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The relationship between work stress and well-being among Chinese primary and secondary school teachers: The chain mediation of affective rumination and work engagement

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Abstract

Background Although scholars have explored the impact of work stress, affective rumination, and work engagement on teachers' well-being, there is a need for more research to investigate the mechanisms through which work stress influences teachers' well-being via affective rumination and work engagement.

Methods Based on the Conservation of Resources Theory and the Job Demands-Resources Model, this study examined the potential indirect roles of affective rumination and work engagement in the association between work stress and well-being among primary and secondary school teachers. A paper questionnaire survey was administered to 760 primary and secondary school teachers (M = 39.84, SD = 8.848) selected through cluster sampling from nine schools in Yancheng City, Jiangsu Province, China. All participants completed structured self-report questionnaires, including measures of work stress, affective rumination, work engagement, and well-being. Data analyses were conducted using structural equation modeling via Amos 24.0.

Results The results are as follows: (1) Work stress has a direct and negative effect on well-being; (2) Work stress indirectly and negatively affects well-being through affective rumination; (3) Work stress indirectly and negatively affects well-being through work engagement; (4) Work stress indirectly and negatively impacts well-being through both affective rumination and work engagement.

Conclusion The results underscore the detrimental effects of work stress and identify the feasibility of interventions targeting affective rumination and work engagement, offering insights into strategies to promote the well-being of primary and secondary school teachers.

Keywords Work stress, Affective rumination, Work engagement, Well-being, Primary and secondary school teachers

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Introduction

Teacher well-being has been recognized as a critical factor in educational quality and student outcomes [1–2]. The Organisation for Economic Co-operation and Development (OECD) has highlighted the importance of teacher well-being in the international education field by including assessments of teacher well-being as an essential component of the Programme for International Student Assessment (PISA) in its 2020 report "Teachers' Well-being: A Framework for Data Collection and Analysis" [3]. Furthermore, the United Nations Educational, Scientific and Cultural Organization (UNESCO) has emphasized the need to prioritize teacher well-being as part of its Sustainable Development Goal 4 (SDG 4) on quality education, noting that teacher well-being is integral to achieving equitable and inclusive education systems worldwide [4]. These policies and reports indicate that enhancing teachers' well-being has become a focal point and value orientation of educational policy.

Well-being refers to an individual's overall satisfaction with their life status and positive emotional experiences that accompany it, including dimensions such as life satisfaction, job satisfaction, and psychological well-being [5]. For teachers, well-being pertains to the joy and sense of accomplishment they gain from the recognition of colleagues and students, as well as the psychological fulfillment that comes from realizing their potential [6]. The well-being of teachers is essential not only for elevating the quality of basic education but also for addressing the comprehensive educational needs of students [7]. Consequently, the study of teachers' well-being holds significant theoretical and practical importance.

Currently, the well-being of primary and secondary school teachers in China confronts numerous challenges [8]. The teaching profession is frequently characterized as a high-intensity, high-pressure occupation, significantly testing the well-being of educators [9]. To enhance teachers' well-being, researchers have delved into various contributing factors, which can be broadly categorized into external and internal factors. Work stress, linked to external work environment conditions, stands out as a pivotal external factor influencing teachers' well-being [10–11]. Job stress denotes the adverse emotional experiences, such as anger, anxiety, tension, frustration, or depression [12], arising from work-related challenges and stressors [13]. It encompasses two components: stressors and stress responses, with stressors primarily covering eight dimensions including educational reform, students, school management, job characteristics, career development, physical and mental characteristics, family, and society [14]. Studies have indicated that work stress can precipitate poor well-being [7], suggesting that a high-stress work environment might evoke a cascade of negative emotional and psychological responses, diminishing life satisfaction and impacting overall well-being. Affective rumination, an internal factor, impacts teachers' well-being [15]. As a subset of work-related rumination, affective rumination refers to the psychological process where individuals repetitively ponder over the causes and implications of work-induced negative emotions or stressful incidents [16]. This form of rumination, by fixating on negative emotions and experiences, can exacerbate emotional distress and lessen the incidence of positive emotional experiences [17], consequently diminishing well-being. Conversely, work engagement, another internal factor, positively influences teachers' well-being [18–19]. Work engagement represents a positive and fulfilling affective and cognitive state at work, characterized by three dimensions: vigor, dedication, and absorption [20]. Research indicates that individual levels of work engagement are positively predictive of teachers' well-being [21]. Teachers who are engaged in their work tend to experience a heightened sense of positive emotions, such as happiness, excitement, and satisfaction, which collectively amplify their overall well-being [22].

