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Who merits more concern: university teachers under task-related or those under interpersonal-related stress?

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The present study aims to explore group types of job stress in university teachers in China. Utilizing an indigenously developed university teachers' job stress scale in China alongside other tools, a survey was conducted on 1988 teachers from 22 Chinese higher education institutions from a person-oriented perspective. Stratified cluster random sampling and K-means clustering techniques were employed to derive a classification model for job stress among university educators. According to job stress characteristics, Chinese university teachers were classified into six significantly heterogeneous groups: relatively high stress, task-related stress, relatively low stress, interpersonal-related stress, extremely low stress, and extremely high stress. The average job burnout and job satisfaction scores of the different groups exhibited varying features. In general, the extremely high stress group should be the most concerned, whereas university teachers with mid-level stress merit less attention. But the medium-stress group was further subdivided. University teachers under task-related stress have more stress-related consequences than those of university teachers under interpersonal-related stress. There are significant differences in the distribution of university teachers' job stress group types across demographic groups defined by gender and university types. University administrators should focus on university teachers under task-related stress. This classification model offers direct references for the stress management and psychological aid of university teachers.

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Introduction

In 1999, China expanded universities and university enrollments, and the number of university students increased substantially. This expansion caused certain difficulties in teaching. University teachers need to take on more work. They were held to a higher standard and their profession afforded certain values both for themselves and society. With increased expectation of academic specialization among university teachers, the stress on teachers is increasingly evident in China (Li, 2006). In addition, higher education expansion drives China's higher education reform into a new phase also have contributed to university teachers' job stress.

Job stress refers to the physical, psychological, and behavioral side effects of the work process, interactions among individuals, and work-related factors (Hu et al. 2009). Individuals working ability and learning ability were all reduced under high stress(-Sterkens et al. 2021).Job stress can lead to physical and psychological disorders (Pan and Wang, 2006), thus reducing individual work efficiency and interest and inducing a lack of initiative and responsibility (Wang et al. 2012), subsequently negatively influencing the organization through work dissatisfaction and high turnover rates (Liu and Wang, 2009). At present, there are many studies on the current situation of teachers' job stress. Zhu et al. (2020) found that Chinese teachers in private colleges and universities in Shandong Province experience high levels of job stress. Fisher's survey of young teachers in England's universities showed that job stress is a common phenomenon in their lives, because they are trying to do well in teaching and scientific research and achieve good results (Fisher, 2017). Zeng and Song (2013) also found that university teachers directly participate in teaching activities and experience teaching pressure. Teaching is a profession with a high level of stress, and the excessive stress is not only detrimental to physical and mental health, but may also have a negative impact on students' health, well-being and educational achievement(Naghieh et al. 2015). At universities, 52% of the teachers reported that "workload was too heavy because of the insufficient number of teachers" and that nearly 60% experienced "great pressure" (Guo, 2008). Furthermore, owing to the distinctive nature of teachers' work, university teachers' job stress not only exerts detrimental effects on their physical and mental well-being but also undermines their work performance. In 2018, Min emphasized that academic professional stress, stemming from various negative influences, can lead to more severe consequences, notably long-term job burnout. This manifestation is characterized by a lack of enthusiasm for work, feelings of rejection, and even the onset of severe physical and mental health issues. Ultimately, such stress undermines individual academic vitality and potentially triggers the migration of internal talent, thereby exerting a significant impact on the sustainable development of universities(Min, 2018). Therefore, it's important to study Chinese university teachers' job stress and provide the related scientific evidence and intervention suggestions.

Existing research on teachers' job stress primarily focuses on its structure and the relationships between job stress and other variables. Zhang et al. (2020) revealed that academic research is the primary source of job stress among Chinese university teachers, both in terms of severity and impact ratio. Related studies have shown that university teachers' job stress does not effectively promote an increase in scientific research output (Bao and Wang, 2012). Under the "double first-class" evaluation system(world-class universities and disciplines), university teachers generally experience high job stress, which has a negative impact on paper publication and scientific research output (Huang, 2021; Zhao and Hu, 2024). The job stress faced by teachers can negatively predict their physical and mental health to a certain extent, and there are significant differences in interpersonal sensitivity and other symptoms among teachers with different levels of mental health (Lu et al. 2021). Job burnout and job satisfaction are two important variables in the study of teachers' job stress. The Job Demands-Resources(JD-R) model proposes that job characteristics can be categorized into job demands and job resources, which serve as precursors to job burnout and engagement. Furthermore, this model assumes the existence of two distinct underlying psychological processes in the workplace: a health impairment process that may culminate in burnout, and a motivational process that can foster work engagement and organizational commitment (Hu et al. 2016). Through the mediating roles of burnout and work engagement, job demands and job resources have been empirically demonstrated to influence various other facets of employee functioning (Van den Broeck et al. 2013), including job satisfaction (Martinussen et al. 2007).

Job burnout is a long-term response to chronic emotional and interpersonal stressors at work, defined by three dimensions of depersonalization, emotional exhaustion, reduced personal accomplishment(Maslach et al. 2001). Teacher burnout refers to a long-term inability to adjust to job stress, leading to physical, emotional, and mental exhaustion and a gradual loss of enthusiasm for work (Pu et al. 2017). Studies have found that job stress is a predictive factor of job burnout. As a helping profession, teachers are more prone to emotional exhaustion and the development of job burnout under high job stress (Wu et al. 2003), meaning that higher levels of job stress are more likely to result in job burnout (Wang and Liu, 2020). Related research showed chronic stress over a long period of time tends to produce job burnout(Vasile, 2011). Job burnout was positively correlated with job stress, but negatively correlated with perceived social support (Kelley, Diane, & Gill, 1993; Betty and Diane, 1993; Wang and Gan, 2003; Wu et al. 2021). After controlling for gender, marital status, position, and teaching experience, teachers' job stress was found to be a significant predictor of job burnout (Zhang et al. 2022).

Job satisfaction refers to the attitude or emotional response of workers towards the job itself, its psychological and physiological aspects. It can also be termed as the sense of fulfillment experienced by workers, representing their subjective reaction to the work situation (Miembazi and Qian, 2017). The job stress of primary and secondary school teachers can directly affect job burnout and also indirectly through job satisfaction (Zhang et al. 2014). Job stress not only directly affects the job burnout of primary and secondary school teachers but also influences job burnout through the chain mediation of emotional labor and job satisfaction (Li et al. 2022). Empirical evidence suggests that job stress exerts an influence on psychological health via the mediating effect of job satisfaction (Pan et al. 2010). However, teacher stress predicted job satisfaction directly in all the above studies.

