of stress assessment which have been classified with respect to the basic assessment requirements into five categories of self-reports, Observers' evaluation, Biophysiological methods, neurological methods, and cognitive/executive functions assessments to reach a better understanding and comparison. The major problem of stress assessment methods is their reliance on individuals/observers interpretation and judgment which result in bias based on one's own beliefs system and schemata. Furthermore, it appears that studies on stress assessment with a standard quantitative assessment and biological/neural basis, are limited which is in turn because limitations of scientific boarders in the domain of stress.

3.1. Self-reports (Autoclitic method)

Up to date, most of assessment techniques in psychosocial sciences have been based on autoclitic and self-report questionnaires, which means that participants/respondents answer to the questions themselves and the evaluation is on their own. In spite of a large body of evidence and literature with such methods/instruments, most authors believe that even the respondent has no deliberate bias for secondary gain, there is still a great deal of probability of unconscious tendency to show oneself better/worse. Therefore, validity of the results of these instruments have ben always ambiguous, because existence and amount of such biases in people's responses are out of control and evaluation. Furthermore, direction of biases (negative/positive) may change during the time, even in a specific individual. However, because a large body of findings and literature about stress are derived from surveys with self-

report/autoclitic instruments, we will announce them at first.

Table 2. The papers which formed the conceptual framework

Authors	Year	Journal	Type of Study	Study groups	Sample size	Method of analysis	Intervention type
Shields, et al. (20)	2016	Neuroscience & Biobehavioral Reviews	Meta-analysis	51	2798	Meta-analysis	-
Rezaei (21)	2006	Daneshvar Raftar	Validation	1	3650	Factor analysis, correlation, repeated measures	-
Smith (22)	2016	Epilepsy and Behavior	Review	26	819	-	-
Burton, et al. (21)	2014	Psychoneuroendocrinology	Experimental	3	70	T-test, analysis of variance, correlation	Experimental
Azad Marz Abadi & Qolami Fesharaki (23)	2011	Journal of Military Medicine	Cross-sectional	1	749	T-test, analysis of variance	-
Zhao, et al (24)	2012	Accident Analysis and Prevention	Quasi-experimental	1	13	Paired T-test for small samples	Experimental
Edwards, et al. (2)	2008	Work Stress	Validation	39	26382	Factor analysis	-
Heidari & Sangari (25)	2011	New Findings in Psychology	Ex-post facto	2	200	Analysis of variance	-
Wu, et al. (26)	2012	Industrial Health	Ex-post facto	1	2721	Regression, correlation	-
Van Droogenbroeck, et al. (27)	2014	Teaching and Teacher Education	Cross-sectional	1	1878	Structural equation	-
Laranjeira (28)	2014	European Psychiatry	Validation	1	146	Factor analysis	-
Moqadam, et al. (29)	2014	Payesh Journal	Cross-sectional	1	300	Analysis of variance, t-test	-
Kim, et al. (30)	2014	Journal of Affective Disorders	Longitudinal	1	579	Repeated measures, analysis of covariance	-
Sadrossadat, et al. (31)	2013	Iranian Journal of Aging	Validation	1	300	Factor analysis, internal consistency, correlation	-
McElroy, & Shevlin (32)	2014	Journal of Anxiety Disorders	Validation	1	208	Factor analysis, internal consistency	-
Tonsing (33)	2014	Asian Journal of Psychiatry	Validation	1	212	Factor analysis, correlation	-
Matsuzaki (34)	2014	Maturitas	Survey	1	1700	correlation	-
Jafari, et al. (35)	2012	Nursing Management	correlational	1	108	Correlation, analysis of variance	-
Rutledge, et al. (36)	2014	Contemporary Clinical Trials	Experimental	2	210	T-test, correlation, analysis of variance	Experimental
Wen, et al. (37)	2010	Science China Information Sciences	Experimental	1	300	Random matrix theory	Experimental
Steinisch, et al. (38)	2014	Psychoneuroendocrinology	Ex-post facto	1	175	Multiple regression	-

Self-report methods are based on check-lists in which respondents are asked to choose experienced events/phenomena from a standard list and/or identify their intensity. In self-report forms, choose/elimination of stressful events are upon to respondents. Autoclitic forms are considered as subjective issues and the probability of bias in responses are high. Another problem of autoclitic forms is that there is no common agreement about definition, appearances, expressions, and meaning of stress not only among respondents and researchers, but also among researchers themselves. Moreover, over-reliance on autoclitic check-lists have made evaluation of contextual and objective characteristics of a given stressful event difficult. Interestingly, almost all self-report instruments are in pen-and-paper format and applicable to those who have adequate intermediate and upper language proficiencies as well as being able to think and write down/choose the suited answers (39-42).