Despite the growing body of research on teacher well-being, several critical gaps remain. First, while numerous studies have examined the direct effects of work stress on well-being, the underlying mechanisms, particularly the sequential psychological processes, are underexplored. Second, although affective rumination and work engagement have been independently linked to well-being, their potential chain mediation effects in the context of work stress remain unclear. Third, existing research has predominantly focused on Western contexts, leaving a paucity of evidence from non-Western settings, such as China, where cultural and institutional factors may shape unique dynamics. These gaps highlight the need for a more nuanced understanding of how work stress influences well-being through sequential mediators, particularly in understudied contexts. This study aims to explore the interrelationships between work stress, affective rumination, work engagement, and well-being within the context of China's primary and secondary education. Furthermore, it seeks to investigate the potential mediating roles of affective rumination and work engagement in the link between work stress and well-being. Toward this end, this study poses four questions: What is the relationship between work stress and well-being among primary and secondary school teachers? Does affective rumination mediate the relationship between work stress and well-being among primary secondary school teachers? Does work engagement also serve as a mediator in this relationship? Do affective rumination and work engagement play a chain mediating role between work stress and well-being among primary and secondary school teachers?

The significance of this study lies in its contribution to advancing the theoretical understanding of the mechanisms underlying teachers' well-being by exploring the chain mediation of affective rumination and work engagement in the relationship between work stress and well-being. This study provides a nuanced perspective on how work stress influences well-being through sequential psychological processes, offering a more comprehensive framework for understanding these dynamics. The findings aim to enrich the existing literature by highlighting the interplay between these factors and providing evidence-based insights that can inform interventions to support the well-being of primary and secondary school teachers.

Theoretical background and research hypotheses

Theoretical background

The Conservation of Resources Theory (COR theory) offers a comprehensive framework for understanding how work stress impacts teachers' well-being. Proposed by American psychologist Hobfoll [23], the COR theory broadly defines resources as those objects, conditions, personal characteristics, and energies that are either inherently valued or serve as means to achieve valued goals [24]. Central to the COR theory is the assumption that individuals strive to accumulate and protect resources, preparing themselves to handle stressful situations and avoid negative outcomes [25]. When individuals perceive a loss of resources as a threat, it can heighten the risk of failure [23]. Those with scarce resources are particularly vulnerable to work stress [26]. If the anticipated return on resource investment falls short, individuals may experience an emotional imbalance, leading to a sense of input-output incongruity [17]. As a coping mechanism, they might conserve resources by diminishing work vitality and reducing learning behaviors at work. From the COR theory perspective, work stress is viewed as a type of resource depletion that leaves teachers feeling overwhelmed and unable to recover, thus inducing stress. Confronted with resource loss due to work stress, teachers might engage in affective rumination, perpetuating a cycle of resource depletion. To cease resource expenditure, teachers may consciously lower their work engagement, which in turn can decrease their sense of well-being.

While COR theory offers valuable insights, complementary frameworks such as the Job Demands-Resources (JD-R) Model could further elucidate the observed relationships. The JD-R Model emphasizes the balance between job demands (e.g., work stress) and job resources (e.g., organizational support), highlighting how excessive demands can deplete resources and impair well-being, while adequate resources can foster engagement and mitigate stress [27]. Applying the JD-R Model to the context of Chinese primary and secondary school teachers, work stress, as a significant job demand, may deplete teachers' psychological and emotional resources, leading to increased affective rumination. This persistent focus on negative emotions further exhausts their limited resources, reducing their ability to engage fully in their work. The theoretical frameworks allow for a holistic understanding of the relationship between work stress and well-being, clarifying the mediating roles of affective rumination and work engagement. The theoretical model is presented in Fig. 1.

Research hypotheses

Work stress and well-being

Work stress is recognized for its detrimental impact on well-being [28]. The Conservation of Resources Theory (COR theory) posits that work stress can precipitate a perception of resource loss, including the exhaustive consumption of time, energy, and psychological resources [25]. This difficulty in sustaining work-life balance can subsequently diminish an individual's sense of well-being. Empirical evidence substantiates this notion, demonstrating a negative predictive relationship between work stress and teachers' well-being. For example, Yang's cross-sectional survey of 393 elementary school teachers revealed a significant negative effect of work stress on their occupational happiness [11]. Liao's study, which surveyed 562 primary and secondary school teachers

