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Original article

Enhancing Workplace Well-being: Unveiling the Dynamics of Leader–Member Exchange and Worker Safety Behavior Through Psychological Safety and Job Satisfaction

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ABSTRACT

Background: In healthcare, ensuring safety is crucial for quality care and patient outcomes. While research links leader–member exchange (LMX) quality to safety behavior, this remains understudied in healthcare. Our study explores LMX's long-term impact on safety behavior, proposing a model that includes the moderated mediating role of psychological safety and job satisfaction in the relationship between LMX and safety behaviors, regarding compliance (SCB) and participation (SPB). By identifying the mechanisms through which LMX influences safety behavior, this study can provide insights into the development of interventions that promote workplace safety and enhance the well-being of healthcare workers.

Methods: We collected data from 325 Algerian healthcare workers across three public hospitals at three points. Through SmartPLS analysis, we used advanced features of Partial Least Squares Structural Equation Modeling (PLS-SEM) alongside PROCESS analysis to evaluate the relationships within our proposed model.

Results: Our analysis found a significant association between higher LMX and increased job satisfaction that positively correlated with enhanced SCB adherence and mediated the LMX–SCB relationship. This relationship was strengthened with high psychological safety.

Conclusion: Our study emphasizes the crucial role of LMX quality in shaping safety behavior among Algerian healthcare workers, providing insights for cultivating a safety culture in healthcare settings, highlighting the significance of prioritizing LMX, JS, and PS to improve workplace safety and support healthcare worker well-being.

1. Introduction

In the dynamic world of healthcare, ensuring worker safety and well-being is the cornerstone of an organization's success. The healthcare industry experienced a significant increase in reported injuries in 2017, totaling 548,100 cases [1]. Researchers have devoted much effort to examining safety behaviors (SBs) due to the unclear origins of accidents and injuries. SB encompasses "actions or conduct displayed by individuals across various occupations to uphold the well-being and safety of workers, clients, the public, and the environment" [2]. These behaviors are divided into two primary categories [3]: safety compliance (SCB) and safety participation (SPB). SCB involves "the fundamental activities necessary for maintaining workplace safety" [4]. SPB includes "actions that do not directly contribute to an individual's personal safety but foster an environment conducive to safety" [4]. Researchers have

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explored factors influencing workers' SB to enhance safety programs' effectiveness [5,6].

Amid the complex challenges faced by healthcare organizations, leadership dynamic emerges as a critical determinant of employee well-being and safety [7,8]. At the heart of this inquiry lies the notion of leader–member exchange (LMX), a construct that explains the quality of relationships between leaders and their followers. LMX refers to "a mutual process wherein leaders and subordinates engage in resource exchange" [9]. This dynamic entails the reciprocal sharing of resources, including information, support, and recognition, grounded in mutual trust, respect, and obligation [9].

Previous research extensively examines how diverse leadership styles (authentic, transformational, and transactional) influence SB [10–12], demonstrating positive links. This highlights leadership's crucial role in cultivating workplace safety. Positive relationships between leaders and followers contribute to cultivating a favorable safety climate [13]. Buttigieg's systematic review [14] underscores the significance of LMX in predicting patient safety indicators in hospital settings. Research in high-risk industries indicates a supportive link between LMX and safety performance [15], emphasizing its role across diverse organizational contexts. While LMX theory highlights the significance of the leader–subordinate relationship in attaining organizational objectives, empirical research on its impact on SB remains limited.

LMX can influence employee SB through direct and indirect pathways [16]. Therefore, it is imperative to identify the essential factor that can amplify this favorable. Current research indicates a positive correlation between job satisfaction (JS), job performance, and organizational culture [17]. JS is defined as "the pleasurable or positive emotional state derived from one's assessment of their job or work experiences" [18]. According to LMX theory, there is a positive correlation between LMX and JS [19–21]. Longitudinal research has paid little attention to investigating LMX as a predictor of JS, with only a few delving into this area [19,21,22]. However, the healthcare industry often overlooks the significance of individual emotional responses to work, such as JS.

Based on the above literature and the research model depicted in Fig. 1, we hypothesize that LMX positively influences JS, which in turn impacts SCB and SPB, two complementary aspects of workplace safety. Specifically:

H1. LMX is positively associated with employee JS.
H2. JS is positively associated with SCB.
H3. JS is positively associated with SPB.