In addition, research necessities have led to the development of several stress-related instruments with different dimensions. For example, Cooper et al. (2000) prepared the second edition of work pressure indicators, which consists of 55 items covering sources of stress, stress management strategies, mental health, physical health, and job satisfaction. Vagg and Spielberger (1998) established a job stress questionnaire covering 20 stressful work events. Valencia Eustress Distress Assessment Scale, a measuring tool developed by Fabio et al. (2018) can measure both positive and negative stress at the same time, containing 42 questions and five factors in total. International studies on job stress types have generally covered such aspects as limited development potential, a lack of control, learned helplessness, and lack of information (Davis and Eshelman, 2000). Numerous job stress questionnaires are based on Rice's Job Stress Scale. Considering the cultural differences between the East and the West, as well as concerns

such as the validity of the measurement instrument, we indigenously developed the Universityteachers' job stress Scale and employed it to measure universityteachers' job stress.

In terms of research content, although scholars have rich research on teachers' job stress, the previous research on the university teachers' job stress mostly focused on independent variables and dependent variables of teachers' job stress, while rarely studying the group types of university teachers' job stress(Liang and Bautista, 2021). In terms of research methods, previous studies have mostly used factor analysis and related studies, both of which are variable-oriented and ignore the heterogeneity of individuals. Factor analysis can explain only the internal structure of job stress, and related research focuses only on the associations between job stress and other variables. Both factor analysis and related research, are variable oriented, have defects, and cannot distinguish groups of job stress in university teachers. Most empirical research is variable-oriented and ignores individual heterogeneity (Liu, 2009). Variable-oriented empirical research is based on the proposition that populations are homogeneous, whereas person-oriented research is based on the propositions that distinct subgroups may exist and that if they do, aggregate-level parameters may contradict parameters estimated for groups or individuals (Von Eye and Bogat, 2006). In psychological research, variables are the main analysis units. However, this approach has limitations: for example, variables and individual descriptions are difficult to translate into a single model (Bergman, 2000). Person-oriented analysis overcomes such drawbacks because the results account for individual information. To remedy the shortcomings of variable-oriented research, person-oriented studies have gradually been developed. Therefore person-oriented analysis is not just a shift in methodology (Zhang and Chen, 2020). On the theoretical level, it involves a different thinking about pursuiting individual goals, which will greatly affect the results of goals. It takes into account the interaction between individual and variable, so it can comprehensively measure the effect of multiple stressors on behavior in an individual, and provide more effective intervention measures for specific groups. For example, role stress in frontline bank employees was investigated through clustering (Arti and Jyoti, 2013). Similarly, clustering was applied to study stress effect patterns in hospital staff nurses (Joel et al. 1997). Research concerned with group types of job stress has been beneficial to understanding the characteristics of different groups of job stress. Previous studies have mostly classified job pressure as high and low (Zeng and Song, 2013). Determining which stress group should be more concerned is worth exploring.

Explore job stress in university teachers' group types and examines heterogeneity within the job stress groups. Only by understanding the job stress group types among university teachers can university administrators help them relieve their pressure. This person-oriented perspective offers pointed references for the stress management and psychological aid of university teachers. In summary, grounded in the theoretical framework of the Job Demands-Resources (JD-R) model, this research has utilized the K-means clustering approach as one of the person-oriented research methods to examine potential teacher subgroups based on distinct stressor combinations, subsequently exploring the associations between the identified subgroups and various outcome variables that pertain to the teaching profession. The study of group types of Chinese university teachers' job stress allows for a more accurate identification of the characteristics of teachers from different groups. This enables the design of more precise and effective pressure management and intervention measures tailored to these specific groups. Furthermore, investigating Chinese university teachers' group types can help uncover disparities in stress perception, burnout levels, and career satisfaction, ultimately providing valuable insights for the formulation of educational policies and promoting educational equity and teacher professional development.

Methods

Participants. To adapt to the complex population, enhance sample representativeness, 2000 university teachers from 22 Universities in China were recruited using stratified cluster random sampling, and 1988 valid questionnaires were obtained after excluding invalid questionnaires; 1020 teachers were male, 3 people are missing gender information. The professional title classification of the participants was as follows: 156 Senior, 568 Vice-Senior, 843 Intermediate, and 395 Junior, 26 people are missing from the professional title information. The university types were as follows: 4 ministerial universities and colleges (985, 211, double first-class) (240 teachers), 10 provincial universities and colleges (1204 teachers), and 8 municipal universities and colleges (544 teachers). "Project 985" refers to a first-class university with world-class standards(The Ministry of Education, 1998); "Project 211" refers to a construction project aimed at developing approximately 100 key universities and a group of key disciplines for the 21st century(State Planning Commission et al. 1995); "double first-class" refers to the development of world-class universities and disciplines(Ministry of Education et al. 2017). Ministerial universities and colleges refer to the institutions that are subordinate to the ministries and departments (units) of the State Council, most of them are key universities; Provincial universities and colleges refer to institutions that are subordinate to various provinces, autonomous regions, municipalities directly under the central government, and most of these universities rely on local financial support, with funds allocated by local administrative departments; Municipal universities and colleges refer to institutions established with funds allocated by municipal governments and managed by their respective educational departments, and these universities typically oversee the higher education endeavors within their respective municipal regions, providing talent support for local economic and social development(Wang et al. 2013). The age distribution of university teachers were as follows: under 30(658 teachers), 31–40(815 teachers), 41–50(383 teachers), 50 and above(112 teachers), 20 people are missing from the age information.