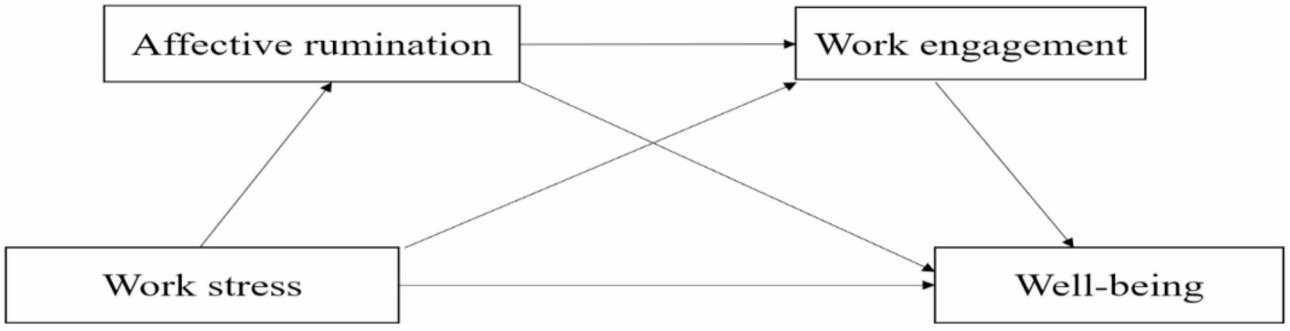

Fig. 1 The proposed theoretical model

across various regions in China, echoed these findings, with work stress negatively forecasting well-being [7]. Arbia et al. through interviews with twenty teachers from diverse Italian regions and employing grounded theory analysis, uncovered a negative correlation between work-related stress and teachers' well-being [9]. Helms-Lorenz and Maulana's longitudinal examination of 338 novice secondary school teachers further confirmed these findings, indicating that stress exerts a negative influence on teachers' psychological well-being [29]. In light of this evidence, the study advances the following hypothesis:

H1 Work stress is significantly and negatively correlated with well-being among primary and secondary school teachers.

Mediating role of affective rumination

A robust negative relationship between work stress and affective rumination has been well documented [30]. Empirical research has shown that work stress can positively predict affective rumination. Cross-sectional studies have consistently demonstrated a significant and direct link between work stress and various forms of work-related rumination, including the affective dimension [15, 31]. Weihe et al. employed a diary study methodology to monitor 74 novice teachers over a five-day period, uncovering that work-related fatigue and incomplete tasks substantially influence affective rumination [32]. In a similar vein, Cropley and Millward Purvis, through a week-long diary study involving 34 primary and secondary school teachers, revealed that those experiencing higher levels of strain were more prone to ruminative thoughts [33]. This collective research illustrates the significant impact of work stress on teachers' affective rumination.

Scholarly inquiry has delved into the correlation between affective rumination and well-being, with studies indicating a negative association between the two [15]. Huhtala et al. demonstrated that rumination correlates inversely with well-being [34]. Teachers who engage in rumination are often deeply enmeshed in negative thought patterns and memories [35], rendering them more susceptible to a reduction in their well-being. The interplay between rumination and well-being has been attributed to the divergence between individuals' perceived emotional expectations and their actual affective states [36]. When individuals continually juxtapose their emotional reality with an idealized resilience or positivity, this can engender a gap that fuels further rumination. The ongoing assessment and incongruity with internalized expectations may intensify sentiments of insufficiency and discontent, thereby degrading their overall well-being.

Empirical evidence suggests that teachers experiencing elevated work stress are more prone to rumination, which in turn is linked to decreased well-being. Moreover, Wu et al. propose that work-related rumination operates as a mediator in the relationship between work stress and well-being, a finding that, while specific to Chinese college teachers, provides valuable insights for expanded research [15]. Based on these insights, the following hypothesis is proposed:

H2 Affective rumination may serve as a mediating factor in the relationship between work stress and well-being among Chinese primary and secondary school teachers.

The mediating role of work engagement

Empirical research has consistently indicated that work stress exerts a notable influence on work engagement [37]. Mérida-López and Extremera, in their survey of 288 primary and secondary school teachers, identified a negative association between work-related stress and the vigor and dedication of teachers [38]. Hu and Yuan, surveying 604 effective teachers, found that work stress was a significant predictor of reduced well-being, particularly among female teachers who reported higher levels of moderate to severe stress compared to their male colleagues [2]. An escalation in negative emotional experiences at work was correlated with a pronounced decline in the well-being of female teachers. Lambert et al. also suggested that work stress among elementary school teachers could lead to diminished work engagement [39].

A substantial body of research has established a positive link between work engagement and well-being [40–41]. Individuals who are highly engaged in their work often report greater job satisfaction and experience more positive emotions [42], which in turn, enhance their overall well-being. Empirical studies have demonstrated that work engagement is a positive predictor of teachers' well-being. For example, a cross-sectional study involving 1,335 basic education teachers from Romania revealed a significant positive relationship between work engagement and well-being [18]. A study of 500 university teachers also observed the similar positive association [43]. Moreover, a longitudinal study of 430 primary and secondary school teachers indicated that higher levels of engagement are likely to be associated with higher levels of well-being at work [44]. This study, therefore, posits that work engagement serves as a mediator in the relationship between work stress and well-being.