There have been identified six most popular self-report stress assessment instruments (table 3). With regard to the popularity, it appears that Occupational Stress Inventory-Revised (OSI-R) and Maslach Burnout Inventory (MBI) have been more frequently used through studies. It would be noteworthy to state that much of the stringent published

papers about stress have focused on occupational stress and both aforementioned instruments assess occupational stress and burnout simultaneously.

Table 3. Popular self-report stress assessment instruments

Instrument	Items	Domains (subscales)	Reliability	Validity
Iran Police Stress Scale (IPSS) (21, 43, 44)	85	1. Non-operational stressors 2. Operational stressors	$\alpha_{\text{non-operational stressors}} = .95$ $\alpha_{\text{operational stressors}} = .95$ $\alpha_{\text{total}} = .97$	EFA: 2 factors CFA: 2 factors
HSE Management Standards Indicator Tool (2, 23, 45-47)	35	1. demands 2. control 3. managers' support 4. peer support 5. relationships 6. role 7. change	$\alpha_{\text{demands}} = .77\text{-}.82$ $\alpha_{\text{control}} = .63\text{-}.78$ $\alpha_{\text{managers' support}} = .75\text{-}.88$ $\alpha_{\text{peer support}} = .75\text{-}.84$ $\alpha_{\text{relationships}} = .63\text{-}.78$ $\alpha_{\text{role}} = .74\text{-}.80$ $\alpha_{\text{change}} = .61\text{-}.79$ $\alpha_{\text{total}} = .78$	EFA: 7 factor CFA: 7 factors
Social readjustment Rating Scale (SRRS) (25, 48-55)	43	1. Personal growth, maturation, and renewal 2. Tension and uncertainty; transitions in personal and/or occupational situations 3. Changes in one's usual routine and relationship 4. Significant changes in family or marriage 5. Personal catastrophes.	Test-retest $r_{\text{non-clinical}} = .89\text{-}.96$ Test-retest $r_{\text{clinical}} = .70\text{-}91$	EFA: 5 factors CFA: 5 factors
Occupational Stress Inventory- Revised (OSI-R) (26, 56-61)	140	1. Occupational Roles Questionnaire (ORQ) include *Role Overload, Role Insufficiency, Role Ambiguity, Role Boundary, Responsibility,* & *Physical Environment.* 2. Personal Strain Questionnaire (PSQ) include Vocational Strain, Psychological Strain, Interpersonal Strain, & Physical Strain. 3. Personal Resources Questionnaire (PRQ) include Recreation, Self-Care, Social Support, Rational/Cognitive Coping	$\alpha_{\text{ORQ}} = .88$ $\alpha_{\text{PSQ}} = .93$ $\alpha_{\text{PRQ}} = .89$ $\alpha_{\text{total}} = .70\text{-}.89$	EFA: 3 dimensions; 14 factors Meta-analysis: 3 dimensions; 14 factors CFA: 2, 3, & 4 dimensions
The Posttraumatic Stress Disorder Checklist (PCL) (62-68)	17	PTSD intensity	$\alpha_{\text{total}} = .85$ Test-retest r = .88	Concurrent validity: 89% with clinical interview
Maslach Burnout Inventory (MBI) (29, 69-76)	22	1. Emotional Exhaustion (EE) 2. Depersonalization (DP) 3. Personal Accomplishment (PA)	$\alpha_{\text{EE}} = .83$ $\alpha_{\text{DP}} = .84$ $\alpha_{\text{PA}} = .87$ Test-retest r = .80	EFA: 3 factors CFA: 3 factors MAP: 3 factors

3.2. Observers' rating methods

Another way of stress assessment is observers' rating methods (or, Observational methods, in brief) in which the responsibility of identification, categorization, and ranging of stressful events and stress intensity is upon the observer/ clinician/ researcher. In other words, the final interpretation of a given event/ phenomenon as ordinary or stressful in life as well as degree, level, and intensity of that event/ phenomenon is done by trained and professional assessors (77).