Instruments

University teachers' job stress scale. This scale measures job stress through 64 items rated on a 0–4 point scale (Wang et al. 2013). Nine factors were extracted through exploratory factor analysis. According to the meaning of the corresponding items, the nine factors were named as follows: leadership and organizational structure (LOS), interpersonal relationships (IR), career development (CD), workload (WL), work joylessness (WJ), work adjustment (WA), scientific research and promotion (SRP), students (ST), and family life (FL). The Cronbach's α coefficient for the scale was 0.97, and the Cronbach's α coefficients for each factor ranged from 0.63 to 0.93. Confirmatory factor analyses using AMOS 17.0, according to the recommendations of Wen (2004), revealed comparative fit indices (CFIs) exceeding 0.9 and a root mean square error of approximation (RMSEA) lower than 0.05, thus indicating that the model fit the data well. In this study, CFI = 0.913, TLI = 0.903, IFI = 0.914, NFI = 0.892, and RMSEA = 0.068. The factor loadings of LOS were between 0.609 and 0.737 (average = 0.698). The factor loadings of IR ranged between 0.520 and 0.707 (average = 0.646). The factor loadings of CD were between 0.604 and 0.685 (average = 0.643). The factor loadings of WL were between 0.602 and 0.673 (average = 0.639). The factor loadings of WJ ranged between 0.599 and 0.726

Table 1 Correlations among university teachers' job stress scale scores.

	JS	LOS	IR	CD	WL	WJ	WA	SRP	ST	FL
1JS	1									
2LOS	0.93**	1								
3IR	0.90**	0.76**	1							
4CD	0.85**	0.78**	0.65**	1						
5WL	0.93**	0.84**	0.81**	0.80**	1					
6WJ	0.82**	0.72**	0.78**	0.60**	0.71**	1				
7WA	0.71**	0.61**	0.57**	0.62**	0.65**	0.42**	1			
8SRP	0.74**	0.67**	0.56**	0.75**	0.72**	0.47**	0.61**	1		
9ST	0.77**	0.71**	0.69**	0.64**	0.69**	0.67**	0.42**	0.51**	1	
10FL	0.74**	0.63**	0.67**	0.58**	0.65**	0.71**	0.48**	0.48**	0.54**	1
M	1.71	1.76	1.53	1.93	1.75	1.42	1.92	1.98	1.68	1.64
SD	0.66	0.77	0.72	0.80	0.73	0.79	0.77	0.92	0.85	0.86

*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$, the same below; JS stands for the total score of the university teachers' job stress scale.

(average = 0.669). The factor loadings of WA were between 0.585 and 0.676 (average = 0.652). The factor loadings of SRP were between 0.658 and 0.747 (average = 0.698). The factor loadings of ST ranged between 0.683 and 0.745 (average = 0.733). The factor loadings of FL were between 0.524 and 0.681 (average = 0.605). Results show that the overall reliability and validity levels of the scale and all factors are high and acceptable, thus providing the basis for the clustering analysis.

The nine factors were applied to measure job stress from different perspectives:

- LOS consists of 14 items that focus on stress from the leadership and the organization. (The leadership does not care and does not pay attention to me)
- IR consists of 14 items regarding interpersonal stress. (I feel that the relationship among colleagues is indifferent)
- CD contains six items for measuring the stress associated with career development. (Academic requirements are continuously becoming higher)
- WL contains nine items concerning daily workload. (I need to complete my work in a limited time)
- WJ comprises six items for measuring joylessness. (I do not like teaching)
- WA comprises six items regarding stress associated with work adjustment. (School policies change frequently)
- SRP consists of three items that focus on the stress related to scientific research and promotion. (The evaluation of professional titles is linked to tasks and publications)
- ST contains three items that describe the stress induced by students. (Students do not respect or understand me)
- FL comprises three items concerning teachers' familial stress. (I always lack sleep)

University teachers' job burnout scale. Based on interviews of Chinese university teachers, we introduced a new dimension, scientific research exhaustion, which is applied to measure university teachers' negative feelings when they struggle to cope with research tasks (Wang et al. 2013) to the three dimensions in Maslach's theory of job burnout and indigenously developed the University Teachers' Job Burnout Scale. This scale measures job burnout through 37 items rated on a 0–4 point scale and contains four factors: depersonalization, reduced personal accomplishment, emotional exhaustion, and scientific research exhaustion. In this study, the Cronbach's α coefficients for the scale and these four factors were respectively 0.96, 0.94, 0.91, 0.89, and 0.92. In this study, CFI = 0.93, TLI = 0.92, IFI = 0.93, NFI = 0.915, and RMSEA = 0.05. The factor loadings of depersonalization ranged between 0.617 and 0.791 (average =0.693). The factor loadings of reduced personal accomplishment ranged between 0.671 and 0.837 (average = 0.758). The factor loadings of emotional exhaustion ranged between 0.573 and 0.765 (average = 0.706). The factor loadings of scientific research exhaustion ranged between 0.673 and 0.844 (average = 0.767). The results show that the reliability and validity levels of the scale and all factors are high and acceptable.

Job satisfaction scale. This study applied the revised Chinese version of the Job Satisfaction Scale to measure job satisfaction (Wang et al. 1993); it consists of 8 items rated on a 5-point scale (Wang et al. 2011). In this study, the Cronbach's α coefficient for the scale was 0.91. In this study, CFI = 0.939, TLI = 0.915, IFI = 0.939, NFI = 0.937, and RMSEA = 0.115. The results show that the reliability and validity levels of the scale are high and acceptable.

Results

Correlation analysis. Correlation analysis revealed significant correlations among the total score and each factor score of the university teachers' job stress scale (Table 1). The data conform to normal distribution and satisfy the requirements for K-means clustering.

K-means clustering. The K-means method was used to cluster the factors because of the large sample size (> 200). First, the optimal number of clusters was determined. Comparing the models with 2–7 clusters, we found small variations in extracting 2- to 5-cluster models and certain overlaps in the results of 7- and 6-cluster models. Considering this variation and the interpretability of the results, the 6-cluster model was chosen (Table 2). We verified the rationality of the clustering analysis by analyzing the variance of the average scores of different types of university teachers. The differences in all factors for the different types of university teachers were extremely significant. Moreover, the effect size (partial η^2) revealed that the results were highly practically significant. Ferguson (2009) summed the low, middle, and high parameter levels corresponding to the criteria of partial η^2 in the social sciences as 0.04, 0.25, and 0.64, respectively. A post hoc analysis revealed significant differences in the average scores of most factors among the different clusters, except those of LOS and IR between cluster 1 and cluster 4, SRP between cluster 2 and cluster 6, and FL between cluster 2 and cluster 3, indicating that almost all factors contributed significantly to the classification. Clusters 1–6 have 253, 218, 593, 388, 314, and 222 teachers, respectively, which is an approximately even distribution.

