INTERNATIONAL JOURNAL OF SOCIAL SCIENCES BULLETIN
ISSN: (E) 3007-1917 (P) 3007-1909

Volume 4, Issue 3, 2026

DEVELOPMENT AND PSYCHOMETRIC VALIDATION OF THE FORMAN MENTAL LOAD SCALE (FMLS)

Syed Murtasim Zia Naqvi[*1], Dr. Sarah Shahed[2]

[*1,2]*Department of Psychology, Forman Christan College University, Lahore, Pakistan*

[*1]murtasimzia12@gmail.com

[*1]**ORCID IDs:** https://orcid.org/0009-0001-8169-3659

Corresponding Author: *
Syed Murtasim Zia Naqvi
DOI: https://doi.org/10.5281/zenodo.21989879

Received	Accepted	Published
01 January 2026	17 March 2026	31 March 2026

ABSTRACT

This study aimed to develop and validate an indigenous, culturally adaptive tool, Forman Mental Load Scale (FMLS), to assess the multidimensional nature of mental load among emerging adults in Pakistan. The research followed a two-phase design. Following item generation, exploratory factor analysis, reliability and validity analyses, and confirmatory factor analysis were conducted. Exploratory factor analysis revealed a six-factor structure: Psychological Load, Cognitive Load, Psychophysiological Load, Psychosocial Load, Psychoemotional Load, and Social Responsibility Load. The FMLS demonstrated excellent internal consistency (α = .96) and test-retest reliability (ICC = .97). Convergent validity was confirmed via positive correlations with the Kessler Psychological Distress Scale (K-10). In contrast, discriminant validity was supported through negative correlations with the Subjective Happiness Scale (SHS). Females reported significantly higher mental load scores than males (p = .004). Exploratory factor analysis supported a six-factor structure, whereas confirmatory factor analysis indicated an acceptable model fit. The FMLS offers a comprehensive, culturally sensitive tool to assess and screen mental load in Pakistani students, addressing a key gap and supporting better understanding and intervention.

Keywords: *mental load, scale development, psychometric properties, exploratory factor analysis, confirmatory factor analysis*

INTRODUCTION

Progress and advancement in today's era have introduced many new stressors, resulting in new phenomena, including mental load. It is becoming a serious concern these days due to increased competition, challenges, and difficulties, as well as the level of work and related expectations, in academics and other professional settings. "Mental load" refers to the cognitive effort involved in remembering, organizing, and coordinating tasks (Sweller, 1988).

The historical development of this concept is embedded in a psychological and physiological context. The study of mental load traces its origins to early theories of stress and cognitive processes. Hans Selye, often referred to as the "godfather of stress," developed the General Adaptation Syndrome in the mid-twentieth century, laying the groundwork for understanding physiological reactions to stress (Tan & Yip, 2018). Around the same time, Walter Cannon's idea of homeostasis emphasized the body's ability to maintain equilibrium under changing conditions,

foreshadowing contemporary stress and load theories (Hutmacher, 2021). These concepts were expanded upon with the introduction of cognitive load theory in the 1980s, which divided mental load into intrinsic, extraneous, and relevant components to better understand its influence on learning and performance (Sweller & Chandler, 1994).

It can be explained on the foundations of different theoretical models and frameworks. Some models focus on the cognitive aspect, and others might focus on the workload aspect. Cognitive Load Theory (CLT) and the Mental Workload Framework are the two most used frameworks for defining it.

Although the concept affects people of all genders, it is felt by each gender differently. Research has shown that it has become a serious concern regarding women's welfare and productivity. A woman herself bears a disproportionate burden of the invisible work; it often results in stress, anxiety, or burnout (Dean et al., 2021). Women are known to bear the brunt of child and domestic responsibilities even after working outside the house (Reich-Stiebert et al., 2023). Some gendered household roles and internalized expectations can lead women to a mental load that is manifested in not being able to perform tasks, resulting in constant distress and worry (Daminger, 2019).

Mental load is also evident in academic and occupational settings worldwide. Vasile et al. (2011) found that cognitive mental load significantly affected academic self-efficacy in the educational environment. It causes fatigue and reduces psychological performance in individuals engaged in various activities (Díaz-García et al., 2021). High mental workload can lead to cognitive fatigue, affecting working memory and attention, which are crucial for task performance; furthermore, sustained mental overload can result in stress, memory lapses, and an increased risk of errors and work-related diseases (Subramanyam et al., 2013).

Measuring mental load can be challenging, with methods ranging from subjective assessments to physiological measures that provide limited insight into cognitive resource allocation. Much research has aimed to identify the multilevel sources of mental load that individuals experience. It is a complex phenomenon that requires significant research, especially in Pakistani culture, to determine psychological vulnerabilities.

Objectives

- This research aimed to develop an indigenous measure to investigate the phenomenon of mental load.
- To determine the reliability and validity of the mental load scale.
- To find the gender differences in mental load in young adults

Operational Definition of Variable

"Mental load is defined as an invisible burden while performing mentally and emotionally challenging tasks that impact your thinking, learning, and functional abilities, causing psychological and physiological fatigue".

Mental load is the perceived, covert difficulty, effort, or burden associated with performing tasks, influenced by task complexity, environmental factors, and individual capacity (Sweller, 1988). This includes the combined emotional and cognitive burden that causes psychological and physiological fatigue during decision-making, planning, and execution, affecting daily household chores and multitasking in occupational responsibilities (Díaz-García et al., 2021; Dean et al., 2021).

Literature Review

Mental load is a complex phenomenon, and many studies have highlighted the associated psychosocial factors. This research has brought new possibilities and insights into the aspects and effects of mental load.

Chen et al. (2021) examined how gender differences affect cognitive load and learning efficiency when using game-based intelligent robots for Chinese idiom learning among elementary school students. The experiment combined games with Zenbo robots and involved 24 fourth-grade students in Taiwan. Results showed that boys had significantly lower cognitive load and higher learning efficiency than girls, although the difference in learning performance

between boys and girls was not statistically significant. The study shows that, although the use of emerging technologies has generally been positive, it can at times be extremely cognitively taxing, particularly for younger students, and that gender differences do play a role in determining such outcomes. Possible reasons for the findings are discussed.

Febiyani et al. (2021) conducted research to understand the learning process between students and lecturers in face-to-face classes. The mental workload in face-to-face learning varies considerably from that in e-learning. This article applies cognitive ergonomics principles to examine students' comfort during e-learning cognitive processes. Using a questionnaire based on the NASA-TLX method, data were collected and analyzed. The results indicate that "effort" had the highest mental workload, at 267.29, suggesting that students expend more effort to attend online classes. The SOFI score is 1.26, indicating that students are tired during online classes.

Dean et al. (2021) conducted a study to synthesize and define mental load as a combination of cognitive and emotional labor, emphasizing how this combination makes it burdensome. The three characteristic properties of mental load within families and society are: (1) invisibility, in that it is invisible work carried out internally but brings out unpaid physical labor; (2) boundaryless, in that it extends to work, leisure time, and sleep time; and (3) enduring, since it's tied to ongoing caregiving. Therefore, it was established that mental load measures should be incorporated into health and social surveys, employers should be encouraged to incorporate work-life balance policies, and governments should treat caregiving as critical infrastructure to reduce the demands of work and care.

Díaz-García et al. (2021) studied mental load and fatigue assessment instruments and reported that both mental load and fatigue are primary factors that reduce performance and lead to several accidents across different types of activities. The study provided a summary and classification of validated instruments used to quantify mental load and fatigue. A total of 40 research papers related to mental load and fatigue were reviewed, focusing on measures and evaluations of mental load and fatigue. Most articles used subjective scales. Although objective techniques are quite expensive and complicated, applied research is necessary for further analysis of brain processes related to mental load and fatigue. It seems that the construction of a battery of tests incorporating the three types of derivations is also necessary.

Schnaubert and Schneider (2022) conducted research analyzing the relationship between mental load or mental effort and meta-comprehension under different multimedia design conditions. According to cognitive load theory, learning is effective only if the material-induced load does not exceed the cognitive resources available for comprehension; therefore, multimedia material should not increase irrelevant cognitive load. Both factors are theoretically assumed to affect comprehension and its metacognitive representation, meta-comprehension.

Klasnić (2023) conducted a study to examine whether gender inequalities in mental labor exist within Croatian households, particularly in the cognitive and emotional tasks associated with family obligations. Data were collected from 1,000 participants in heterosexual relationships, revealing significant gender gaps. Women report more mental labor in cleaning, grocery planning, and social family life, whereas men handle car maintenance. Women experience a higher mental load due to the frequency and volume of their tasks, influenced by factors such as upbringing, socioeconomic status, and household dynamics. In contrast, men's mental load is lighter, especially when raised in egalitarian environments or partnered with women of higher socioeconomic status.

Haupt and Gelbgiser (2023) conducted a study to investigate the association between the level of stress due to an uneven distribution of cognitive labor within families and potential family work conflict. Results show significantly higher cognitive labor and family work conflict for women but not for men.