Such methods which are often called objective, in contrast with self-reports which are known as subjective, have the advantage of consensus and mutual agreement about the definition of stress, its representations/ projections/ expressions in courses of life, and its characteristics and futures, because assessors of each method are trained in a specific theoretical framework and act as instructions of the process demands. In addition, as assessors observe exterior expressions/ representations of stress in individuals, they would rate and record objective criteria of stress and one's response to it. This would result in formulation and standardization of the process of measurement/study and provides the possibility of comparison between various situations as well as results of different studies. Furthermore, Observational approaches try to provide more accurate indices of objective intensity of stressful events with examining the contexts in which stressful events occurred [for more details, see (78)].

Despite all these advantages, Observers' rating methods have some shortcomings compared to self-reports. The most important problem is their higher costs, because assessors shall be trained, temporal and local coordination of assessor and participant/client/ patient is not easy, and independent rating and review of scaling needs a huge amount of time and effort. Another issue is the low level of communication, because just a few studies on stress implemented observers' rating methods. The third, is the low empirical validity of such methods because of meagre usage in studies as a result of high administrative costs (79, 80). The most popular methods of Observers' ratings are presented in table 4. As it is obvious, there are only two popular methods of raters' rating in order to assessment of stress. It shall be noted that these two methods are called "Golden Standard" of (semi-)structured interviews and many diverse and limited

methods have been derived from them during recent years. LEDS is the best and most completed observers'/interviewers' method which is indeed the most expensive one, too. Training the raters of LEDS as well as administration of it costs a lot and when the spent time is taken to account, most researchers prefer not to use such method. CAPS is the other method which is specifically used to assess and evaluated PTSD in individuals. CAPS raters shall be qualified clinical psychologists with a great deal of training in PTSD and rating system of CAPS before administration of it.

Table 4. Most popular observers' rating methods of stress assessment

Instrument	Format	Target	Duration	segments
Life Events and Difficulties Schedule (LEDS) (81-87)	Semi-structured interview	Assessment of life-time stress in all kinds	1-3 hours	1. interview 2. rating procedure 3. consensus/expert rater process
Clinician-Administered PTSD Scale for DSM (CAPS) (36, 88-94)	Structured interview	PTSD assessment	45-60 minutes	1. interview 2. rating procedure

3.3. Biological & physiological methods

Physiological responses to stress are considered as important indices of diagnosis of health/disease. Because patterns of susceptibility to disorders/diseases and their prevalence are related to age, gender, race, geographical/ecological distribution, etc., therefore finding indices beyond these limitations to assess and evaluate stress, becomes a priority in biophysiological studies of stress (95, 96).

In recent years, many authors have been interested in using noninvasive and simple methods of biophysiological diagnosis. Implementation of low-price user-friendly equipment, ease of application in various situations, being portable, and rapid indication/response are some of features of biophysiological stress assessment instruments which are taken to account by authors and researchers. Researchers have focused on methods to assess individuals stress levels by means of saliva, galvanic skin response (GSR), skin conductance level (SCL), heart rate variability (HRV), skin/body temperature, and the level of perspiration (96-100).

There are many biophysiological methods of stress assessment from which some most applicable and cost-effective methods are announced in table 5. It shall be noted that there are various and numerous methods of stress assessment which are mostly laboratory-based and/or neither are cost-effective nor rapid and therefore have no feasibility to apply and operate in large number of population or in studies.

Table 5. Biophysiological methods of stress assessment

Method	Mechanism of action	Type
salivary alpha amylase (sAA) assessment (101-111)	sAA assessment by cocorometer	Noninvasive
Skin conductance (112-122)	Assessment of GSR, EDR, PGR, SCR, SCL	Noninvasive
Polygraph (AKA, lie detector) (123-130)	Assessment of blood pressure, pulse, respiration, SCL, and perspiration.	Noninvasive
Cortisol assessment (131-138)	Blood/ salivary/ hair/ urine/ perspiration tests to assess levels of cortisol	Invasive
Blood pressure (139-147)	Assessment of blood pressure, and/or pulse	Noninvasive
Electrocardiography (ECG/EKG) (148-158)	Assessment of heart electrical activity	Noninvasive
Voice stress analysis (116, 159-164)	Comparative assessment & analysis of futures of human voice waves	Noninvasive

3.4. Neurological methods

According to current findings, stress response initiates from central nervous system (CNS). Such stress response then transforms into a global physiological type by HPA axis and is transferred to other body organs and systems (5). Therefore, it could be proposed that CNS is the center for stress response and stress response signals initiate from this system and if there would be proper and accurate instruments, stress and stress response could be assessed from its origin (165-168).