Given the weight of SB, JS emerges as another crucial element that can showcase a positive attitude and encourage proactive behavior [23]. JS motivates adherence to safety rules and activities, fostering a positive attitude toward safety-related tasks [24], which can increase positive influence toward SB. Several studies support the mediator role of JS in relationships associated with performance aspects. Ni et al [25] highlighted JS's role in promoting SB, encouraging compliance and knowledge sharing. Crede et al [26] revealed JS mediating relationships between antecedent variables and workplace behaviors. Ancarani et al [27] demonstrated JS's mediation in the relationship between work–family conflict and SPB. Positive LMX interactions are expected to increase JS, which then promotes both SCB and SPB, thereby enhancing overall safety performance. Thus, we hypothesize that:

H4. JS mediates the relationship between LMX and SCB.
H5. JS mediates the relationship between LMX and SPB.

The suggestion that LMX consistently boosts employee JS and improves worker SPB oversimplifies organizational dynamics. While positive supervisor relationships usually enhance JS, this is not universally applicable. Situational factors may moderate this, altering its intensity or direction. Researchers emphasize the necessity of open communication between leaders and followers to ensure high-quality LMX [28,29]. We speculate that cultivating psychological safety (PS) can facilitate such relationships and strengthen bonds between leaders and employees [30].

PS has emerged as a vital factor that may enhance leader–employee relationships, particularly within the framework of LMX. While Edmondson [30] defines PS as "a shared belief among individuals within a workplace regarding whether it's safe to engage in interpersonal risk-taking," this belief significantly affects employee openness and willingness to seek feedback, engage in honest communication, collaborate, and innovate [31]. This foundation allows employees to engage fully, which, as highlighted by Dramanu et al [32], is critical for assessing how leadership influences employees' attitudes and behaviors [33].

Research has directly linked PS to improved work performance [34,35] and demonstrated its ability to enhance work engagement through factors like organizational support, safety climate, and performance outcomes [36,37]. Although PS's specific role as a moderator between LMX and SBs has been underexplored, studies examining safety climate as a moderator suggest that PS could serve a similar purpose. For example, the moderating effect of safety climate on the relationship between LMX and safety citizenship behavior suggests the potential for PS to play a parallel role [38].

Furthermore, PS has often been examined as a mediating factor in organizational contexts, influencing aspects like voice behavior and the dynamics of LMX [39], which could have relevant implications for SBs. This relationship has yet to be fully examined, and current literature points to valuable pathways through which PS could enhance the positive effects of LMX on SBs, presenting promising directions for future research.

The broader organizational behavior literature shows PS as a potent moderator, particularly enhancing outcomes in team creativity, performance, and cooperation; for example, [40,41]. For

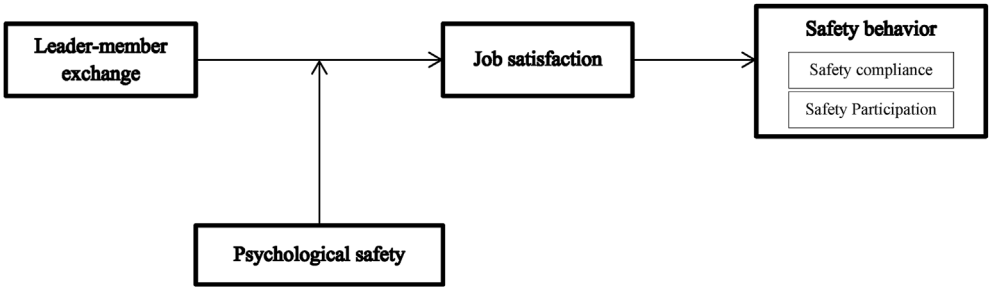

Fig. 1. Theoretical model.

instance, Gao et al [33] demonstrated that PS significantly strengthens the link between LMX and affective commitment, while Yang et al [42] found that PS amplifies thriving at work and employee creativity. These findings support our proposed model, where PS plays an essential role in moderating the influence of LMX on SBs, underscoring the need for further exploration in this area.

Drawing on the Conservation of Resources (COR) theory, JS is viewed as both an outcome and a resource that individuals seek to attain and safeguard in the workplace [43]. Likewise, LMX represents valuable information or resources for employees, and PS serves as an interpersonal resource [33]. Different resources do not act independently; instead, they interact with each other like a traveling "caravan" [44]. The COR theory posits that individuals with abundant resources are more adept at obtaining and retaining them, experiencing less depletion [45]. Ample PS resources foster relaxed, secure environments, promoting professional growth and reducing stress [46,47]. Interacting with PS, which involves encouraging risk-taking, learning from mistakes, and supporting professional growth, enhances long-term relationships between leaders and employees. We hypothesize that by prioritizing these aspects of PS, organizations can enhance the quality of LMX relationships, leading to enhanced satisfaction among their members and consequently improving their workers' SPB. Consequently, we hypothesize that:

H6. PS moderates the indirect effect of LMX on SCB through JS such that the relationship is strengthened when PS is high.
H7. PS moderates the indirect effect of LMX on SPB through JS such that the relationship is strengthened when PS is high.