Vitellozzi et al. (2024) studied the gender-differentiated impact of mental load-the unobservable cognitive and emotional cost of

managing a household-on the gender gap in earnings. An experiment in Nairobi randomly primed participants with mental load and then assigned them to either manual or cognitive tasks. It was found that mental load lowers female productivity in manual tasks but not in cognitively demanding tasks, whereas no significant effects were found on men.

Theoretical Framework

Cognitive Load Theory (CLT) was developed by John Sweller in 1988. He proposed a framework for understanding how individuals process and manage information. The theory emphasizes the cognitive demands placed on a person and the capacity to handle them effectively. Mental load is a subtype of cognitive load, referring to the number of cognitive resources that a given task requires. Mental load can be understood as a component of cognitive load, influencing the total capacity for learning and performance (Sweller, 1988).

Sweller discussed the different types of loads in cognitive load theory. Intrinsic load is the inherent difficulty of the information being processed and is determined by the interactivity of factors in the information and the learner's prior knowledge. Intrinsic load is inevitable but can be optimized by tailoring the difficulty of learning materials to the learner's expertise (F. Paas et al., 2010). On the other hand, extraneous load is determined by the way information is presented to the learner. If the task instructions are poorly presented or ineffective, the load will increase, diverting the learner's attention from essential content. Mental load, as conceptualized under this load division, involves the additional effort required to negotiate unnecessary complexity (Chandler & Sweller, 1991). Germane load refers to the cognitive effort or resources devoted to forming and automating schemas, which are necessary for long-term knowledge retention through learning and processing information. This aspect of cognitive load is directly influenced by the learner's motivation and engagement (Van Merriënboer & Sweller, 2005).

Mental load is strongly related to the cognitive effort required to perform a task. It is shaped by three factors: intrinsic, extraneous, and germane, including task complexity, environmental distractions, and the individual's capacity for attention and working memory (Paas & Van Merriënboer, 1994). Mental load not only affects learning outcomes but also the efficiency of decision-making and problem-solving. Tasks with higher intrinsic complexity or poorly designed instructions may increase mental load (Sweller et al., 2011). A simple example is that solving a mathematical problem requires more cognitive resources than recalling your phone number. Individual differences in the intensity of mental load can arise from additional factors such as prior knowledge, cognitive abilities, and motivation, which significantly influence how mental load is perceived and managed (Kalyuga, 2009). Effective instructional design can minimize extraneous load. Techniques may include segmentation, scaffolding, and dual-modality presentations to reduce mental overload (Mayer & Moreno, 2003).

Conceptual Framework of Mental Load

This research was based on an integrated model of multidimensional mental load. This mental framework helped explain the interactions among cognitive, emotional, workload, social, physiological, and psychological factors that contribute to mental load, as identified in the literature. Considering the four factors, the model provides a comprehensive view essential for evaluating and analyzing mental load.

The cognitive dimension emphasizes the role of mental processes in task performance, particularly task complexity, memory load, and multitasking demands. The emotional dimension focuses on task-related stressors, emphasizing the emotional and psychological factors involved such as stress perception, affective responses, and coping strategies. The workload dimension focuses on physical external factors in the task environment that contribute to mental load, such as time pressure, information overload, task unpredictability, and responsibility level. The social dimension explores how interpersonal and sociocultural factors affect mental load, including role expectations, social support availability, social comparison and judgment, communication

demands, and cultural and societal norms. The physiological dimension addresses the physical and neurobiological correlates of psychological distress, including sleep disruption, somatic symptoms, energy depletion, and burnout risk.
The psychological dimension focuses on factors such as perceived control, self-efficacy, rumination and worry, and distress.

Association Among Dimensions

Mental load is a multidimensional construct shaped by the dynamic interplay of cognitive, emotional, workload, social, physiological, and psychological dimensions. These dimensions are deeply interrelated. Together, they form a complex, interdependent system in which each factor can reinforce or mitigate the others, ultimately determining the overall mental burden an individual experiences.

Conceptual Framework of Forman Mental Load Scale

The scale construction based on important domains of mental load is as follows:

I. Cognitive Load

- Intrinsic Load: Reflects the complexity of the task itself and the effort required to understand and process it.
- Extraneous Load: Stems from task-irrelevant factors, such as poor instructions or distractions.
- Germane Load: Involves the mental resources dedicated to learning and schema building.

II. Emotional Load

- Captures the emotional impact of the task or environment, such as stress, frustration, or motivation.
- It also discusses the influence of emotional states on task performance and decision-making.

III. Psychophysiological Load

- Refers to the physical demands that contribute to mental strain, such as fatigue or physical discomfort from prolonged task performance.

IV. Social Load

- Arises from social interactions, expectations, or the pressure to collaborate and communicate effectively with others.

V. Temporal Load

- Relates to memory, time pressure, deadlines, and the perceived adequacy of time available to complete tasks.

VI. Psychological Load

- Referring to the presence of psychological vulnerabilities, including constant distress and worry.

Rationale of the Study

The current study is focused on exploring mental load in young adults living in Pakistan. With growing demands in both personal and professional settings, stress and mental exhaustion have escalated particularly in developing countries, where socio-economic and cultural factors significantly impact mental well-being. Currently, there is no robust systematic review that applies the instrument to measure mental load (Díaz-García et al., 2021b). In Pakistan, mental health challenges are further intensified by societal expectations, complex family dynamics, and limited access to mental health resources. Existing scales are predominantly developed in the Western context and may not fully address the various aspects of mental load in Pakistani society.

Purpose of Study

The purpose of this study is to develop an indigenous scale on mental load and to measure its reliability and validity.

Hypotheses

- The Forman Mental Load Scale will exhibit high levels of internal consistency among items.
- The Forman Mental Load Scale will have a positive correlation with psychological distress

and a negative correlation with subjective happiness.

Methodology

This study includes two main phases. Phase I of the study includes the development of an indigenous scale on mental load in educated young adults. Phase II comprised the establishment of the psychometric properties of this indigenous scale for mental load.

Research Design

The scale was constructed following DeVellis' classical model of scale development (DeVellis, 2017).

Phase I: Construct Conceptualization and Item Generation

This phase consisted of interviews and a focus group to generate an indigenous list of items, which was later validated through expert review and shortlisted for a pilot study.

An extensive review of the existing literature was undertaken to understand the theoretical frameworks, measurement tools, and dimensions relevant to the construction. Following this, qualitative data were collected through semi-structured interviews and focus group discussions with participants representative of the target population to capture lived experiences, culturally embedded expressions, and contextual nuances of the construct. Based on insights from literature and qualitative data, an initial item pool was developed. Items were worded to reflect the language and expressions commonly used by the target population, ensuring both relevance and comprehensibility. A panel of subject-matter experts in psychology, psychometrics, and clinical practice reviewed the item pool for content validity, relevance, clarity, and redundancy. Feedback was guided for modifications such as item rewording, elimination, or addition. The refined item pool was administered to a small sample of the target population to evaluate the items' clarity, readability, and response patterns. Feedback was used to make necessary adjustments before proceeding with large-scale data collection.

Phase II: Item Analysis and Establishing Cutoffs

This phase involved collecting data to measure the underlying constructs or dimensions. Exploratory Factor Analysis (EFA) revealed the factor structure in the data, whereas Confirmatory Factor Analysis (CFA) tested the validity of a hypothesized factor structure based on theoretical assumptions. Internal consistency of the items was determined using Cronbach's Alpha. Furthermore, Receiver Operating Characteristic (ROC) curve analysis was used to establish cut-off scores.

A sample size of at least five-fold per item was collected, ensuring adequate representation of the target population of young adults aged 18-26 years enrolled in universities. EFA was conducted to explore the underlying factor structure of the item pool. The number of items was reduced by eliminating those with low factor loadings or high cross-loadings.

After EFA, CFA was performed on a separate sample to test the fit of the hypothesized factor structure. Model fit indices such as CFI, TLI, RMSEA, and SRMR were used to assess model adequacy. Internal consistency of the final scale was examined using Cronbach's alpha for each factor and the overall scale. Additionally, test-retest reliability was assessed by administering the scale to a subsample at two time points separated by 4 weeks. Criterion validity was assessed by correlating with the pre-established criteria based on demographics and validated measures assessing similar constructs. The strength and direction of correlations were analyzed to determine concurrent validity. Construct validity was evaluated through both convergent and divergent validity assessments. Convergent validity was examined by examining correlations between the new scale and theoretically related constructs, while divergent validity was tested by correlating it with relevant measures. Descriptive statistics including means, standard deviations, and ranges were computed for the final scale and its subscales to provide normative data for the target population. ROC curve analysis was employed to determine optimal cut-off scores.

Participants

The sample size was 5 times the number of items generated in the initial item pool, as recommended by Carpenter (2017). The sample was taken from young adult university students 18-26 years.

Sampling Strategy

The study employed a multi-stage, purposive and stratified sampling strategy, dividing participants into distinct sub-samples (Samples A–G) to correspond with specific steps across both phases of the research.

Sample A:

This sample was comprised of theoretical models, published literature, and existing measures related to mental load.

Sample B:

A purposive sample of six Subject Matter Experts (SMEs) participated in focus group discussions.