Synchronous to advances in diagnostic knowledge and technology, modern stress assessment techniques have been developed which have the capability to investigate stress and stress response in CNS. From theoretical and practical points of view, in diagnostic techniques, the highest temporal accuracy is for electroencephalography (EEG). EEG records brain electrical activity from the outer surface of skull. In this method, voltage oscillations derived from ionic currents within brain neurons are registered and recorded from the surface of the skull in a noninvasive and passive form. From clinical aspect, EEG is applied to any method which records spontaneous electrical activity of the brain in a short period of time (3 to 15 minutes). This record is done by some electrodes (at least 19 active electrodes) placed on certain points of the skull. Diagnostic applications of EEG are generally concentrated on spectral content, so that neural oscillation of EEG graphs are compared to general states of reference populations (169-171).

EEG instrument comprises some electrodes, a cap for electrode placement, connector wires, amplifier for signal/wave reinforcement, and an apparatus to transform waves/signals to a graph/curve (172, 173).

Today in research methods, especially in psychological and neuroscience domains quantitative electroencephalography (QEEG) is applied. In this method, waves gained by

electrodes, after transmission from amplifier, instead of going to an analog registration apparatus and graph-drawing, would connect to computers via some media and been processed by special analytic programs. This analyses are based on two methods of Forier analysis and wavelet analysis. Therefore, there would be a chance of comparing each individual's brain electrical status with others as well as reference population. Furthermore, there are a wide range of processing and analysis of registered waves that resulted in an increasing attention and use of QEEG as a diagnostic and/or pretest-posttest instrument (174-177).

Usually QEEG is described based on rhythmic and transient activities. Rhythmic activity is divided according to frequency bands which have Greek alphabetical names. Most of registered rhythmic brain waves are ranged between 1-20Hz. Wave range between 1-4Hz is called delta, 4-7Hz theta, 8-15Hz alpha, 16-32Hz beta, and 32Hz and upper range is called gamma. It has been determined that each of these ranges are associated with specific brain-region activity. In addition, each of these ranges are correlated with specific situations and different behavioral functions (178-182).

Two frequency bands has especially been emphasized on stress studies more than the others; α band (8-15 Hz) and β (16-31 Hz). α waves are mostly in occipital regions of both hemisphere; more amplitude in dominant lobe. This frequency band represents relaxed and reflective state, closed eyes, inhibition control, and focus. Studies have shown the reduction of amplitude of this band in the time of stress response in human beings, compared to natural state (183-189).

Beta band which is 16-31 Hz has a symmetrical distribution in both hemispheres, mostly seen in frontal lobes and have waves with low amplitude. Increase in this wave band indicates stress response, situations of anxiety and obsession, vigilance, and active thinking. Furthermore, if individual is undertaking benzodiazepines, β waves amplitude would be more than natural state (190-193).

Studies on stress-related situations which implement QEEG, usually analyze the amplitude of brain oscillations, especially α and/or β, of individuals in resting state (base line) or a desired peaceful state of mind comparing to stressful states. Differences between these two situations represents individuals' stress response, brain regions dealing with stress response, and the amount and intensity of such involvement (24, 194-197). Up to date, because of high costs of apparatuses and softwares of QEEG, implementation of such methods in studies that purely assess/evaluate stress and related changes in brain oscillations are limited and directly linked to the financial budgeting of professional institutions.

3.5. Cognitive functions assessment scales

Cognitive functions are actions/processes like perception, intuition, logic, and memory. The fundamental concept in the study of cognitive functions is executive functioning (EF); important constructs in direct and control of behaviors/actions. EF has various components such as inhibitory control, working memory, time perception and internal language. EF develops throughout lifespan and gradually enables individual to solve more difficult and complicated tasks (198, 199).

EF represents a set of coordinated mental capabilities/activities in frontal lobe. These include capabilities such as time management, attention, focus shift, planning and organization, remembering details, behavioral restriction/inhibition, and using past experiences in current activities. Whenever a problem occurs in EF, behavioral inhibition reduces and this affects individual's performance. Furthermore, abilities to learn, memory, mathematical skills, reading, and socio-affective interactions are linked to EF. Authors have added up academic, occupational, and life achievements and even moral and ethical viewpoints to such cognitive functions (200, 201).