Table 2 Average scores and standard deviations of the nine factors for the six clusters in the Universityteachers' job stress Scale.

	cluster 1(253)		cluster 2(218)		cluster 3(593)		cluster 4(388)		cluster 5(314)		cluster 6(222)		F	Partial η^2
	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD		
LOS	2.07	0.40	2.18	0.53	1.43	0.38	2.05	0.33	0.65	0.41	2.94	0.46	1030.00***	0.72
IR	1.90	0.40	1.52	0.48	1.24	0.37	1.90	0.36	0.54	0.33	2.63	0.53	896.53***	0.69
CD	2.20	0.47	2.64	0.51	1.62	0.44	2.12	0.35	0.79	0.46	3.04	0.50	888.32***	0.69
WL	2.08	0.39	2.17	0.41	1.45	0.33	2.00	0.30	0.64	0.39	2.85	0.45	1181.00***	0.75
WJ	1.72	0.41	1.17	0.49	1.10	0.46	2.01	0.36	0.40	0.37	2.54	0.59	849.62***	0.68
WA	2.57	0.41	2.44	0.52	1.70	0.52	1.76	0.45	0.10	0.59	2.80	0.62	475.55***	0.55
SRP	2.30	0.58	3.01	0.61	1.65	0.60	2.04	0.47	0.79	0.61	3.04	0.61	611.85***	0.61
ST	1.68	0.48	1.87	0.73	1.39	0.53	2.22	0.48	0.58	0.50	2.84	0.62	564.32***	0.59
FL	2.31	0.55	1.38	0.58	1.31	0.57	2.04	0.52	0.61	0.49	2.78	0.59	577.72***	0.59

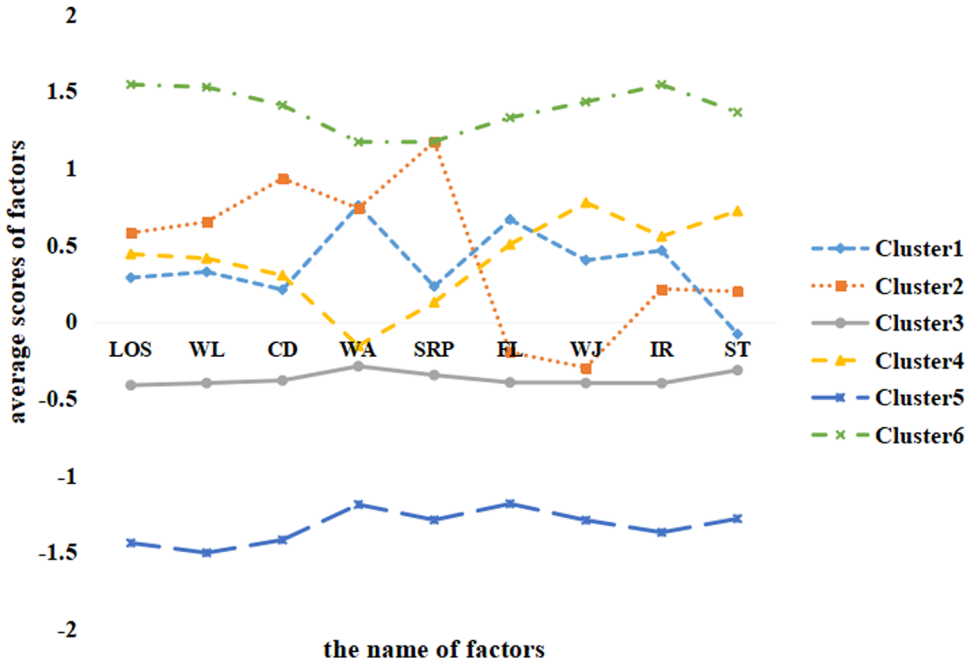

Fig. 1 Average scores for each factor among clusters. In Figure, cluster 1 = relatively high stress group, cluster 2 = task-related stress group, cluster 3 = relatively low stress group, cluster 4 = interpersonal-related stress group, cluster 5 = extremely low stress group, and cluster 6 = extremely high stress group.

The standardized average scores of each cluster for all factors are plotted in Fig. 1, where the central position represents zero. Among the nine factors, LOS, WL, CD, WA, and SRP are task-related and are applied to measure the pressure induced by the work. By contrast, FL, WJ, IR, and ST are interpersonal-related factors, which are used to measure the pressure induced by social interactions. From this perspective, cluster 6 was labeled "extremely high stress" (i.e., extremely high task- and interpersonal-related stress) because of the extremely above-average levels for each factor. Conversely, cluster 5 was labeled "extremely low stress" (i.e., extremely low task- and interpersonal-related stress) because of the extremely below-average levels for each factor. Similarly, university teachers with relatively high-average levels for each factor (cluster 1) were labeled "relatively high stress" (i.e., relatively high task- and interpersonal-related stress), and those with relatively below-average levels for each factor (cluster 3) were labeled "relatively low stress" (i.e., relatively low task- and interpersonal-related stress). Interestingly, the task- and interpersonal-related scores in two clusters were inversely related, meaning that task-related stress does not necessarily positively correlate with interpersonal-related stress in university teachers. The curves of these clusters, which cross within the middle-stress level, suggest that the medium-stress group is more likely to appear heterogeneity. This phenomenon indicates that university administrators should focus on university teachers with mid-level stress. Cluster 2, with relatively high task-related stress and relatively low interpersonal-related stress were labeled "task-related stress," and Cluster 4 with relatively low task-related stress and relatively high interpersonal-related stress were labeled "interpersonal-related stress."