Affective rumination is an important factor that negatively affects work engagement [45]. According to the COR Theory, when teachers ruminate on negative emotions, it may deplete their cognitive resources, thereby affecting their attention, focus, and ultimately, work efficacy [46]. Geisler et al., in a three-wave study of 1067

teachers, discovered that affective rumination negatively predicted teacher work exhaustion, consequently influencing work engagement [47]. In light of these findings, the study proposes the following research hypotheses:

H3 Work engagement mediates the association between work stress and well-being among primary and secondary school teachers.

H4 Affective rumination and work engagement jointly play a chain mediating role in the relationship between work stress and well-being among primary and secondary school teachers.

Method

Participants and procedure

This study has been reviewed and approved by the Ethics Committee at Qufu Normal University, ensuring adherence to ethical standards. Initial consent was obtained from school principals, and a suitable time for teacher collective research and teaching was scheduled. During the survey, questionnaires assessing work stress, affective rumination, work engagement, and well-being were distributed. Researchers explained the survey's purpose, ensured anonymity, and emphasized the confidentiality of responses. Participants were informed of their voluntary participation and the option to withdraw at any time if they felt uncomfortable with any questions, before they completed the questionnaires. Completed questionnaires were collected immediately by the researchers, who expressed gratitude for the participants' involvement.

Participants were recruited via cluster sampling from nine schools in Yancheng City, Jiangsu Province, China. To determine the required sample size, G*Power 3.1 software was utilized [48], with an effect size set at 0.3 and an alpha level set at 0.05. The calculation indicated that a total of 145 participants were needed to achieve a statistical power of 0.95. The survey was conducted on-site from March 15 to May 23, 2024, employing a cluster sampling method. Two primary schools, four junior high schools, and three senior high schools were selected for participation. A total of 880 questionnaires were distributed, with 760 returned and deemed valid, resulting in an effective response rate of 86.36%. The demographic distribution of the participants included 247 males and 513 females, with ages ranging from 23 to 58 years (M = 39.84, SD = 8.848). The sample comprised 34.3% high school teachers, 36.2% junior high school teachers, and 29.5% primary school teachers. Educational backgrounds were as follows: 0.8% held a college degree, 87.5% had a bachelor's degree, and 11.7% were undergraduate students.

Materials

Work stress scale

Work stress was evaluated using the stressor subscale of the Primary and Secondary School Teachers' Work Stress Scale, developed by Shi et al. [14]. This stressor subscale is composed of 36 items across 8 dimensions, including educational reform, students, school management, job characteristics, career development, physical and mental characteristics, family issues, and social concerns. For this study, the two dimensions of students and job characteristics were selected from the stressor subscale, given their prominence as stressors for teachers in China [7]. These dimensions encompass 12 items, such as student-related items (e.g., "I feel difficulty in teaching due to the large individual differences among students") and job characteristics (e.g., "It is difficult to manage the multiple roles of a teacher"). Scoring is based on a 5-point scale, ranging from 0 (No stress) to 4 (Extreme stress), with higher scores indicating increased stress levels. The reliability and validity of this 12-item scale established in prior research [7].

Affective rumination scale

The affective rumination subscale of the Work-Related Rumination Scale, developed by Cropley et al. [49], was utilized to assess affective rumination. This scale comprises 5 items (e.g., "I feel angry when thinking about work-related matters during my leisure time"), rated on a 5-point Likert scale ranging from 1 (never) to 5 (always). Elevated scores denote a higher degree of affective rumination. The scale's reliability and validity have been demonstrated in previous studies [32].

Work engagement scale

Work engagement was measured using a simplified version of the Work Engagement Scale, developed by Schaufeli et al. [50]. This scale contains 9 items that cover three dimensions: vigor (e.g. "As soon as I wake up in the morning, I am eager to go to work"), dedication (e.g. "I am proud of the work I do"), and absorption (e.g. "I immerse myself in my work"). Each item is rated on a 7-point Likert scale from 0 (Never) to 6 (Always), with higher scores signifying greater work engagement. The scale's reliability and validity have been confirmed in previous research [51].

Well-being scale

Well-being was evaluated using the Chinese version of the Short Depression-Happiness Scale, revised by Wang et al. [52]. The scale consists of 6 items (e.g., "I felt pleased with the way I am"), with responses ranging from 1 (never) to 4 (often). After reversing the response scale for 3 items, higher total scores indicate better well-being.