Our proposed framework seeks to deepen understanding of SBs by exploring the moderated mediation effects of JS and PS, offering new insights into promoting SBs through leader–member relationships in healthcare contexts.

2. Materials and methods

2.1. Participants and data collection

The study utilized data from a longitudinal survey conducted among healthcare workers at three public hospitals in Southeastern Algeria. A total of 750 employees voluntarily participated after receiving information about the study's purpose. They completed printed questionnaires during working hours, accompanied by a cover letter ensuring confidentiality. Data were collected over three waves to assess a moderated mediation model, aiming to establish genuine causal effects, as recommended by Cole and Maxwell [29], and to track potential changes in variables over time. This approach aimed to minimize issues related to common method bias and spurious causality, particularly in longitudinal studies [49,50]. The longitudinal investigation involved data collection at three-month intervals following standard longitudinal research procedures [51]. Additionally, respondents were instructed to include their grandparents' names in surveys for coherence across waves, following the method outlined by Carmeli et al [52]. From the first-wave survey, 520 responses were considered usable, constituting 76% of the total responses. Subsequently, baseline respondents completed a second questionnaire (T2), but only 415 responses (79.8%) were usable after matching with the first-wave data. Only these respondents proceeded to the final survey (T3), yielding 325 usable responses (89.87%). The response rate from the initial to final dataset was 35%, primarily consisting of females (74.8%). The largest age group represented in the table is the 30–40 age range, accounting for 50.6% of the participants. Nearly half (47.4%) held nursing positions, the largest group (35.1%) having less than three years of experience. Table 1 presents a summary of the sample characteristics.

2.2. Measures

2.2.1. Leader–member exchange

The study used seven items from the LMX scale to assess respondents' perceptions regarding their exchange relationships with supervisors, relying on existing research [53,54]. A sample item is "My supervisor would be personally inclined to help me solve problems in my work." Responses were measured on a five-point Likert scale (1 = strongly disagree, 5 = strongly agree). The Cronbach's alpha value was 0.926.

2.2.2. Psychological safety

PS was measured with Adair's innovative PS scale [55], which integrates elements from the Teamwork Climate and Safety Climate subscales in the SCORE survey along with Edmondson's original seven items. This concise scale consists of six items designed to target the unique cultural and environmental aspects of healthcare. A sample item is "The culture in this work setting makes it easy to learn from the errors of others" (1 = strongly disagree, 5 = strongly agree). Cronbach's alpha value was 0.746.

2.2.3. Job satisfaction

Five items adapted from Brayfield et al [56] were utilized to assess JS. A sample item is "I feel fairly well satisfied with my present job" (1 = strongly disagree, 5 = strongly agree). The Cronbach's alpha values at time points 1 and 2 were 0.780 and 0.713, respectively.

2.2.4. Safety compliance behavior

SCB was assessed with three items that measure the extent to which workers follow safety protocols and conduct their tasks in a safe manner, following the approach established by Neal and Griffin [3]. A sample item is "I use all the necessary safety equipment to do my job." The Cronbach's alpha values at the three time points (T1, T2, and T3) were 0.876, 0.899, and 0.833, respectively.

2.2.5. Safety participation behavior

Moreover, three items adapted from Neal and Griffin [3] were used to assess SPB, which entails promoting safety programs and exerting extra effort to enhance workplace safety. A sample item is "I voluntarily carry out tasks or activities that help to improve workplace safety." The Cronbach's alpha values at the three time points (T1, T2, and T3) were 0.786, 0.713, and 0.801, respectively.

Table 1
Sample characteristics (N = 325)

Demographic		Frequency	Percentage (%)
Gender	Male	82	25.2
	Female	243	74.8
Age group	Less than 30	101	31.2
	30-40	164	50.6
	41-50	37	11.3
	51 years or older	22	6.9
Work experience	Less than 3	114	35.1
	4-10	96	29.5
	11-15	62	19.1
	16-20	23	7.1
	20 years or older	30	9.2
Professions	Nurses/nurse assistants	154	47.5
	Physicians	50	15.5
	Laboratory	45	13.7
	Another position	76	23.3

2.2.6. Control variables

Considering that existing studies indicated associations between age and SCBs [57,58], as well as gender and work experience affecting employees' perceptions of behavioral safety [59], gender (1 = "male," 2 = "female"), age (in years), and work experience (in years) were included as control variables in the SEM model for this study.