Combining the six clusters and job burnout and satisfaction. The correlation coefficients of the six clusters and university teachers' job burnout were computed to substantiate criterion validity. First, the total scores and scores of the four factors in the University Teachers' Job Burnout Scale were standardized; subsequently, the average scores of all factors in the six clusters were calculated (Fig. 2). The clusters appear to present unique average score trends for each factor. Similar to the average job stress

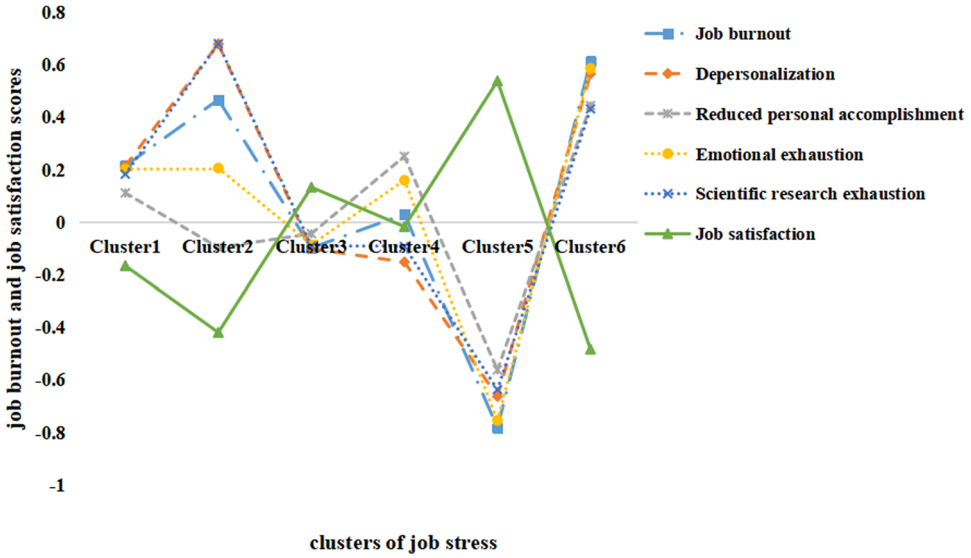

Fig. 2 Combining the six clusters and job burnout and satisfaction scores.

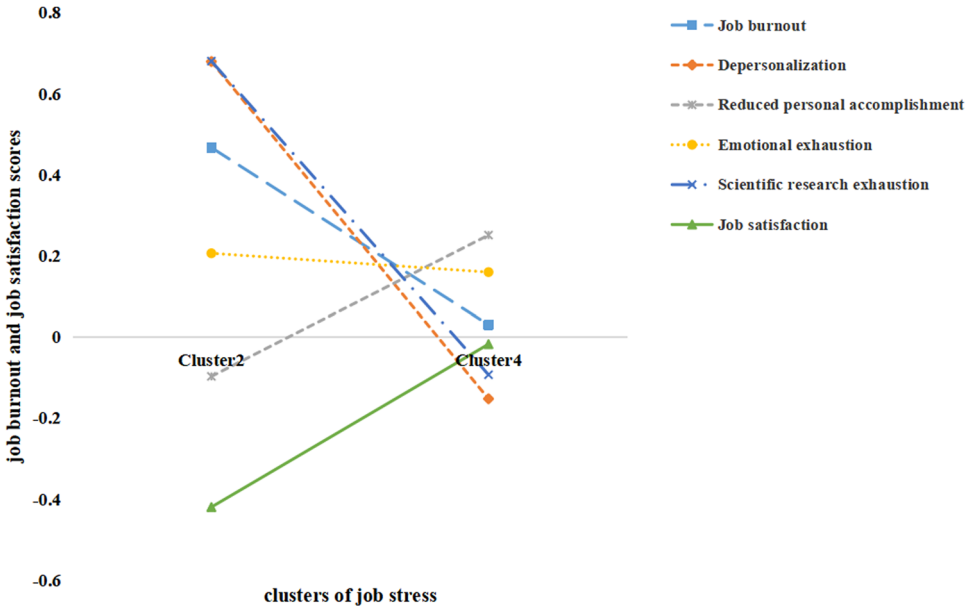

Fig. 3 Average scores of job burnout and satisfaction in clusters 2 and 4.

scores, average job burnout scores in clusters 6 and 5 were the highest and lowest, respectively. The average score in cluster 5 was significantly lower than those of the other clusters for all job burnout factors, whereas no significant differences were observed between clusters 2 and 6 for total job burnout and depersonalization scores. The average job burnout scores in clusters 1 and 3 were relatively high and low, respectively. Thus, the average scores of job burnout are consistent with those of job stress.

Figure 3 reveals that the average scores of clusters 2 and 4 exhibit contrasting trends. In cluster 2, the average scores for each factor exhibit a unique trend: scientific research exhaustion > depersonalization > job burnout > emotional exhaustion > reduced personal accomplishment. By contrast, cluster 4 exhibits a nearly opposite trend: reduced personal accomplishment > emotional exhaustion > job burnout > scientific research exhaustion > depersonalization. A paired comparison clarified that significant differences exist between clusters 2 and 4, except for emotional exhaustion (the average scores for job burnout, emotional exhaustion, scientific research exhaustion, and depersonalization in cluster 2 are all higher than those in cluster 4). The average scientific research exhaustion score in cluster 2 (task-related stress) was considerably higher than that in cluster 6 (extremely high stress), demonstrating that scientific research exhaustion is a unique feature of cluster 2. In addition, no significant differences were observed between clusters 1 and 4 for reduced personal accomplishment and emotional exhaustion, and no significant differences were observed between clusters 3 and 4 for depersonalization and scientific research exhaustion. Cluster 2 did not differ in reduced personal accomplishment with cluster 3 or in emotional exhaustion with cluster 1. In addition, the total and factor scores of job burnout all differed significantly among the different job stress clusters.

We used job satisfaction as the criterion variable to test classification effectiveness. Clusters 5 and 6 exhibited the highest and lowest job satisfaction scores, and the average job satisfaction scores in clusters 1 and 3 were relatively low and high,

Table 3 Distribution of university teachers' job stress group types with different demographic variables.