Sample C:

A separate group of seven SMEs was engaged to conduct content validation of the initial item pool.

Sample D:

A pilot study sample of 60 university students aged 18–26 years was recruited to assess the preliminary item pool for clarity, comprehensibility, and appropriateness.

Sample E:

The sample size was determined using the guideline of at least 5 participants per item in the final item pool (Carpenter, 2017) to ensure robust factor-analytic procedures.

Sample F:

A sample of 260 participants was used for confirmatory factor analysis.

Sample G:

A subsample equivalent to 10% of Sample E was selected to assess convergent and divergent validity.

Sample H:

Similarly, another 10% of Sample E was designated for establishing criterion validity.

Inclusion Criteria

- Young adults with an age range of 18-26 years were included (Bonnie et al., 2015).
- Both men and women were included in the study.
- Young adults from public and private universities were included.
-

Exclusion Criteria

- Young adults with any neurological, physiological, and psychiatric disability were not included in the research.

Materials and Measures

Demographic Sheet

The demographic variables in this study included age, gender, education, birth order, marital status, family structure, family members, income, study hours, travel time, sleep patterns, exercise habits, and household responsibilities.

Kessler Psychological Distress Scale (K10) – Kessler et al. (2003)

The Kessler Psychological Distress Scale (K10) is a self-reporting tool used to assess psychological distress. It comprises 10 questions regarding emotional states on a five-point Likert scale. Low scores on K-10 indicate a lower level of psychological distress, whereas high scores propose higher levels of psychological distress. K10 has an internal consistency of 0.84 to 0.94 and a test-retest reliability of 0.70 to 0.90.

The Subjective Happiness Scale - Lyubomirsky & Lepper (1999)

The SHS is a global subjective happiness scale consisting of four items. The internal consistency ranges from 0.79 to 0.94, whereas the test-retest reliability ranges from 0.55 to 0.90.

Procedure

The Ethical Review Committee and the Institutional Review Board of the Department of Psychology at Forman Christian College University approved the research topic. The permission letter was obtained from the institution to collect the required data. All ethical considerations were taken into account, including informed consent, privacy, confidentiality, and potential harm to participants. Data were collected through interviews, focus groups, and surveys to develop a questionnaire, which was later used in the study. The results were analyzed through SPSS

to determine the scale's factors, reliability, and validity.

Analysis and Discussion

Statistical Analysis

The analysis was done through SPSS 26.

Results

Phase I – Item Generation

A total of 80 items were generated after analyzing the themes from focus groups and interviews. The initial Item pool was given to seven reviewers, and I-CVI was calculated. The criteria for retaining the items were that they were greater than 0.78, as suggested (Lynn, 1986). A pilot study was conducted on the initial item pool.

Table 1

Mean and Standard Deviation of Age in Years of the Participants in Sample E (N=402)

Variable	M	SD
Age (in years)	22.09	2.12

Note: M is Mean, and *SD* is Standard Deviation.

Table 2

Frequencies And Percentage of Demographic Variables of Participants in Sample E (N=402)

Variables	f	%
Gender		
Male	170	42.3 %
Female	232	57.7 %
Education		
BS	304	75.6 %
MS/MPhil	84	20.9 %
PhD	14	3.5 %
Birth Order		
First	154	38.3 %
Middle	143	35.6 %
Last	93	23.1 %
Only	12	3.0 %
Marital Status		
Single	293	72.9 %
Romantic Partnership	48	11.9 %
Engaged	41	10.2 %
Married	15	3.7 %
Divorced	3	.7 %
Widowed	2	.5 %

Family System		
Nuclear	296	73.6 %
Joint	106	26.4 %
Employment Status		
Part Time	68	16.9 %
Self Employed	52	12.9 %
Un Employed	282	70.1 %
Travel Time		
Less than 30 Min's	133	33.1 %
30 to 60 Min's	145	36.1 %
More than 1 Hour	80	19.9 %
More than 2 Hour's	44	10.9 %
Sleep Hours		
Less than 4 Hours	57	14.2 %
4 to 6 Hours	181	45.0 %
7 to 9 Hours	121	30.1 %
More than 9 Hours	43	10.7 %
Exercise		
Never	183	45.5 %
1 to 3 times a week	126	31.3 %
4 to 6 times a week	62	15.4 %
Daily	31	7.7 %
Household Responsibilities		
Yes	186	46.3 %
No	216	53.7 %

Phase II – Exploratory Factor Analysis

An Exploratory Factor Analysis (EFA) was conducted to investigate the underlying structure of the Forman Mental Load Scale (FMLS). Kaiser-Mayer-Olkin (KMO) Measure of Sampling Adequacy and Bartlett's Test of Sphericity (N=402). The results of the KMO and Bartlett's Test indicated that the data are highly suitable for factor analysis. The Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy was 0.944, which was within the "excellent" range (values above 0.90), suggesting that the sample was more than adequate for factor extraction (Kaiser, 1974). Furthermore, Bartlett's Test of Sphericity is highly significant ($\chi^2(1128) = 9927.566$, $p < .001$), confirming that the correlation matrix is not an

identity matrix and that meaningful correlations exist among the variables (Bartlett, 1954). Taken together, these findings strongly supported the dataset's suitability for factor analysis.

Factor Extraction and Retention Criteria. Exploratory Factor Analysis was performed utilizing Principal Component Analysis with Varimax rotation. Scree plot analysis was conducted to identify the factors to retain.

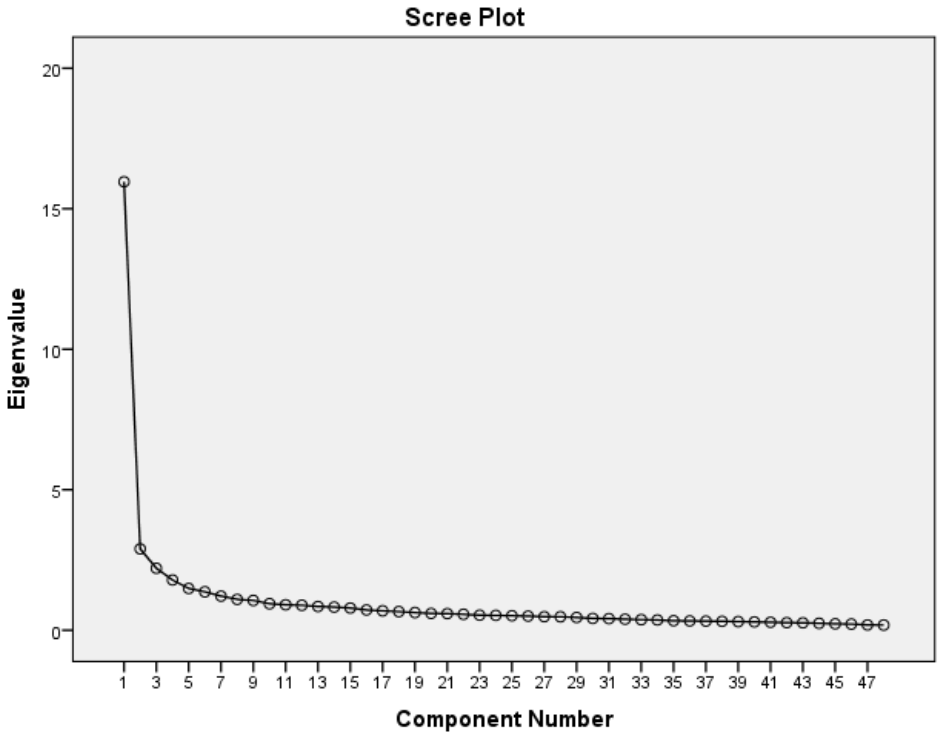

Figure 1. Scree Plot Explaining the Factor Structure of FLMS.

The scree plot displays the eigenvalues associated with each principal component, plotted in descending order. Based on this pattern, it was decided to retain only 5 to 6 components for further analysis, as they capture most of the meaningful variance.