2.3. Data analysis

The current research investigates a moderated mediation model involving LMX, SCB, and SPB, with a focus on JS as a mediator and PS as a moderator. To understand these relationships, a thorough SmartPLS analysis was conducted using the two-stage method of Hair et al [60].

Initially, the measurement model's reliability and validity were carefully assessed through advanced features of PLS-SEM within SmartPLS. Subsequently, we proceeded to examine the structural model to evaluate the significance of the proposed hypotheses, utilizing the SmartPLS 4 PROCESS tool. This versatile tool encompasses conditional process analysis (CPA) and integrates mediation and moderation analysis. CPA is utilized when an investigator hypothesizes or theorizes that the mechanism by which one variable influences another through one or more mediators is dependent on the size or value of one or more moderator variables [61]. Through this tool, we gain valuable insights into the moderated mediating effects between exogenous and endogenous variables, aligning with theoretical frameworks and statistical guidelines established by Hayes [61]. Its functionality closely mirrors the outcomes produced by the PROCESS macro in SPSS. The model analyzed in our study bears similarity to Hayes Process Macro Model 7.

In each analysis, control variables representing individual differences that might be associated with one or more of our dependent variables were incorporated into the model. Specifically, age, gender, and work experience were included to enhance the accuracy of estimating the relationships among the variables of interest. To address common method bias (CMB), we conducted Harman's single-factor test. The results, explaining 28% of the overall variance, indicate that CMB may not be a significant issue in our study.

3. Results

3.1. Descriptive statistics

Table 2 illustrates the descriptive statistics and the correlation matrix among the study variables. T1-LMX positively correlated with T2-JS ($r = 0.221$, $p < 0.001$), while T2-JS related to both T3-SCB ($r = 0.323$, $p < 0.001$) and T3-SPB ($r = 0.253$, $p < 0.001$). These results can lay the groundwork for further data analysis.

3.2. Assessment of measurement model

The statistical assessment of the measurement model encompasses both convergent and discriminant validity. To ensure convergent validity, we computed factor loadings, composite reliability (CR), and average variance extracted (AVE) [62]. All items were required to have factor loadings exceeding 0.7 to be deemed acceptable [63]. In line with the suggestion of Hair et al [40], items below 0.4 in loadings were targeted for removal, while those between 0.4 and 0.7 were under consideration for deletion, contingent upon enhancing CR or AVE. Consequently, specific items from constructs T1-PS, T1-JS, T2-JS, and T3-JS with low factor loadings (below 0.4) were initially excluded to enhance the AVE. Specifically, item T1-PS6 was removed from the PS construct, while items T1-JS1, T1-JS5, T2-JS1, and T2-JS5 were deleted from the JS construct

Table 2
Descriptive statistics and correlation of study variables

	Mean	SD	α	CR	AVE	1	2	3	4	5	6	7	8	9	10	11	12	13
1. T1-JS	3.971	0.778	0.780	0.820	0.604													
2. T1-LMX	3.739	0.937	0.926	0.940	0.692	0.104												
3. T1-PS	3.964	0.746	0.835	0.882	0.602	0.315***	0.092											
4. T1-SCB	3.919	0.951	0.876	0.923	0.801	0.209***	-0.118***	0.129***										
5. T1-SPB	3.996	0.705	0.786	0.826	0.635	0.193***	0.087	0.184***	0.440***									
6. T2-JS	4.162	0.658	0.713	0.790	0.560	0.472***	0.221***	0.472***	0.235***	0.176***								
7. T2-SCB	3.907	0.965	0.899	0.937	0.833	0.005	-0.067	0.544***	0.623***	0.303***	0.256***							
8. T2-SPB	4.141	0.630	0.713	0.839	0.635	0.145**	0.143**	0.307***	0.319***	0.647***	0.294***	0.382***						
9. T3-SCB	4.053	0.777	0.833	0.900	0.750	0.121**	-0.075***	0.22***	0.788***	0.375***	0.323***	0.74***	0.438***					
10. T3-SPB	3.952	0.800	0.801	0.883	0.715	0.129**	0.134**	0.524***	0.251***	0.444***	0.253***	0.567***	0.555***	0.366***				
Control variables																		
11. Age	31.36	9.520	—	—	—	0.376***	0.160***	0.851***	0.091***	0.163***	0.440***	0.414***	0.215***	0.129***	0.467***			
12. Experience	3.919	0.951	—	—	—	0.209***	-0.118***	0.129***	0.043***	0.44***	0.235***	0.623***	0.319***	0.788***	0.251***	0.091		
13. Gender	1.748	0.434	—	—	—	-0.085	0.044	-0.098***	0.102***	0.047	0.057	0.024	0.043	0.052	0.027	-0.072	0.102	

**, $p < 0.01$; ***, $p < 0.001$.
α, Cronbach's alpha; AVE, average variance extracted; CR, composite reliability; JS, job satisfaction; LMX, leader–member exchange; PS, psychological safety; SCB, safety compliance behavior; SPB, safety participation behavior.

in line with the recommendations of Hair et al. These adjustments enhanced the measurement model's psychometric properties, ensuring more reliable constructs for further analyses.