Variables	Relatively high stress	Task-related stress	Relatively low stress	Interpersonal-related stress	Extremely low stress	Extremely high stress	Effective total
Male	139 (13.6%)	83 (8.1%)	297 (29.1%)	221 (21.7%)	160 (15.7%)	120 (11.8%)	1020 (100%)
Female	113 (11.7%)	135 (14%)	296 (30.7%)	166 (17.2%)	153 (15.9%)	102 (10.6%)	965 (100%)
Effective total	252 (12.7%)	218 (11%)	593 (29.9%)	387 (19.5%)	313 (15.8%)	222 (11.2%)	1985 (100%)
Senior	25 (16%)	8 (5.1%)	53 (34%)	34 (21.8%)	21 (13.5%)	15 (9.6%)	156 (100%)
Vice-Senior	73 (12.9%)	59 (10.4%)	170 (29.9%)	111 (19.5%)	85 (15%)	70(12.3%)	568 (100%)
Intermediate	98 (11.6%)	103 (12.2%)	248 (29.4%)	164 (19.5%)	138 (16.4%)	92 (10.9%)	843 (100%)
Junior	55 (13.9%)	48 (12.2%)	113 (28.6%)	73 (18.5%)	63 (15.9%)	43 (10.9%)	395 (100%)
Effective total	251 (12.8%)	218 (11.1%)	584 (29.8%)	382 (19.5%)	307 (15.6%)	220 (11.2%)	1962 (100%)
Ministerial University	31 (12.9%)	38 (15.8%)	62 (25.8%)	48 (20%)	29 (12.1%)	32 (13.3%)	240 (100%)
Provincial University	146 (12.1%)	102 (8.5%)	377 (31.3%)	259 (21.5%)	215 (17.9%)	105 (8.7%)	1204 (100%)
Municipal University	76 (14%)	78 (14.3%)	154 (28.3%)	81 (14.9%)	70 (12.9%)	85 (15.6%)	544 (100%)
Effective total	253 (12.7%)	218 (11%)	593 (29.8%)	388 (19.5%)	314 (15.8%)	222 (11.2%)	1988 (100%)
Under 30	74 (11.2%)	79 (12%)	202 (30.7%)	133 (20.2%)	114 (17.3%)	56 (8.5%)	658 (100%)
31–40 Years old	109 (13.4%)	91 (11.2%)	232 (28.5%)	162 (19.9%)	122 (15%)	99 (12.1%)	815 (100%)
41–50 Years old	50 (13.1%)	38 (9.9%)	114 (29.8%)	70 (18.3%)	62 (16.2%)	49 (12.8%)	383 (100%)
More than 50 years	17 (15.2%)	9 (8%)	36 (32.1%)	18 (16.1%)	16 (14.3%)	16 (14.3%)	112 (100%)
Effective total	250 (12.7%)	217 (11%)	584 (29.7%)	383 (19.5%)	314 (16%)	220 (11.2%)	1968 (100%)

respectively. These four groups of university teachers' job satisfaction and job stress were negatively correlated. However, clusters 2 and 4 showed different trends. Specifically, the job satisfaction score of the task-related stress group (cluster 2) was significantly lower than that of the interpersonal-related stress group (cluster 4). A paired comparison revealed that no significant differences exist between clusters 1 and 4. In addition, no significant differences were observed between clusters 2 and 6. Therefore, we conclude that the task-related stress group is more likely to exhibit lower job satisfaction than the interpersonal-related stress group.

Distribution characteristics of university teachers' job stress group types with different demographic variables. Table 3 presents the distribution of university teachers across various job stress group types, segmented by gender, professional titles, university types, and age.

Significant differences were observed in the distribution of job stress group types among university teachers of different genders ($\chi^2 = 23.014$, $df = 5$, $p < 0.001$). Specifically, interpersonal-related stress accounted for 21.7% of all male teachers but only 17.2% of female teachers. Conversely, task-related stress comprised 8.1% of male teachers' stress but a higher 14% among female teachers. This suggests that male teachers tend to experience more interpersonal-related stress, while female teachers experience more task-related stress.

No significant differences were found in the distribution of job stress group types among university teachers with different professional titles ($\chi^2 = 12.992$, $df = 15$, $p = 0.603$). No significant differences were noted in the distribution of job stress group types among university teachers across different age groups ($\chi^2 = 14.165$, $df = 15$, $p = 0.513$).

Significant differences were evident in the distribution of job stress group types among university teachers from different university types ($\chi^2 = 55.139$, $df = 10$, $p < 0.001$). Within the task-related stress category, ministerial universities had the highest proportion of teachers (15.8%), while provincial universities had the lowest (8.5%). Conversely, provincial universities had the highest proportion of teachers under interpersonal-related stress (31.3%). In the category of extremely high stress, municipal universities had the highest proportion of teachers (15.6%). This indicates that teachers at ministerial universities experience more task-related stress, teachers at provincial universities face more interpersonal-related stress, and teachers at municipal universities endure a high degree of extremely high stress.

Discussion

Classification model and characteristics of the six clusters. This study adopted a person-oriented perspective to measure job stress indicators of university teachers in nine factors and used K-means clustering to obtain the classification model of job stress in university teachers. The results indicate that LOS, WL, CD, WA, and SRP are types of pressure related to task, whereas FL, WJ, IR, and ST are types of pressure related to interpersonal relationships; the former is produced in the process of university teachers' work and the latter produced in their interactions with others. In future studies, this classification can be further tested and improved. To a certain extent, the two-dimensional classification (task- and interpersonal-related) in this study is theoretically appropriate and feasible.

This study identified six significantly heterogeneous group types of job stress in university teachers: relatively high stress, task-related stress, relatively low stress, interpersonal-related stress, extremely low stress, and extremely high stress. The extremely high-stress group accounted for 11.2% of the valid samples, and university teachers in this group exhibited the highest scores in nearly all nine job stress factors. Such teachers experience intense task- and interpersonal-related stress, which may reduce their work enthusiasm and affect their physical and mental health. By contrast, the extremely low-stress group accounted for 15.8%, and university teachers in this group exhibited the lowest scores in all nine job stress factors. Such university teachers actively adapt to the teaching environment but may not be the most efficient. The Yerkes–Dodson law states that performance increases with cognitive arousal but only to a certain extent, beyond which performance decreases; a corollary is that an optimal level of arousal exists for a given task. In this study, the medium-stress group is subdivided into four groups, as detailed herein. The relatively high-stress group accounted for 12.7%, and the university teachers in this group exhibited high

scores in all nine job stress factors. Such university teachers successfully cope with the teaching environment but experience certain types of pressure. The relatively low-stress group accounted for 29.8%, the largest proportion in this study. The university teachers in this group reported low scores in all nine job stress factors. Therefore, these teachers cope with work-related pressure and work efficiently.