Stress affects EF dramatically. Studies have found that stress have some role on downfall of cognitive and executive functions. Because there is no specific task for assessment of EF, any test that can evaluate the performance in this domain would be considered as a stress-assessment scale. It shall be noted that any decline in cognitive and EF would be considered as a result of stress only if medical and neurological diagnostic procedures have found no structural, genetic, endo/exogenous injury/damage, and/or a disorder prior to the stress assessment (22, 202-205). Therefore, EF assessment tasks (with a precise screening of precedent factors) could be also used as beneficial stress assessment and/or evaluation tools, more on inhibition, cognitive flexibility, and working memory (20). In order to better demonstrate the EF assessment methods/ instruments, they are being divided into two subgroups of traditional and computer-assisted classes. Traditional methods are some test batteries which administered by interviewer and based on pen-and-pencil techniques, whereas computer-assisted techniques implement specifically designed computer softwares to evaluate and assess EFs.

3.5.1. Traditional methods of EF assessment

3.5.1.1. Montreal Cognitive Assessment (MoCA) Scale

This scale has been originally developed to identify minor cognitive impairments (MCI). This instrument evaluates short-term memory, visuospatial ability, executive performance, attention and concentration and working memory, language, and local and temporal orientation. According to the authors, this scale has the ability to assess stress influences on cognitive performance. Authors reported MoCA to have high correlations with other neuropsychological scales; correlation between MoCA and MMSE was reported .87, accuracy/sensitivity of scale to detect people with mild cognitive disturbances was .90 and for people with Alzheimer's disease was 100% (206-209).

3.5.1.2. Wechsler Memory Scale (WMS)

Wechsler Memory Scale (WMS) is a battery test which administered individually and designed considering current theories of memory. One of the characteristics of WMS is its sensitivity to stress, which means that any kind of exposure to acute/chronic would result in decreased scores in the test, depending on the type of stress (210-214).

WMS scale is designed to assess memory and learning abilities of people between 16 to 89 and inspects deliberately complex brain/behavioral relations and coordination engaged in learning and memory. Sub-scales

comprise auditory (immediate/delayed), visual (immediate/delayed), immediate memory, auditory recognition, general memory, and working memory (212, 215, 216).

3.5.2. Softwares that assess indices of executive functioning (EF)

As executive functioning is mostly engaged in processes such attention, perception, reaction time, inhibition, decision making, memory, and information processing, it might be plausible that assessment of such performances would give us a kind of stress assessment. To do so, there shall be at least a pretest-posttest experimental design to evaluate stress effects on participants. There are studies in which stressful events and inductive experimental stress have been compared to natural environments. However, there is no standard assessment protocol/instrument/method about such studies yet. Moreover, up to date there is not clear how stress can affect each of aforementioned higher cortical functions. Another issue is the lack of base-lines about natural and stress-impaired levels of activity for such categories (217-221).

Regarding the advancement of information technology in recent years, there have been developed several software packages to assess, evaluate and even rehabilitate/improve executive functions. These softwares have been designed to meet various needs of studies/treatments/ activities, but no one has the complete set of assessment instruments for executive functions (Table 6).

Table 6. Popular softwares to assess cognitive functions

software	company	abilities	accessibility	website
PEBL	Sourceforge	100 tests of cognitive functions	Free downloadable software	http://pebl.sourceforge.net/
COGNIPLUS (CPS)	Schuhfried	Assessment and rehabilitation of cognitive functions	Exclusive software and hardware	http://www.schuhfried.com/cogniplus-cps/cogniplus-cps/
Vienna Test System (VTS)	Schuhfried	Assessment of psychological and cognitive abilities	Exclusive software and hardware	http://www.schuhfried.com/viennatestsystem10/vienna-test-system-vts/
CogLab 2	Wadsworth	46 test to assess cognitive abilities	Online/ downloadable software	http://coglab.wadsworth.com/
CogLab 5	Cengage learning	52 test to assess cognitive abilities	online	https://coglab.cengage.com/

4. Discussion and Conclusion

In the present study literature on methods and instruments of stress assessment have been reviewed. According to the systematic review design accompanied by Delphi method, the domains of the review determined and afterwards, the selection process initiated. The final structure of the results comprised autoclitic inventories, raters' ratings, biological and physiological methods, neurological methods, and executive functioning inspections.