Table 3
Item Loadings for Exploratory Factor Analysis with Varimax Rotation of FLMS in Sample E (N=402)

Sr No	Item No.	Item Statement	F1	F2	F3	F4	F5	F6
1	FMLS1	I often feel tired without doing any work.	.16	.23	.79	.04	.13	.09
2	FMLS2	I often feel the need for more rest even when I have not done much.	.14	.24	.78	.10	.17	.07
3	FMLS3	I often feel sleepy without any obvious reason.	.14	.14	.75	.05	.08	.11
4	FMLS4	I often feel mentally exhausted with little or no work.	.20	.18	.74	.08	.13	.16
5	FMLS5	I often have difficulty concentrating.	.22	.27	.67	.06	.00	.14

6	FMLS8	I often find it difficult to focus on personal activities because of my unfinished tasks.	.17	.27	.29	.25	.07	.48
7	FMLS9	I often prioritize the feelings of others over my own.	.18	.19	.16	.13	-.04	.53
8	FMLS10	I often handle difficult situations in my family.	.01	.03	.03	.17	.23	.72
9	FMLS11	I often anticipate potential problems and plan to manage them.	.11	.18	.04	.10	.11	.74
10	FMLS12	I often feel burdened to keep everything running smoothly.	.18	.24	.29	.12	-.02	.55
11	FMLS13	I often feel drained by the end of the day.	.07	.67	.28	.11	.10	.24
12	FMLS14	I often feel stressed out while working on academic tasks in class.	.22	.61	.27	.24	.03	.11
13	FMLS15	I often feel a burden while working on an academic task.	.26	.69	.22	.15	-.00	.04
14	FMLS16	I often find some courses more challenging than others.	.21	.71	.11	.05	.14	.16
15	FMLS17	I often feel mentally blank while studying.	.34	.49	.30	-.07	.12	.11
16	FMLS18	I am often unable to relax because my mind is constantly focused on pending responsibilities.	.19	.56	.14	.24	.24	.12
17	FMLS19	I often experience frustration when my efforts to manage things are not acknowledged.	.19	.49	.22	.07	.17	.15
18	FMLS34	I often cancel my personal plans due to academic obligations.	.14	-.07	.10	.67	.15	.11
19	FMLS35	I often sacrifice sleep to complete my tasks.	.08	.21	-.01	.64	.18	.23
20	FMLS36	I often worry about maintaining good grades to enhance future opportunities.	.21	.24	.10	.63	-.12	.11
21	FMLS37	I often am unable to fully enjoy leisure activities because of academic worries.	.28	.11	-.04	.64	.12	.13
22	FMLS38	I often feel an invisible burden from managing multiple academic responsibilities.	.37	.19	.11	.60	.05	.08
23	FMLS40	I often feel overwhelmed by the number of things I need to keep track of.	.34	.28	.21	.46	-.03	.16
24	FMLS43	I often feel burdened to keep track of my academic deadlines.	.36	.52	.11	.17	.04	.24
25	FMLS44	I often feel that complex academic tasks significantly increase my mental burden.	.38	.47	.18	.24	.03	.17

26	FMLS52	I often make mistakes when I am overwhelmed by challenging academic tasks.	.52	.33	.02	.15	.13	.04
27	FMLS55	I often feel anxious due to challenging academic tasks.	.50	.37	.14	.28	.02	-.01
28	FMLS56	I often have difficulty getting out of bed due to academic pressure.	.58	-.02	.30	.18	.14	-.02
29	FMLS57	I often feel demotivated to perform a task due to its complexity.	.69	.10	.24	-.05	.09	.14
30	FMLS58	I often feel that challenging academic tasks hinder and reduce the quality of work in that task.	.70	.19	.17	-.03	.09	.18
31	FMLS59	I often feel that challenging academic tasks hinder and reduce my creativity in that task.	.71	.08	.19	.11	.05	.17
32	FMLS61	I often feel tense after my classes.	.55	-.05	.17	.13	.37	.11
33	FMLS62	I often feel overstimulated due to academic work.	.56	.23	.17	.27	.23	.05
34	FMLS63	I often experience mood fluctuations due to a challenging academic routine.	.44	.237	.146	.302	.302	.072
35	FMLS64	I often find it difficult to regulate my emotions after a mentally challenging task.	.54	.28	.03	.19	.18	.03
36	FMLS65	I often feel stressed due to unexpected class tasks.	.59	.24	.05	.21	.16	.03
37	FMLS66	I often feel the class tasks make me feel overwhelmed and panic.	.69	.16	.07	.28	.15	.02
38	FMLS67	I often feel worried due to the closely packed deadlines.	.64	.27	-.00	.22	-.07	.14
39	FMLS68	I often find it difficult to remember things due to challenging academic tasks.	.60	.23	.11	.33	.07	.12
40	FMLS69	I often feel stuck due to mentally demanding academic work.	.58	.20	.08	.38	.22	.05
41	FMLS70	I often feel emotionally numb due to the increasing academic mental burden.	.55	.13	.10	.30	.25	.10
42	FMLS75	I often feel there is an invisible burden on me during class while performing an academic task.	.48	.23	.18	.20	.37	.11
43	FMLS76	I often feel low on energy while working on academic tasks.	.45	.37	.11	.21	.31	.11
44	FMLS77	I often feel hopeless due to the mental burden.	.35	.19	.17	.13	.57	-.03
45	FMLS78	I often feel worried about financial matters making me feel burdened.	.23	.23	.11	.09	.62	.16

46	FMLS79	I often feel I have been sacrificing activities that I like.	.01	.24	.15	.27	.67	.10

The EFA using Varimax rotation of the FLMS revealed a six-factor structure that captures distinct yet interconnected dimensions of mental, emotional, and academic burden. Factor 1 (F1) reflects academic overload and cognitive strain, characterized by feelings of demotivation, anxiety, and diminished creativity in response to complex academic tasks. This is evident in items such as feeling "stuck" or overwhelmed by deadlines (FMLS57, FMLS66, FMLS69). Factor 2 (F2) represents mental overload, encompassing stress, mental fatigue, and the sensation of being mentally "blank" while studying (FMLS13, FMLS15, FMLS16), pointing to the exhaustion associated with sustained cognitive effort. Factor 3 (F3) captures physical and mental exhaustion, as seen in items indicating unexplained tiredness or sleepiness (FMLS1, FMLS3, FMLS4), suggesting symptoms of burnout or energy depletion. Factor 4 (F4) centres on academic pressure and personal sacrifice, where individuals report cancelling personal plans, losing sleep, and worrying about grades to meet academic expectations (FMLS34, FMLS35, FMLS36). Factor 5 (F5) addresses the emotional and financial burden, including feelings of hopelessness, financial stress, and interpersonal strain (FMLS77 and FMLS78). Factor 6 (F6) reflects personal responsibility and family-related burden, capturing efforts to manage family issues while feeling weighed down by caregiving or household responsibilities (FMLS10, FMLS11, FMLS12). A few items exhibited cross-loadings (e.g., FMLS24) or weak loadings (e.g., FMLS9), indicating potential complexity or areas for refinement in the scale. Together, these six factors underscore the multidimensional nature of burden as measured by the FLMS, spanning academic, physical, emotional, and personal domains with important implications for scale validation and targeted intervention development.

Table 4
Eigenvalues and Variance Explained by Factors of FLMS in Sample E (N=402)

Factors	Eigen Values	% of Variance	Cumulative %
Factor 1	15.96	33.25	33.25
Factor 2	2.90	6.04	39.28
Factor 3	2.20	4.59	43.88
Factor 4	1.80	3.73	47.60
Factor 5	1.49	3.10	50.70
Factor 6	1.37	2.85	53.55

The results revealed six factors with eigenvalues greater than 1.0, collectively accounting for 53.55% of the total variance. The decreasing variance explained by successive factors suggests a well-distributed but multidimensional construct. Overall, the cumulative variance exceeding 50% supports the adequacy of the six-factor model and provides evidence for the construct validity of the FMLS.

Table 5
Inter-Scale Correlation of FMLS in Sample E (N=402)

Factors/ Subscales	PL	CL	PPL	PSL	PEL	SRL	TFMLS
F1 Psychological Load	-						
F2 Cognitive Load	.70**	-					
F3 Psychophysiological Load	.50**	.60**	-				
F4 Psychosocial Load	.61**	.54**	.34**	-			
F5 Psychoemotional Load	.56**	.44**	.38**	.35**	-		

F6 Social Responsibility Load	.48**	.57**	.46**	.47**	.34**	-	
Total FMLS	.92**	.86**	.68**	.71**	.64**	.66**s	-

Note: *p< .05, **p< .01, ***p < .001 PL = Psychological Load; CL = Cognitive Load; PPL = Psychophysiological Load; PSL = Psychosocial Load; PEL = Psychoemotional Load; SRL = Social Responsibility Load.

Pearson Correlation Analysis was conducted to examine inter-scale relationships among the FMLS subscales and their correlations with the total score. The results revealed that the PL subscale had a significant, positive, and strong correlation with the CL subscale, and moderate correlations with the remaining subscales. The CL subscale showed significant, positive, and moderate to strong correlations with the PPL, PSL, and SRL subscales. The PPL subscale demonstrated moderate correlations with PSL, PEL, and SRL. The PEL subscale also showed moderate, positive correlations with all other subscales. The SRL subscale was significantly and positively correlated with all subscales, particularly with CL and PSL. Furthermore, all subscales demonstrated strong, positive correlations with the full FMLS score, with PL and CL showing the highest correlations, indicating that each dimension contributes meaningfully to the overall measure of mental load. These findings support the multidimensional structure of the FMLS and suggest good internal consistency among its subscales.

Establishing Construct Validity

Convergent and discriminant validity methods were employed to establish the scale's construct validity, ensuring that related constructs were appropriately correlated (convergent validity) and that distinct constructs remained sufficiently differentiated (discriminant validity).