Table 1 Descriptive statistics and correlation analysis ($N = 760$)

	M	SD	1	2	3	4
1 work stress	2.464	0.927	1			
2 affective rumination	3.105	0.808	0.441**	1		
3 work engagement	3.307	1.137	-0.259**	-0.207**	1	
4 well-being	3.199	0.597	-0.249**	-0.274**	0.247**	1

Note: *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$, same below

Statistical analysis

Data analysis was performed utilizing SPSS 24.0 and Amos 24.0. Initially, a common method bias analysis was conducted to ensure data validity [53]. Subsequently, Pearson correlation tests were used to examine intervariable relationships. Thirdly, the measurement model's reliability and validity were assessed using factor loadings, Cronbach's α, Composite Reliability (CR), and Average Variance Extracted (AVE). Model fit was evaluated using standard goodness-of-fit indices. Finally, a bootstrap method was employed to test for both the independent and chain mediating effects of affective rumination and work engagement [54].

Results

Common method bias

In this study, the potential for common method bias was rigorously assessed using Harman's single-factor test [53]. An exploratory factor analysis (EFA) was applied to all survey items. The unrotated solution yielded five eigenvalues exceeding the value of 1, with the primary factor accounting for 32.711% of the variance. This percentage falls short of the 40% threshold that would typically raise concerns about common method bias [55]. To further validate the robustness of our findings, we additionally employed the marker variable technique [56], selecting a theoretically unrelated variable to the key constructs. The low correlations between the marker variable and the primary variables suggest that common method bias is unlikely to significantly impact our results. These findings suggest that common method bias is not a significant concern in the current research.

Correlation analyses

As are presented in Table 1, the correlational analysis indicates that work stress, affective rumination, work engagement, and well-being are all significantly positively correlated with each other. Specifically, work stress and well-being demonstrated a significant negative relationship (r =-0.249, $p < 0.01$); work stress and affective rumination exhibited a significant positive relationship ($r = 0.441$, $p < 0.01$); affective rumination was significantly negatively related to well-being (r = -0.274, $p < 0.01$); work stress was significantly and negatively related to work engagement (r = -0.259, $p < 0.01$); work engagement was significantly positively related to well-being ($r = 0.247$, $p < 0.01$); and affective rumination significantly and negatively related to work engagement (r = -0.207, $p < 0.01$).

Table 2 Evaluation of reliability and validity

Latent variable	SC	*P*	Cronbach's a	CR	AVE
Work stress	0.600-0.873	***	0.941	0.942	0.576
Affective rumination	0.813–0.917	***	0.942	0.945	0.775
Work engagement	0.651–0.876	***	0.935	0.939	0.632
Well-being	0.696–0.903	***	0.912	0.913	0.638

SC = standardized coefficients

Table 3 The test for discriminant validity of potential variables

Potential variable	Work stress	Affective rumination	Work engagement	Well-being
Work stress	**0.759**			
Affective rumination	0.452***	**0.880**		
Work engagement	-0.236***	-0.210***	**0.795**	
Well-being	-0.247***	-0.293***	0.262***	**0.799**

Note: The square root of the AVE of four latent constructs is given in the diagonal, and the correlation coefficient is given on the below diagonal

The measurement model

The measurement model was evaluated using Confirmatory Factor Analysis (CFA), by reporting its reliability and validity. The Cronbach's α coefficients exceeded the threshold of 0.7, signifying good internal consistency and reliability of the scales [57]. The standardized factor loadings for each item were above the recommended level of 0.50 [58], and the Composite Reliability (CR) values surpassed 0.7 [59], while the Average Variance Extracted (AVE) values were all above 0.5 [60], collectively indicating satisfactory convergent validity of the constructs. Discriminant validity was assessed by ensuring that the square root of the AVE for each construct was greater than its inter-construct correlations [59].

As detailed in Table 2, Cronbach's α values ranged from 0.912 to 0.942, indicative of high reliability. The standardized factor loadings varied between 0.600 and 0.917, and the CR and AVE values ranged from 0.913 to 0.945 and from 0.576 to 0.775, respectively, further confirming the convergent validity of the constructs. Table 3 displays the square roots of AVE for each construct, which were found to be higher than their respective inter-construct correlations, thereby demonstrating adequate discriminant validity.