Autoclitic inventories included Iran Police Stress Scale (IPSS), HSE Management Standards Indicator Tool, Social readjustment Rating Scale (SRRS), Occupational Stress Inventory- Revised (OSI-R), The Posttraumatic Stress Disorder Checklist (PCL), and Maslach Burnout Inventory (MBI). It appears that Occupational Stress Inventory-Revised (OSI-R) and HSE Management Standards Indicator Tool have more subscales and therefore, appear to better discriminate/differentiate between various components of steers response.

Raters' ratings, are systems of objective behavioral assessments which are comprehensive and deliberate methods of stress analysis and more suited to evaluate chronic stress rather than acute stress. There are a few rater's ratings of stress which have been derived from two cardinal interviews which are called golden standards, namely Life Events and Difficulties Schedule (LEDS), and Clinician-Administered PTSD Scale for DSM (CAPS). These protocols are more expensive than autoclitic ones and the rater requires to be well trained.

Aforementioned biological and physiological methods are salivary alpha amylase (sAA) assessment, skin conductance, polygraph (AKA, lie detector), cortisol assessment, blood pressure, electrocardiography (ECG/EKG), and voice stress analysis. Among them, salivary alpha amylase (sAA) assessment and ECG/EKG are the fastest and yet most reliable techniques of biological assessment of stress response.

The core idea of neurological methods lies under electroencephalographical analysis which nowadays could be performed via computer-assisted instruments (QEEG) and interpretative complementary softwares. Most of the stress analysis in this way focus on the level of two wave bands of α and β and their pattern change compared to resting state and normal population.

The last class of stress assessment methods were (EF) inspections. Two major types of assessment of EF are traditional and computer-assisted methods. Popular traditional methods include Montreal Cognitive Assessment (MoCA) Scale and Wechsler Memory Scale (WMS). Popular softwares of EF assessment involve PEBL, COGNIPLUS (CPS), Vienna Test System (VTS), CogLab 2, and CogLab 5. Authors have meta-analytically found that inhibition, cognitive flexibility, and working memory are among the EFs that are more sensitive to stress (20), although there is still a need to calibrate and comparative studies to distinguish the relative (and hopefully exact) impact size of stress on each of EFs.

There appear to be several important points in order to assess and evaluate stress both in studies and real life (occupational/ clinical settings) within stress literature. First point is the lack of consensus on definition and meaning of stress construct among authors (5). This issue would be considered as the first obstacle to determine suited stress assessment instrument(s). Second is the selection of appropriate approach to assess stress (response); It seems as if there is no consensus among authors on preferences of assessment methods. Third, most of the body of the literature see stress from a unimodal, rather than a biopsychosocial viewpoint. Forth, many of amazing and creative methods of stress assessment are costly and the major part of the authors/ projects cannot afford such budgets; these include the instruments as well as trainings. Fifth, yet there is no database about baselines of normal and natural performance in comparison to stressful situation in many issues of human life especially brain oscillations and EFs. These baselines shall cover private and occupational life and gender-specific as well as age-specific. The sixth issue would be cut-off points. Traditionally, there are few classifications and nosologies on description of pathological states. However, in the case of stress it appears that there shall be at least zones of healthy/ normal, borderline, at-risk, and pathological responses.

One of the issues of stress assessment is evaluation of stress response and its mechanisms in non-clinical population, which is also known as health psychology. Contradictory to the traditional viewpoint, nowadays, more non-clinical population sectors tend to implement psychosocial solutions to improve their health; WHO has been succeeded in its social awareness policies on primary preventions and (inter)national (non)governmental organization have changed their policies and roadmaps to incorporate psychosocial educations in their formal planning and strategies (222-224). This highlights the importance of stress assessment and determination of borderline and at-risk populations. Therefore, the need to calibrate and standardization of protocols of stress assessment in mass population is increasing and inevitable. Most of the nations have started to administrate life skills in large public scales and to do so, authors need to establish more deliberate, classified and standardized methods of stress assessment.

In conclusion, it appears that in spite of a large body of research/study on stress, there is still a gap between desired multidimensional biopsychosocial protocols of stress assessment to assess both clinical and non-clinical population within private, social and occupational environments. This, in fact is a great opportunity for authors to conduct and administrate new methods and/or calibrate/standardize current methods of stress assessment as well as establishment of various specific baselines of stress response for each (non-)clinical population sector.

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