Table 7

Pearson's Correlation Between FMLS and K-10 Subscales for Convergent Validity in Sample G (N=60)

Subscales	F1	F2	F3	F4	F5	F6	K-10
F1 Psychological Load	-						
F2 Cognitive Load	.74**	-					
F3 Psychophysiological Load	.51**	.54**	-				
F4 Psychosocial Load	.63**	.68**	.40**	-			
F5 Psychoemotional Load	.57**	.49**	.34**	.33*	-		
F6 Social Responsibility Load	.39**	.67**	.36**	.42**	.40**	-	
K10	.46**	.29*	.37**	.28*	.34**	.13	-

Note: *p< .05, **p< .01, ***p < .001

To assess convergent validity, the K-10 was used. The K-10 measures general psychological distress and has been widely validated as a sensitive indicator of anxiety and depressive symptoms. These two FMLS subscales are theoretically relevant to an extent, as they capture cognitive and physiological burdens that often co-occur with elevated psychological stress. The table shows that Pearson's correlation analysis was conducted to examine the convergent validity of the Forman Mental Load Scale. K-10 scores showed significant positive correlations with Psychological Load, r = .46, p < .01; Cognitive Load, r = .29, p < .05; Psychophysiological Load, r = .37, p < .01; Psychosocial Load, r = .28, p < .05; and Psychoemotional Load, r = .34, p < .01. The correlation with Social Responsibility Load was weak and non-significant, r = .13, p > .05. Overall, the findings supported the convergent validity of five FMLS subscales, whereas convergent validity was not supported for the Social Responsibility Load subscale.

Table 8

Pearson's Correlation Between FMLS and SHS Subscales for Discriminant Validity in Sample G (N=60)

Subscales	F1	F2	F3	F4	F5	F6	SHS
F1 Psychological Load	-						
F2 Cognitive Load	.74**	-					
F3 Psychophysiological Load	.51**	.54**	-				
F4 Psychosocial Load	.63**	.68**	.40**	-			
F5 Psychoemotional Load	.57**	.49**	.34**	.41**	-		
F6 Social Responsibility Load	.39**	.67**	.36**	.34**	.13	-	
SHS	-.46**	-.29*	-.37**	-.33*	-.02	-.52**	-

Note: *p< .05, **p< .01, ***p < .001

Discriminant validity was evaluated by examining the relationship between the Subjective Happiness Scale (SHS) and the subscales of the Forman Mental Load Scale (FMLS). The SHS measures overall subjective well-being and positive emotional states, which are theoretically distinct from the construct of mental load. Pearson's correlation analysis was conducted to examine the discriminant validity of the Forman Mental Load Scale. SHS scores showed significant negative correlations with Psychological Load, r = −.46, p < .01; Cognitive Load, r = −.29, p < .05; Psychophysiological Load, r = −.37, p < .01; Psychosocial Load, r = −.33, p < .05; and Social Responsibility Load, r = −.52, p < .01. The correlation with Psychoemotional Load was negligible and non-significant, r = −.02, p > .05. Overall, the inverse associations were theoretically consistent; however, the moderate correlations for Psychological Load and Social Responsibility Load indicate some overlap with subjective happiness. Therefore, the findings provide partial rather than complete support for discriminant validity.

Establishing Criterion Validity

To assess the criterion-related validity of the new scale, gender was used as the criterion variable, with two categories: male and female. Mean scores on the mental load scale were compared between these groups using an independent samples t-test.

Table 9

Mean, Standard Deviation, t value, significance, Lower Limit and Upper Limit of Confidence Interval and Cohen's d of Forman Mental Load Scale (N=402)

Note: *p< .05, **p< .01, ***p < .001, *n*= no. of participants, *M*= Mean, *SD*= Standard deviation, *LL*= Lower limit and *UL*= Upper limit. *FMLS_T*= Forman Mental Load Scale Total

No.	Male			Female			t	p	95% CI		Cohen's d
	n	M	SD	n	M	SD			LL	UL	
FMLS_T	170	151.02	31.26	232	160.00	28.49	-3.00	.003**	-14.87	-3.09	-.30

An independent samples t-test was conducted to compare scores between males and females. There was a significant difference in scores between males (M = 160.81, SD = 32.95) and females (M = 169.90, SD = 29.83); t (400) = -2.89, p = .004, d = 0.28. This suggests that females scored significantly higher on than males.

Reliability Analysis

Table 10

Internal Consistency of FMLS (N=402)

	Number of Items	α
FMLS (Initial)	48	.96
FMLS (Final – Post CFA)	46	.96

Note: FMLS = Forman Mental Load Scale; α = Cronbach's Alpha Coefficient

The internal consistency of the Forman Mental Load Scale (FMLS) was assessed using Cronbach's alpha. The scale consists of 48 items and yielded a high reliability coefficient of α = .96 in the current sample. The model was revised to 46 items after Confirmatory Factor Analysis CFA); the reliability coefficient remained the same at α = .96. This indicates excellent internal consistency, suggesting that the items within the FMLS are highly interrelated and consistently measure the construct of mental load.

Test-Retest Reliability of Forman Mental Load Scale

For the analysis, the Intra-Class Correlation Coefficient (ICC) was computed for Test Time 1 and Test Time 2.

Table 11

Intra-Class Correlation Coefficient (ICC) for Scores of First and Second Administration of FMLS (N=60)

	ICC	LB	UB
FMLS (Average Measure)	.97	.95	.98

Note = *p< .05, **p< .01, ***p < .001 LB= Lower Bound, UB= Upper Bound

The ICC results of 0.97 indicate excellent test-retest reliability for the FMLS scores between the two administrations. The narrow confidence interval (0.95–0.98) reinforces the stability and consistency of the measurement. The results provide strong empirical support for the temporal stability of the FMLS, indicating that participants' scores remained highly consistent when the measure was repeated under similar conditions.

Establishing Cut-Off Scores

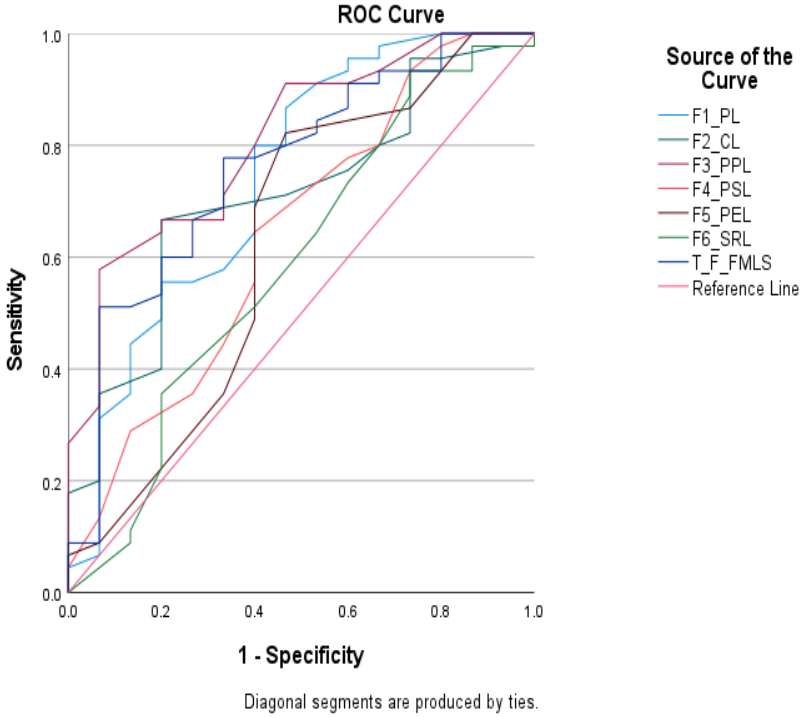

Figure 2. ROC Curve Explaining the Cutoff Structure of FLMS.

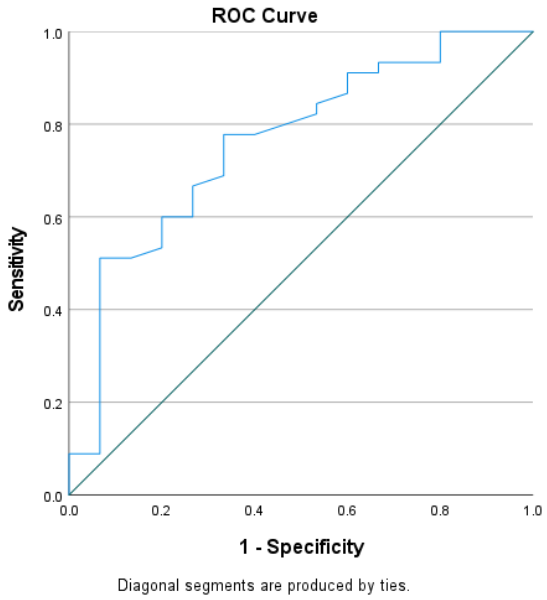

Table 12
Summary of ROC Analysis for Subscales of FMLS (N=60)

Subscales	AUC	SE	p	95% CI	
				LL	UL
F1 Psychological Load	.74	.08	.00**	.59	.90
F2 Cognitive Load	.71	.07	.02*	.56	.85
F3 Psychophysiological Load	.81	.06	.00***	.69	.93
F4 Psychosocial Load	.64	.09	.11	.47	.81
F5 Psychoemotional Load	.63	.09	.15	.44	.81
F6 Social Responsibility Load	.59	.09	.31	.41	.77
Forman Mental Load Scale (FMLS)	.74	.07	.00**	.62	.90

Note: *p< .05, **p< .01, ***p < .001 AUC = Area Under the Curve; SE = Standard Error; *p* = significance value; CI = Confidence Interval; LL = Lower Limit; UL = Upper Limit.