In this study, the other two types of job stress in university teachers, task-related and interpersonal-related stress, also reveal that these stress types can be imbalanced. The task-related stress group accounted for 11.0%, and university teachers in this group exhibited high scores in the five task-related stress factors but low scores in the four interpersonal-related factors. The average scores of the five task-related stress factors were all above average and those of three interpersonal-related factors (excluding ST) were below average. Such university teachers feel pressure mainly from the work itself. Despite this work-related pressure, their interpersonal relationships are harmonious. The interpersonal-related stress group accounted for 19.5%, and university teachers in this group reported high scores in the four interpersonal-related factors but low scores in the five task-related stress factors. Such university teachers experience pressure mainly from their social interactions. In the interpersonal-related stress group, the average scores of eight factors (excluding WA) are above average. To a certain extent, university teachers experience more job stress from work-related tasks than from interpersonal relationships. After in-depth interviews with university teachers with different titles, Liang and Bautista (2021) also found that the higher the title, the more biased the stressors are towards courses, and the lower the title, the more pressure comes from interpersonal relationships. The distinction of different types of teachers reveals that there are both quantitative and qualitative differences in teachers' job stress, which fully reflects the value and necessity of the "person-oriented" research idea for the study of teachers' job stress types.

Notably, previous studies differ in perspectives on work pressure classifications. For example, a cluster-based study revealed three distinct types of employees, overloaded, unclear, and underutilized employees, according to their response to role stressors (Arti and Jyoti, 2013). The differences between job stress classifications in university teachers and those in other professionals can be attributed to the unique professional characteristics of university teachers. As mentioned above, university teachers are under stressors of scientific research and promotion (SRP), students (ST), which are rarely found in other profession (Wang et al. 2013).

Job burnout and satisfaction among clusters. In this study, we used job burnout and satisfaction as the criterion variables to test the effectiveness of classification and determined that different clusters present unique trends in the average scores of university teachers' job burnout. The average scores of job burnout in the extremely high-stress and extremely low-stress groups were the highest and lowest, respectively. The average scores for all job burnout factors in the extremely low-stress group were significantly lower than those of other clusters, whereas the average scores for most job burnout factors in the extremely high-stress group were significantly higher than those of other clusters. The average job burnout scores of the relatively high-stress and relatively low-stress groups were relatively high and low, respectively. Thus, the job burnout scores of these four university teachers' groups are consistent with their job stress scores. The results are consistent with those of previous studies. Job stress significantly positively influences emotional exhaustion and depersonalization (David, 2003), and teachers experiencing higher stress were more burned out (Mary et al. 2011); Work overload, work pressure, professional qualifications and singleness have contributed to the development of job burnout(López-López et al. 2019). There is a positive correlation between job burnout and stress, and high pressure will lead to more frequent job burnout, and the perceived stress level depends on the psychological characteristics of coping with occupational and life stressors(Makara et al., 2019). In this study, average scores of nine factors in task- and interpersonal-related stress groups exhibited nearly opposite trends. In the task-related stress group, the average scores of reduced personal accomplishment were below average, whereas those of job burnout and the other three factors were above average. In the interpersonal-related stress group, the average scores of reduced personal accomplishment, emotional exhaustion, and job burnout were above average, whereas those of scientific research exhaustion and depersonalization were below average. Moreover, the average scores of all factors, except for reduced personal accomplishment in the task-related stress group, were higher than those in the interpersonal-related stress group. According to the general adaptation syndrome theory, an individual's adaptation to stress occurs over three stages: alarm reaction, resistance, and exhaustion. Individuals undergoing additive pressure are in the stage of exhaustion and can easily succumb to this pressure (Hans Selye, 1951). From this perspective, the extremely high-stress group is more likely to experience job burnout because they must simultaneously cope with task- and interpersonal-related stress. However, the average scores of scientific research exhaustion in the task-related stress group are higher than those in the extremely high-stress group. In China, university teachers' remuneration and career advancement are directly related to scientific achievements (e.g., number of academic papers published). However, achieving a scientific breakthrough is difficult; the intense competition induces substantial scientific research stress in university teachers, suggesting that task-related job stress accelerates job burnout. By contrast, interpersonal stress is less likely to lead to occupational burnout.

In addition, the psychological pressure of serving in a position of high responsibility often causes teachers teaching dissatisfaction (Yu et al. 2015), the decrease of teaching satisfaction will affect job burnout (Li and Zhang, 2022). In this study, the average job satisfaction scores in the relatively high-stress, task-related stress, and extremely high-stress groups are below average, those in the interpersonal-related stress group is zero, and those of the relatively low-stress and relatively high-stress groups are above average. Notably, the average score in the task-related stress group is lower than that in the extremely high-stress group only, affirming that task-related stress affects job satisfaction. Interpersonal relationships at universities are relatively simple. With the enrollment expansion of universities and universities, communication between teachers and students are decreasing substantially. In China, many universities and universities have several campuses; therefore, most teachers have few opportunities to communicate with other university staff, and evaluations of colleagues are not as critical as their actual performance. Thus, interpersonal-related stress has little effect on the job satisfaction of university teachers. However, university teachers must complete most of their work tasks independently; therefore, task-related stress is more likely to lead to job dissatisfaction. The differences in job burnout and job satisfaction in these two groups imply that more attention should be paid to university teachers facing task-related stress.

Distribution differences in university teachers' job stress group types with different demographic variables. In this study, we examined the distribution characteristics of university teachers'

job stress group types across different genders, professional titles, university types, and age groups. The findings revealed significant differences in the distribution of job stress types among university teachers of different genders. Specifically, male teachers were more frequently categorized as experiencing interpersonal-related stress (21.7%), whereas female teachers were more often assigned to the task-related stress type (17.2%). This aligns with the observation made by Liu (2019) that female teachers experience lower interpersonal pressure but higher overall job stress compared to male teachers. This may be related to the fact that female teachers are expected to undertake both teaching and research tasks while also primarily responsible for raising children and managing family responsibilities. It may also be associated with the characteristic of women being good at communication, which leads to female teachers experiencing greater pressure in their professional duties compared to male teachers(Liu, 2019).

Regarding professional titles, no significant differences were found in the distribution of job stress types among university teachers. In terms of national higher education construction, regardless of their professional titles, all university teachers need to bear heavy workloads in scientific research activities, and at the same time, they are subject to higher requirements from all aspects of family, society, and school (Zhu, 2016). Therefore, the distribution of job stress types among Chinese university teachers is not affected by their professional titles.