Table 4 Goodness of fit index of the structural model

Fit index	X^2/df	GFI	AGFI	CFI	TLI	NFI	SRMR	SMSEA
Suggested value	0–3	> 0.900	> 0.900	> 0.900	> 0.900	> 0.900	< 0.080	< 0.080
Value of this study	1.158	0.975	0.968	0.966	0.966	0.975	0.0561	0.014

Table 5 Mediating effects of affective rumination and work engagement ($N = 760$)

Path relationship		Point estimate	Product of coefficient		Bootstrapping			
					Bias-corrected 95% CI		Percentile 95% CI	
			SE	Z-value	Lower	upper	lower	upper
Test of indirect, direct and total effects								
DistalIE	WS→AR→WE→WB	-0.007	0.003	-2.333	-0.016	-0.002	-0.015	-0.002
ARIE	WS→AR→WB	-0.060	0.015	-4.000	-0.093	-0.034	-0.092	-0.032
WEIE	WS→WE→WB	-0.022	0.008	-2.750	-0.041	-0.010	-0.039	-0.009
TIE	Total indirect effect	-0.090	0.017	-5.294	-0.128	-0.060	-0.126	0-0.059
DE	WS→WB	-0.072	0.030	-2.400	-0.131	-0.012	-0.132	0-0.014
TE	Total effect	-0.163	0.028	-5.821	−0.218	-0.111	-0.218	-0.110
Percentage of indirect effects								
P1	DistalIE/TIE	0.083	0.041	2.024	0.022	0.186	0.019	0.180
P2	ARIE/TIE	0.668	0.088	7.591	0.469	0.814	0.472	0.817
P3	WEIE/TIE	0.249	0.078	3.192	0.116	0.429	0.109	0.417
P4	TIE/TE	0.555	0.138	4.022	0.352	0.903	0.342	0.884
P5	DE/TE	0.445	0.138	3.225	0.097	0.648	0.116	0.658

Note: WS = Work stress, AR = Affective rumination, WE = Work engagement, WB = well-being, Standardized estimating of 1000 bootstrap sample, ***$p < 0.001$

The structural model

The structural model was assessed using a series of goodness-of-fit indices. A well-fitting structural model is indicated when the ratio of chi-square to degrees of freedom (x2 / df) falls between 0 and 3, the Goodness-of-Fit Index (GFI), Adjusted Goodness-of-Fit Index (AGFI), Normed Fit Index (NFI), Tucker-Lewis Index (TLI), and Comparative Fit Index (CFI) are all above 0.9, and the Standardized Root Mean Square Error of Approximation (SRMR) and Standardized Root Mean Square Error of Approximation (SMSEA) are less than 0.08 [61].

Table 4 presents the fit indices as follows: X2 / df = 1.158 (X2 = 530.378, df = 458), GFI = 0.975, AGFI = 0.968, CFI = 0.966, TII = 0.966, NFI = 0.975. All indices are within the suggested thresholds, suggesting an excellent fit for the structural model.

Testing for mediation effect

This study employed the bootstrap method to scrutinize the mediating effects among the four constructs. Mediation is considered statistically significant when the confidence intervals, derived from the Bias-Corrected bootstrap at a 95% confidence level, do not include zero [54]. Data analysis was performed using Amos 24.0 software. The results concerning the mediating roles of affective rumination and work engagement between work stress and well-being are presented in Table 5.

The direct effect of work stress on well-being was found to be significant (β = -0.072, $P < 0.05$), thereby supporting the acceptance of the first hypothesis. Affective rumination and work engagement were identified as mediators in the relationship between work stress and well-being, with a total indirect effect of -0.090 ($P < 0.001$). Specifically, the indirect effects were constituted by three distinct pathways: The pathway of work stress → affective rumination → work engagement → well-being exhibited an indirect effect of -0.007 with a 95% confidence interval of [-0.016, -0.002]; The pathway of work stress → affective rumination → well-being showed an indirect effect of -0.060 with a 95% confidence interval of [-0.093, -0.034]; The pathway of work stress → work engagement → well-being had an indirect effect of -0.022 with a 95% confidence interval of [-0.041, -0.010]. The Bootstrap method yielded 95% confidence intervals for all three indirect effects that excluded zero, indicating that each of the indirect effects is statistically significant, thus supporting hypotheses 2, 3, and 4.

Furthermore, this study evaluated the proportion of the indirect effects for affective rumination and work engagement as partial mediators. As detailed in Table 5, of the three significant indirect effects, affective rumination accounts for 66.8% of the total indirect effect, while work engagement represents 24.9%. The combined indirect effect of affective rumination and work engagement constitutes 8.3% of the total indirect effect, which is the least substantial mediating role. Figure 2 illustrates the specific mechanisms by which work stress influences teachers' well-being through the pathways of affective rumination and work engagement.