ROC curve analysis demonstrated that the Forman Mental Load Scale (FMLS) showed acceptable discriminatory ability (AUC = .761, 95% CI [.619, .902], *p* = .003). The optimal cut-off score, determined using Youden's Index, was ≥ 144, yielding a sensitivity of 77.8% and a specificity of 66.7%.

Table 13
Cut-off Scores for Each Subscale on FMLS Based on the Youden Index (N=60)

	Optimal Threshold	Sensitivity	Specificity	Youden's Index
F1 Psychological Load	48.5	.91	.47	.38
F2 Cognitive Load	29.5	.80	.33	.13
F3 Psychophysiological Load	11.5	.91	.40	.31
F4 Psychosocial Load	15.5	.78	.33	.11
F5 Psychoemotional Load	8.5	.82	.53	.36
F6 Social Responsibility Load	15.5	.73	.40	.13
Forman Mental Load Scale (FMLS)	143.5	.78	.67	.45

Note: *p< .05, **p< .01, ***p < .001

Youden's Index was used to identify the optimal cut-off scores for the Forman Mental Load Scale (FMLS) and its subscales. The total FMLS demonstrated the highest overall diagnostic performance, with an optimal cut-off score of ≥ 144 (Youden's Index = .45).

Confirmatory Factor Analysis

Confirmatory Factor Analysis (CFA) is conducted to test whether the hypothesized factor structure of a set of observed variables.

Table 14
Model Fit Indices of Confirmatory Factor Analysis for FMLS in Sample H (N=260)

Model	χ^2	Df	GFI	CFI	NFI	RMSEA
Model Fit	1560.97	947	.80	.91	.80	.05

Note: GFI = Goodness of fit index; CFI = Comparative fit index; NFI = Normative Fit Index; RMSEA = Root Mean Square error of approximation; *df*= Degree of Freedom; χ^2 = chi-square

The results of the Confirmatory Factor Analysis (CFA) for the FMLS (N = 260) indicate an acceptable model fit. The chi-square to degrees of freedom ratio (χ^2/Df ≈ 1.65) falls within the

acceptable range. The Comparative Fit Index (CFI = .91) and the Root Mean Square Error of Approximation (RMSEA = .05) both meet recommended thresholds, indicating good model fit. However, the Goodness-of-Fit Index (GFI = .80) and the Normative Fit Index (NFI = .80) do not meet recommended thresholds. Collectively, these results suggest that the model demonstrates a reasonably good fit to the data.

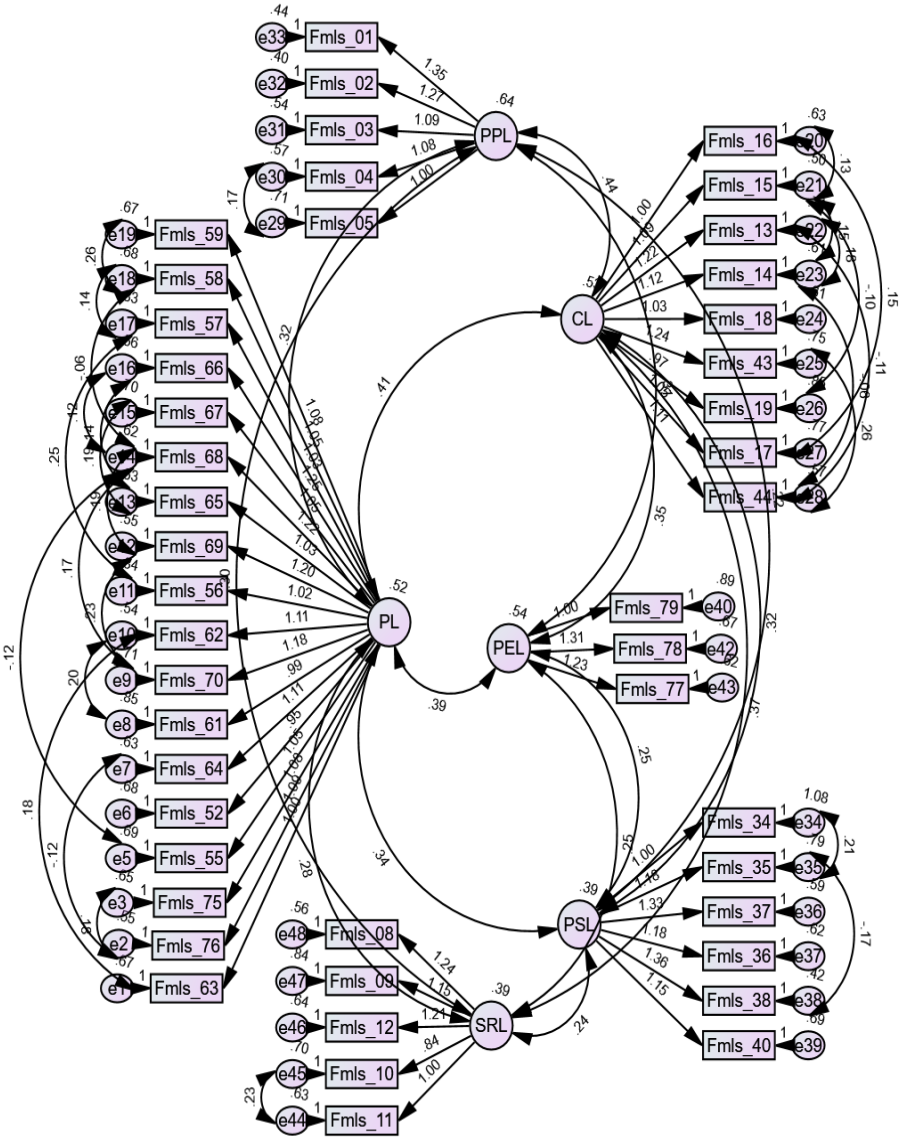

Figure 3. Confirmatory Factor Analysis through Model Fit Assessment

Discussion

The present study aimed to develop and psychometrically validate the Forman Mental Load Scale (FMLS) as an indigenous instrument for assessing mental load among Pakistani young adults. The findings provide strong support for the reliability and validity of the scale and demonstrate that mental load is a multidimensional construct comprising Psychological Load, Cognitive Load, Psychophysiological Load, Psychosocial Load, Psychoemotional Load, and Social Responsibility Load. The six-factor solution identified through Exploratory Factor Analysis (EFA) and subsequently supported through Confirmatory Factor Analysis (CFA) is consistent with the conceptual framework proposed in the current study and extends previous conceptualizations of mental load beyond purely cognitive processes to include emotional, physiological, and social dimensions (Sweller, 1988).

The EFA produced a stable six-factor structure accounting for 53.55% of the total variance, indicating that mental load among Pakistani university students consists of several interrelated yet distinct domains. This finding supports previous literature suggesting that mental load is a multidimensional phenomenon rather than a unitary construct. Mental load is influenced by cognitive, emotional, and physiological demands and recommended the development of comprehensive assessment instruments Díaz-García et al. (2021). Similarly mental load was described as an interaction of cognitive and emotional labor that extends across academic, occupational, and family settings Dean et al. (2021). The emergence of Social Responsibility Load as an independent factor in the present study further highlights and emphasises on the importance of incorporating culturally relevant factors Pakistani society, where family obligations and interpersonal expectations contribute substantially to everyday mental burden.

The reliability analyses demonstrated excellent psychometric performance of the FMLS. The overall internal consistency remained $\alpha = .96$ before and after CFA, indicating that the items consistently measure the underlying construct while maintaining high homogeneity. Cronbach's alpha values above .90 indicate excellent internal consistency during scale development DeVellis (2017). Furthermore, the test–retest reliability coefficient (ICC = .97) demonstrated outstanding temporal stability, suggesting that the FMLS yields highly consistent scores across repeated administrations. These findings indicate that the scale can be confidently used in both research and clinical settings for the assessment of mental load.

Furthermore, the Construct validity was supported through convergent and discriminant validity analyses. As expected, the FMLS showed significant positive correlations with the Kessler Psychological Distress Scale (K-10), indicating that higher mental load was associated with greater psychological distress, consistent with previous research (Díaz-García et al., 2021; Subramanyam et al., 2013). However, the Social Responsibility Load subscale was not significantly associated with psychological distress, possibly reflecting the cultural normalization of family and caregiving responsibilities among Pakistani young adults. Discriminant validity was demonstrated through significant negative correlations with the Subjective Happiness Scale (SHS), suggesting that greater mental load is associated with lower subjective well-being. Although the Psychoemotional Load subscale showed a negligible association with subjective happiness, overall findings provide satisfactory evidence for the construct validity of the FMLS.