In terms of age, no significant differences were observed in the distribution of job stress types among university teachers. Each stress group type comprised a similar proportion of teachers from various age brackets. The initiation of Chinese "double first-class" initiative has presented new opportunities for universities and teachers of various age groups, both in terms of resource allocation and institutional innovation. Consequently, the job stress faced by university faculty has become increasingly prominent and complex (Guan and Duan, 2020).

Lastly, significant differences emerged in the distribution of job stress types among university teachers from different university types. Ministerial universities had a higher proportion of teachers categorized as task-related stress (15.8%), provincial universities showed a predominance of interpersonal-related stress (31.3%), and municipal universities reported a significant rate of extreme stress (15.6%). The heightened task-related stress in ministerial universities is likely due to their esteemed academic reputation and rigorous expectations for research output and teaching quality. Provincial universities, on the other hand, may possess more intricate organizational structures and interpersonal networks, necessitating increased efforts in interpersonal communication and coordination. Municipal universities' teachers, concurrently shouldering teaching, research, and social service roles, confront multifaceted expectations from schools, students, parents, and society, compounded by potential resource constraints that could hinder their professional development and work effectiveness, ultimately augmenting their stress perceptions (Wu, 2017; Liu, 2019).

Innovation and limitation. This study possesses several innovations. Firstly, While scholars worldwide have conducted extensive research on teachers' job stress, much of this work has focused on the causes and impacts of stress, with limited attention given to the classification of stress groups (Li et al. 2022; Mary et al. 2011). Understanding the specific types of job stress among university teachers enables administrators to adopt targeted measures to alleviate their stress, thereby providing a well-informed basis for the pressure management and psychological support of university teachers. Secondly, the university teachers' job stress Scale compiled by the author team, tailored to Chinese university teachers, is an original outcome in the early stage, ensuring the reliability and validity of the research tools and reflecting the characteristics of Chinese university teachers in terms of job stress types. Finally, the study encompasses a larger sample coverage, with extensive and valuable data, encompassing various types of universities and stratified into three levels: ministerial, provincial, and municipal universities and colleges. It involves Chinese university teachers of different teaching ages, titles, and genders.

However, there are some limitations to this study. The Effort-Reward Imbalance Model(ERI) indicates that rewards (salary, respect, promotion or job security) as an independent factor affect the physical and mental health of employees (Siegrist et al. 2016). Low rewards can frustrate employees' basic expectations of equivalent returns in labor exchanges, thus generating negative emotions. In China, variations in economic development levels and educational environments exist across different regions (eastern, central, and western). According to survey data from a study on the reform of the salary system for Chinese university teachers in the context of "double first-class" construction, the western region is relatively remote compared to the eastern and central regions, and its economic development level and environmental conditions are relatively backward. The salary level of university teachers is significantly lower than that in the central and eastern regions. The low salary level or income inequality is one of the important sources of pressure for this group of teachers. Teachers who are not economically secure are more likely to face the risk of negative health outcomes (Reevy and Deason, 2014). Therefore, future research can further consider the impact of regional variables on the distribution of job stress types among university teachers. Secondly, while the sample in this study covers 22 universities and involves three tiers of university types, there are numerous universities in China. Thus, future research can expand the sample coverage, increase the number of universities and university teachers studied, and enhance the generalizability of the results as needed. Lastly, the types of job stress experienced by university teachers are not static and may change over time. Therefore, future research can adopt a longitudinal approach to explore the dynamic changes in the types of job stress among university teachers.

Conclusion

Chinese university teachers were classified into six types of job stress. According to the characteristics of job stress, Chinese university teachers were classified into six significantly heterogeneous groups: relatively high stress, task-related stress, relatively low stress,interpersonal-related stress, extremely low stress, and extremely high stress. The average job burnout and job satisfaction scores differed and exhibited varying features among the groups. This study complements and extends existing research. Related research can explore only the relationships between job stress and other variables, and factor analyses can determine only structures and dimensions of job stress.

University teachers with task-related stress merit more concern. In general, the extremely high-stress group must be the most concerned, whereas university teachers with mid-level stress can be given less attention. With a person-oriented perspective, this study further subdivided the medium-stress group through K-means clustering, showing that the medium-stress group is more likely to appear heterogeneity. University teachers under task-related stress have more stress consequences than those under interpersonal-related stress. Chinese university teachers face high scientific pressure, and most university teachers must complete their work tasks independently. Task-related stress directly causes higher dissatisfaction and job burnout. This

classification model of job stress offers direct references for the stress management and psychological aid of university teachers. Not all university teachers under medium-stress undergo identical stress-related experiences. University administrators must intensify their concern for university teachers with task-related stress and help them adjust to the role of university teachers.

University teachers with different job stress types exhibit significant demographic variations. There are significant gender differences in job stress types, with male teachers experiencing more interpersonal-related stress and female teachers encountering more task-related stress. Moreover, university types significantly influence the distribution of job stress types, as evidenced by the higher prevalence of task stress among teachers in ministerial universities, interpersonal-related stress in provincial universities, and extremely high stress in municipal universities. In contrast, neither professional titles nor age significantly impact the distribution of job stress types. Consequently, to effectively alleviate teachers' job stress, it is imperative to consider both gender and university type, and implement tailored and reliable measures accordingly.

Data availability

Sharing data publicly may result in an invasion of personal privacy, so we choose not to share data.

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Author contributions

MT, PW, and XYL conducted research and wrote the main manuscript. XYL, JCM, XQY, and XW collected the data, performed data analyses. TZ participated in the data analysis and polished the manuscript. All authors reviewed the manuscript.

Competing interests

The authors have no competing interests to declare that are relevant to the content of this article.

Ethical approval

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments. The protocol was approved by the Ethics Committee of Shandong Normal University(No. sdnu-2023-10-15-23).

Informed consent

Informed consent was obtained from the participants before the commencement of the study between October 20 and 30, 2023. All participants have been fully informed that their anonymity is assured, why the research is being conducted, how their data will be utilized, and if there are any risks to them of participating. They were also reminded that they could withdraw from the study at any time without any negative consequences.

Additional information

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