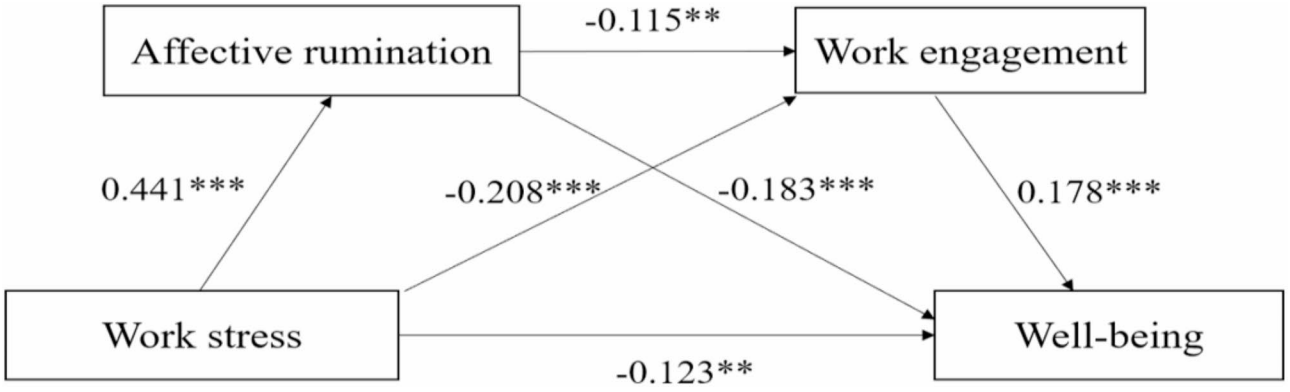

Fig. 2 The path diagram, $^{**}p < 0.01$, $^{***}p < 0.001$

Discussion

Empirical evidence suggests that work stress, affective rumination, and work engagement significantly influence the well-being of primary and secondary school teachers. However, there remains a gap in understanding the precise mechanisms by which work stress affects teachers' well-being through affective rumination and work engagement. This study aimed to construct a mediation model to explore whether work stress is indirectly related to teachers' well-being via affective rumination and work engagement. The findings, implications, and limitations are presented below.

Findings

The results of the study indicated a direct and negative relationship between work stress and well-being among primary and secondary school teachers. This finding not only corroborates previous research establishing a negative correlation between work stress and teachers' well-being [11] but also aligns with the proposition that higher levels of work stress are associated with reduced happiness among teachers [10]. From a theoretical perspective, these results strongly support the COR theory, which posits that work stress depletes teachers' psychological resources, thereby impairing their ability to maintain well-being [62]. One potential explanation is that work-induced stress can diminish job enthusiasm, decrease job satisfaction, and consequently affect well-being levels. Additionally, sustained work stress may lead to physiological illnesses such as heart disease, hypertension, and ulcers [63], further impacting well-being. This study further substantiates the idea that work stress is a predictive factor of teachers' well-being.

Affective rumination was identified as a significant partial mediator between work stress and well-being among primary and secondary school teachers. This finding is consistent with previous research suggesting a negative relationship between work stress and affective rumination [31–32], as well as between affective rumination and teachers' well-being [34, 36]. These findings further support the Wu et al.'s notion that affective rumination plays a mediating role between work stress and teachers' well-being [15]. From the perspective of the Job Demands-Resources (JD-R) Model, work stress, as a job demand, depletes teachers' psychological resources, leading to increased affective rumination as a maladaptive coping mechanism. These results support the notion that work stress is instrumental in shaping affective rumination, which subsequently affects teachers' well-being.

Work engagement was found to play a significant partial mediating role between work stress and well-being among primary and secondary school teachers. This finding is consistent with previous research suggesting a negative relationship between work stress and work engagement [2, 39], as well as between work engagement and teachers' well-being [18, 44]. According to COR theory, work engagement can be seen as an individual resource that helps resist or mitigate the loss of resources caused by work stress, thereby reducing its negative impact on well-being. From the perspective of the JD-R Model, work engagement acts as a motivational process that buffers the negative effects of job demands (e.g., work stress) on well-being. This study reiterates the importance of work engagement in the dynamic between work stress and teachers' well-being.

The study notably demonstrated that affective rumination and work engagement operate in a sequential chain of indirect effects within the context of work stress and well-being among primary and secondary school teachers. The underlying reason for this dynamic is that work stress is perceived as a potential threat to teachers' valuable resources. The immediate reaction to such a threat is affective rumination, where teachers may become excessively preoccupied with negative emotions and stressors, potentially depleting their emotional resources. Teachers who engage in affective rumination may transition into a state of diminished work engagement, marked by low levels of vigor, dedication, and absorption. This transition

not only reduces the capacity for more positive utilization of existing resources but also diminishes their sense of well-being. It is important to note that although both affective rumination and work engagement as mediators were established, their effect sizes were 0.668 and 0.249, respectively, which were higher than the effect of serial mediation. This indicates that the mediation of affective rumination has a more significant impact on teachers' well-being. This suggests that when intervening in teachers' well-being at the school level, cultivating affective rumination should be given greater priority.