The moderate to strong positive intercorrelations among all six FMLS subscales further support the multidimensional conceptualization of mental load. While each dimension reflects a unique aspect of the construct, their significant associations indicate that psychological, cognitive,

emotional, physiological, and social demands interact to influence an individual's overall mental burden. This finding is consistent with Cognitive Load Theory, which proposes that multiple sources of cognitive demand collectively influence performance and adaptation (Sweller, 1988), while also supporting more recent perspectives that conceptualize mental load as an interaction between cognitive, emotional, and contextual demands (Dean et al., 2021).

The present study revealed significant gender differences, with females having relatively higher mental load than males. This finding is consistent with previous research suggesting that women experience greater cognitive and emotional burden due to increased caregiving, household, and emotional responsibilities (Dean et al., 2021; Haupt & Gelbgiser, 2023; Klasnić, 2023; Reich-Stiebert et al., 2023). In the Pakistani context, traditional gender roles may further contribute to these differences. The ability of the FMLS to detect these expected gender differences provides additional support for its criterion validity.

The ROC analysis further demonstrated the practical utility of the FMLS by establishing an optimal cutoff score with acceptable sensitivity and specificity for identifying individuals experiencing elevated mental load. These findings suggest that the scale may serve as an effective screening instrument for identifying university students who may benefit from psychological support or early intervention. Consequently, the FMLS has potential applications in university counselling centres, mental health services, and future researches investigating mental load among young adults.

Overall, the findings demonstrate that the Forman Mental Load Scale (FMLS) is a reliable, valid, and culturally appropriate instrument for assessing multidimensional mental load among Pakistani emerging adults. By addressing the limitations of existing measures developed in the West and incorporating culturally relevant dimensions of mental load, the FMLS represents an important contribution to indigenous psychological assessment. The scale provides researchers and mental health professionals with a comprehensive tool for identifying mental load, facilitating early psychological screening, and informing interventions aimed at improving mental well-being among young adults in Pakistan.

Conclusion

The development of the Forman Mental Load Scale (FMLS) represents a significant contribution to indigenous psychological assessment by providing a culturally relevant instrument for measuring multidimensional mental load among Pakistani emerging adults. The scale was developed and validated through a rigorous two-phase process involving Exploratory Factor Analysis (EFA) followed by Confirmatory Factor Analysis (CFA), which supported its six-factor structure. The findings demonstrated excellent internal consistency, strong test–retest reliability, satisfactory evidence of validity, and an acceptable model fit, indicating that the FMLS possesses sound psychometric properties. The inclusion of culturally relevant dimensions enhances the ecological validity of the instrument and makes it well suited for assessing mental load within the Pakistani context. The FMLS has potential applications in psychological research, educational settings, clinical practice, and mental health screening, while future studies should evaluate its applicability across more diverse populations and longitudinal settings.

Implications

The following are some theoretical, practical, and societal implications of the current research:

- Supports the expansion of Cognitive Load Theory into real-life academic contexts beyond laboratory-controlled settings.
- Proposes a new multidimensional model of mental load specific to university settings that can be integrated into educational psychology frameworks.
- Universities can design targeted mental health and academic counselling services to address specific dimensions of mental load.

- Interventions can be developed to equip students with better prioritization and coping strategies.
- Interventions that mitigate student mental load may lead to better-prepared and psychologically resilient graduates.

Study Limitations

Despite the study's strengths, some limitations as well:

- The Forman mental load scale is a newly developed construct, and no prior validated scale exists for comparison.
- The sample primarily included university students from a specific cultural and educational background, limiting generalizability.
- Minimum ratio to sample size Confirmatory Factor Analysis (CFA) was used.
- Participants' responses may be influenced by social desirability bias or recall bias.
- The scale has not yet been tested across diverse educational or cultural populations.
- Time constraints during the study limited the breadth of data collection and depth of analysis, potentially affecting the generalizability of the findings and the refinement of the scale's model fit.

Recommendations for Future Research

- Conduct longitudinal studies to examine the stability of mental load over time.
- Test the FMLS across diverse cultural and educational contexts for cross-cultural validation.

Acknowledgements

The authors gratefully acknowledge the students who participated in the study and the academic experts who contributed to the evaluation of the scale items.

Funding Information

This research was done solely for academic proposes and was a part MS Clinical Psychology Thesis. It received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

Conflict-of-Interest Statement

The authors declare that they have no conflicts of interest related to this research.

REFERENCES

Bartlett, M. S. (1954). A note on the multiplying factors for various χ^2 approximations. *Journal of the Royal Statistical Society: Series B (Methodological), 16*(2), 296–298. https://www.jstor.org/stable/2984057

Bonnie, R. J., Stroud, C., Breiner, H., & Families, B. O. C. Y. A. (2015, January 27). *Introduction*. Investing in the Health and Well-Being of Young Adults - NCBI Bookshelf. https://www.ncbi.nlm.nih.gov/books/NBK284791/#:~:text=Young%20adulthood%2C%20spanning%20approximately%20ages,and%20engaged%20members%20of%20the

Carpenter, S. (2017). Ten Steps in scale Development and Reporting: a guide for researchers. Communication Methods and Measures, 12(1), 25 44. https://doi.org/10.1080/19312458.2017.1396583

Chandler, P., & Sweller, J. (1991). Cognitive load Theory and the format of instruction. *Cognition and Instruction*, *8*(4), 293–332. https://doi.org/10.1207/s1532690xci0804_2

Chen, B., Hwang, G.-H., & Wang, S.-H. (2021). Gender Differences in Cognitive Load when Applying Game-Based Learning with Intelligent Robots. *Educational Technology & Society*, *24*(3), 102–115. https://www.jstor.org/stable/27032859

Daminger, A. (2019). The cognitive dimension of household labor. *American Sociological Review*, *84*(4), 609–633. https://doi.org/10.1177/0003122419859007

Dean, L., Churchill, B., & Ruppanner, L. (2021). The mental load: building a deeper theoretical understanding of how cognitive and emotional labor over load women and mothers. *Community Work & Family*, *25*(1),

13–29. https://doi.org/10.1080/13668803.2021.2002813

DeVellis, R. F. (2017). Scale Development Theory and Applications (4th ed.). Thousand Oaks, CA Sage. - References - Scientific Research Publishing. (n.d.-b). https://www.scirp.org/reference/referencespapers?referenceid=2323603

Díaz-García, J., González-Ponce, I., Ponce-Bordón, J., López-Gajardo, M., Ramírez-Bravo, I., Rubio-Morales, A., & García-Calvo, T. (2021). Mental Load and Fatigue Assessment Instruments: A Systematic review. *International Journal of Environmental Research and Public Health*, *19*(1), 419. https://doi.org/10.3390/ijerph19010419

Febiyani, A., Febriani, A., & Ma'sum, J. (2021). Calculation of mental load from e-learning student with NASA TLX and SOFI method. *Jurnal Sistem Dan Manajemen Industri*, *5*(1), 35–42. https://doi.org/10.30656/jsmi.v5i1.2789

Galy, E., Cariou, M., & Mélan, C. (2011). What is the relationship between mental workload factors and cognitive load types? *International Journal of Psychophysiology*, *83*(3), 269–275. https://doi.org/10.1016/j.ijpsycho.2011.09.023

Goode, W. J. (1960). A theory of role strain. *American Sociological Review, 25*(4), 483–496. https://doi.org/10.2307/2092933

Gulzar, S., Yahya, F., Nauman, M., Mir, Z., & Mujahid, S. (2012). *Frustration among University Students in Pakistan*. https://www.semanticscholar.org/paper/Frustration-among-University-Students-in-Pakistan-Gulzar-Yahya/4639c2383f164bf64989752e6fd966e0e7f10a62

Haji, F. A., Rojas, D., Childs, R., De Ribaupierre, S., & Dubrowski, A. (2015). Measuring cognitive load: performance, mental effort and simulation task complexity. *Medical Education*, *49*(8), 815–827. https://doi.org/10.1111/medu.12773

Hart, S. G., & Staveland, L. E. (1988). Development of NASA-TLX (Task Load Index): Results of empirical and theoretical research. In *Advances in psychology* (pp. 139–183). https://doi.org/10.1016/s0166-4115(08)62386-9

Haupt, A., & Gelbgiser, D. (2023). The gendered division of cognitive household labor, mental load, and family–work conflict in European countries. *European Societies*, *26*(3), 828–854. https://doi.org/10.1080/14616696.2023.2271963

Hidayat, V., Sumin, S., Kartowagiran, B., & Ayriza, Y. (2022). A Multidimensional Concept of Mental Workload: A Systematic Review. *Journal of Educational Health and Community Psychology*, *11*(4), 833. https://doi.org/10.12928/jehcp.v11i4.24203

Hsieh, Y. H., & Tsai, C. C. (2011). *The relationships among science-related major student's information commitment, mental load and mental effort*. National Taiwan Normal University. https://scholar.lib.ntnu.edu.tw/en/publications/the-relationships-among-science-related-major-students-informatio-2

Hu, L. T., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling, 6*(1), 1–55. https://doi.org/10.1080/10705519909540118

Hutmacher, F. (2021). Putting stress in historical context: Why it is important that being stressed out was not a way to be a person 2,000 years ago. *Frontiers in Psychology*, *12*. https://doi.org/10.3389/fpsyg.2021.539799

Kaiser, H. F. (1974). An index of factorial simplicity. *Psychometrika*, *39*(1), 31–36. https://doi.org/10.1007/BF02291575

Kalsbeek, J., & Sykes, R. (1967). Objective measurement of mental load. *Acta Psychologica*, *27*, 253–261. https://doi.org/10.1016/0001-6918(67)90066-2

Kalyuga, S. (2009). Knowledge elaboration: A cognitive load perspective. *Learning and Instruction*, *19*(5), 402–410. https://doi.org/10.1016/j.learninstruc.2009.02.003

Kessler, R. C., Barker, P. R., Colpe, L. J., Epstein, J. F., Gfroerer, J. C., Hiripi, E., Howes, M. J., Normand, S. T., Manderscheid, R. W., Walters, E. E., & Zaslavsky, A. M. (2003). Screening for serious mental illness in the general population. *Archives of General Psychiatry*, *60*(2), 184. https://doi.org/10.1001/archpsyc.60.2.184 *Copyright © World Health Organization 2003*

Klasnić, K. (2023). *Exploring Gender Inequalities in Mental Load: A Croatian Household Study on Mental Tasks with the Largest Gender Gap*. https://www.croris.hr/crosbi/publikacija/prilog-casopis/823536

Lazarus, R. S., & Folkman, S. (1984). *Stress, appraisal, and coping*. Springer.

Leiter, M. P., & Maslach, C. (2016). Latent burnout profiles: A new approach to understanding the burnout experience. *Burnout Research*, *3*(4), 89–100. https://doi.org/10.1016/j.burn.2016.09.001

Luthra, R., & Haux, T. (2022). The mental load in separated families. *Journal of Family Research*, *34*(2), 669–696. https://doi.org/10.20377/jfr-743

Lynn, M. R. (1986). Determination and quantification of content validity. *Nursing Research*, 35(6), 382–385. https://doi.org/10.1097/00006199-198611000-00017

Lyubomirsky, S., & Lepper, H. S. (1999). A measure of subjective happiness: Preliminary reliability and construct validation. Social Indicators Research, 46, 137-155.

Mayer, R. E., & Moreno, R. (2003). Nine ways to Reduce Cognitive Load in Multimedia Learning. *Educational Psychologist*, *38*(1), 43–52. https://doi.org/10.1207/s15326985ep3801_6

Minkley, N., Kärner, T., Jojart, A., Nobbe, L., & Krell, M. (2018). Students' mental load, stress, and performance when working with symbolic or symbolic–textual molecular representations. *Journal of Research in Science Teaching*, *55*(8), 1162–1187. https://doi.org/10.1002/tea.21446

Mir, S. R. (2024). Exploring the impact of mental workload on performance the role of working memory. https://doi.org/10.31234/osf.io/hkn4t

Misra, R., & McKean, M. (2000). College students' academic stress and its relation to their anxiety, time management, and leisure satisfaction. *American Journal of Health Studies, 16*(1), 41–51.

Noreen, N., Ziaullah, Iqbal, W., Rahman, A., Khan, S., Shah, A., Iqbal, J., Bibi, A., & Sultan, A. (2023, September 30). *Determinants of Stress and Its Association with Academic Performance of Undergraduate Students of Nursing in Pakistan*. https://poverty.com.pk/index.php/Journal/article/view/148

Nunnally, J. C., & Bernstein, I. H. (1994). *Psychometric theory* (3rd ed.). McGraw-Hill.

Paas, F. G. W. C., & Van Merriënboer, J. J. G. (1994). Instructional control of cognitive load in the training of complex cognitive tasks. *Educational Psychology Review*, 6(4), 351–371. https://doi.org/10.1007/bf02213420

Paas, F., Van Gog, T., & Sweller, J. (2010). Cognitive Load Theory: New conceptualizations, specifications, and Integrated research perspectives. *Educational Psychology Review*, *22*(2), 115–121. https://doi.org/10.1007/s10648-010-9133-8

Pascoe, M. C., Hetrick, S. E., & Parker, A. G. (2020). The impact of stress on students in secondary school and higher education. *International Journal of Adolescence and Youth*, *25*(1), 104–112. https://doi.org/10.1080/02673843.2019.1596823

Reich-Stiebert, N., Froehlich, L., & Voltmer, J. (2023). Gendered Mental Labor: A

systematic literature review on the cognitive dimension of unpaid work within the household and childcare. *Sex Roles*, *88*(11–12), 475–494. https://doi.org/10.1007/s11199-023-01362-0

Riese, H. (1999). Mental Fatigue after Very Severe Closed Head Injury: Sustained Performance, Mental Effort, and Distress at Two Levels of Workload in a Driving Simulator. *Neuropsychological Rehabilitation*, *9*(2), 189–205. https://doi.org/10.1080/713755600

Roman-Liu, D., Grabarek, I., Bartuzi, P., & Choromański, W. (2013). The influence of mental load on muscle tension. *Ergonomics*, *56*(7), 1125–1133. https://doi.org/10.1080/00140139.2013.798429

Rubio-Valdehita, S., López-Higes, R., & Díaz-Ramiro, E. (2014). Academic context and perceived mental workload of psychology students. *The Spanish Journal of Psychology*, *17*. https://doi.org/10.1017/sjp.2014.57

Sanders, A. F. (1979). Some remarks on mental load. In *Springer eBooks* (pp. 41–77). https://doi.org/10.1007/978-1-4757-0884-4_5

Schnaubert, L., & Schneider, S. (2022). Analysing the relationship between mental load or mental effort and metacomprehension under different conditions of multimedia design. *Frontiers in Education*, *6*. https://doi.org/10.3389/feduc.2021.648319

Shaikh, B., Kahloon, A., Kazmi, M., Khalid, H., Nawaz, K., Khan, N., & Khan, S. (2004). Students, stress and Coping Strategies: A case of Pakistani medical school. *Education for Health*, *17*(3), 346–353. https://doi.org/10.1080/13576280400002585

Sharma, B., Kumar, A., & Sarin, J. (2016). Academic stress, anxiety, and depression among college students: A brief review. *Indian Journal of Health and Wellbeing*, 7(5), 519–523.

Subramanyam, M., Muralidhara, P., & Muralidhara, P. (2013, May 21). *Mental Workload and Cognitive Fatigue: a study*. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2267649

Sweller, J. (1988). Cognitive load during problem solving: Effects on learning. *Cognitive Science*, *12*(2), 257–285. https://doi.org/10.1207/s15516709cog1202_4

Sweller, J. (2011). Cognitive Load Theory. *The psychology of learning and motivation* (pp. 37–76). https://doi.org/10.1016/b978-0-12-387691-1.00002-8

Sweller, J., & Chandler, P. (1994). Why some material is difficult to learn. *Cognition and Instruction*, *12*(3), 185–233. https://doi.org/10.1207/s1532690xci1203_1

Tan, S., & Yip, A. (2018). Hans Selye (1907–1982): Founder of the stress theory. *Singapore Medical Journal*, *59*(4), 170–171. https://doi.org/10.11622/smedj.2018043

van Hooff, M. L. M., & Geurts, S. A. E. (2014). The role of gender in the relationship between mental load and well-being. *Work & Stress*, *28*(3), 288–305. https://doi.org/10.1080/02678373.2014.922259

Van Merriënboer, J. J. G., & Sweller, J. (2005). Cognitive Load Theory and complex Learning: recent developments and future directions. *Educational Psychology Review*, *17*(2), 147–177. https://doi.org/10.1007/s10648-005-3951-0

Vasile, C., Marhan, A., Singer, F. M., & Stoicescu, D. (2011). Academic self-efficacy and cognitive load in students. *Procedia - Social and Behavioral Sciences*, *12*, 478–482. https://doi.org/10.1016/j.sbspro.2011.02.059

Victorian Population Health Survey. Melbourne: Department of Human Services, Victoria; 2001.

Vitellozzi, S., Cecchi, F., & Rapallini, C. (2024). The Invisible Family Load: Mental Load and the Gender Earnings Gap in Kenya. *Social Science Research Network*. https://doi.org/10.2139/ssrn.4731717

Wei, Z., Macwan, A. P., & Wieringa, P. A. (1998). A quantitative measure for degree of automation and its relation to system performance and mental load. *Human Factors the Journal of the Human Factors and Ergonomics Society*, *40*(2), 277–295. https://doi.org/10.1518/001872098779480406

Xie, Y. J., Cao, D., & Li, Y. (2022). A multidimensional perspective on mental load: Cognitive, emotional, and social components. *Frontiers in Psychology*, *13*, 879156. https://doi.org/10.3389/fpsyg.2022.879156

Zoer, I., Ruitenburg, M., Botje, D., Frings-Dresen, M., & Sluiter, J. (2011). The associations between psychosocial workload and mental health complaints in different age groups. *Ergonomics*, *54*(10), 943–952. https://doi.org/10.1080/00140139.2011.606920