Implications

The study yields implications of both theoretical and practical implications. Theoretical implications are as follows: Firstly, this research offers a comprehensive analysis of the impact of work stress on teachers' well-being, contributing to the literature on well-being antecedents and addressing the research gap concerning the relationship between work stress and well-being. By integrating COR Theory and the JD-R Model within the unique context of Chinese primary and secondary education, the study validates the logical sequence "stressors → resource conservation mechanisms → work behaviors → well-being". This integration not only sheds light on the dynamic resource processes in educational settings but also demonstrates how cultural and institutional factors in China shape these mechanisms, thereby reinforcing the influence of resource supplementation and consumption on well-being. Secondly, the introduction of affective rumination and work engagement as mediating variables substantiates the relevance of affective rumination in well-being research while advancing theoretical understanding of their interplay. The findings demonstrate how the JD-R Model's motivational and health impairment processes operate sequentially in the Chinese educational context, with affective rumination representing resource depletion and work engagement reflecting resource investment. This sequential mediation provides a more nuanced understanding of the psychological processes linking work stress and well-being.

Practical implications are as follows: Firstly, to mitigate stress, educational administrators should prioritize reducing teachers' workloads, potentially through smaller class sizes, streamlined administrative tasks, and rationalized assessment practices, fostering a more congenial environment for effective teaching [7]. Specifically, evidence-based interventions such as mindfulness-based stress reduction (MBSR) programs and cognitive-behavioral therapy (CBT) workshops could be implemented to equip teachers with practical tools for stress management [64–65]. Secondly, to reduce affective rumination, schools should offer ample care and support, including timely psychological counseling and encouragement, to mitigate chronic rumination and assist staff in managing performance pressures. Structured interventions, such as rumination-focused cognitive training and positive psychology exercises, could be introduced to help teachers break the cycle of negative thinking and build emotional resilience. Regular collection of feedback on work experiences, with adjustments to performance targets for those exhibiting high levels of affective rumination, can prevent resource depletion and associated negative impacts, offering enhanced emotional support for employees [17]. Thirdly, to bolster work engagement, schools should supply necessary resources and support to alleviate teachers' administrative burdens, enabling them to focus more on teaching and student development. Establishing a fair evaluation system that acknowledges and rewards teachers' efforts and achievements can increase their work engagement and loyalty. Additionally, peer support programs and mentorship initiatives could foster a collaborative work environment, further enhancing engagement and well-being.

Limitations and future research directions

This study, while offering valuable insights, has several limitations that suggest directions for future research. Firstly, the reliance on cross-sectional questionnaires to examine the relationships among primary and secondary school teachers' work stress, affective rumination, work engagement, and well-being may be subject to cultural and cognitive biases that could influence the results' credibility. Given the dynamic and fluctuating nature of these variables, future studies could employ longitudinal designs, diary methods, or phase-by-phase data collection to capture temporal variations and enhance the robustness of findings. Secondly, the sample in this study was limited to teachers from a select few schools in Jiangsu Province, which may constrain the generalizability of the findings. Future research should expand the participant selection to diverse regions to enhance the representativeness of the sample and strengthen the conclusions drawn from the study. Thirdly, while this study investigated affective rumination and work engagement as mediators between work stress and well-being, it acknowledged that well-being is a multifaceted construct influenced by additional factors such as social relationship, motivation, and self-assessment. Other potential mediators, including coping strategies, personality traits, and organizational support, could further clarify this relationship. Future studies should broaden the scope of variables considered to yield more robust results and to provide practical recommendations that can be applied in educational settings.

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Author contributions
YS designed the study, performed the statistical analysis, and contributed to writing the manuscript. HZ collected the data and proofread the English expression. CZ and WJ contributed to revising the manuscript. WX collected the data and performed the statistical analysis. All authors have read and approved the final manuscript.

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Data availability
The datasets generated and/or analysed during the current study are not publicly available due to ethical issues but are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate
This manuscript is not under review elsewhere and the results have not been published previously or accepted for publication. This manuscript has been seen and approved by all authors. All methods were performed in accordance with the relevant guidelines and regulations. The questionnaire and methodology for this study was approved by the research ethics committee of at Qufu Normal University before data collection.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

Informed consent
Written informed consent was obtained from all participants included in the study.

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