Table 3 displays strong loadings (0.639 to 0.938) for most items, indicating valid measures for their constructs. All constructs have AVE >0.5 and CR > 0.7 (Table 2), meeting recommended thresholds [63,64] and affirming convergent validity.

Heterotrait-monotrait ratio (HTMT) was conducted to assess discriminant validity [65], revealing that all pairs in Table 4 were below 0.90, which indicates distinct constructs. Subsequently, both convergent and discriminant validity were established.

3.3. Structural model assessment

The second step involves examining the structural model through evaluations of R-squared (R^2) and path coefficients. R^2 values, commonly used in regression analysis to assess model fit, gauge the model's predictive capacity by indicating the percentage of variance in the endogenous variable explained by the exogenous variable. In Fig. 2, the prediction of T3-SCB relied on baseline LMX, T2-JS, and T2-SCB, explaining 75.6% of the variance. Similarly, T1-JS and T1-SCB together accounted for 40.5% of the variance in T2-SCB. Additionally, T3-SPB's prediction involved baseline LMX, T2-JS, and T2-SPB, explaining 44.6% of the variance, while T1-JS and T1-SPB explained 41.9% of the variance in T2-SPB. T2-JS was also predicted with a variance of 40.2%, indicating satisfactory predictive accuracy of the structural model. Additionally, the model fit was assessed using the standardized root mean square residual (SRMR) which assesses the disparities between observed and expected correlations. The SRMR values were 0.076 for the saturated model and 0.110 for the estimated model, further validating the structural model's adequacy. The multicollinearity issue was evaluated by computing the VIF for the endogenous constructs, all of which exhibited VIF values below the threshold of 5 [60].

3.3.1. Hypothesis testing

To test our study hypotheses and validate the research model, we used bootstrapping analysis with 5000 resamples [64]. The findings regarding the hypothesized relationships are outlined in Table 5. LMX has a significant impact on employee JS ($\beta = 0.134$, $p < 0.001$), confirming H1. Similarly, JS significantly influences SCB ($\beta = 0.175$, $p < 0.001$), supporting H2. However, the lack of

Table 3
Factor loadings of the items

Construct	Measurement statement	λ
Leader–member exchange		
LMX1	My supervisor would be personally inclined to help me solve problems in my work.	0.798 (T1)
LMX2	My working relationship with my supervisor is effective.	0.848 (T1)
LMX3	My supervisor considers my suggestions for change.	0.805 (T1)
LMX4	My supervisor and I are suited to each other.	0.807 (T1)
LMX5	My supervisor understands my problems and needs.	0.857 (T1)
LMX6	My supervisor recognizes my potential.	0.867 (T1)
LMX7	I have enough confidence in my supervisor that I would defend and justify his/her decisions if he or she were not present to do so.	0.837 (T1)
Psychological safety		
PS1	The culture in this work setting makes it easy to learn from the errors of others	0.690 (T1)
PS2	It is easy for personnel here to ask questions when there is something that they do not understand	0.871 (T1)
PS3	Disagreements in this work setting are appropriately resolved	0.788 (T1)
PS4	In this work setting, it is difficult to discuss errors (Reverse-Scored)	0.797 (T1)
PS5	My suggestions about quality would be acted upon if I expressed them to management	0.720 (T1)
Job satisfaction		
JS2	I feel fairly well satisfied with my present job.	0.854 (T1) 0.844 (T2)
JS3	I feel that I am happier in my work than most other people.	0.731 (T1) 0.640 (T2)
JS4	I find real enjoyment in my work.	0.741 (T1) 0.747 (T2)
Safety compliance behavior		
SCB1	I use the correct safety procedures for carrying out my job.	0.882 (T1) 0.903 (T2) 0.852 (T3)
SCB2	I use all the necessary safety equipment to do my job.	0.915 (T1) 0.938 (T2) 0.895 (T3)
SCB3	I ensure the highest levels of safety when I carry out my job.	0.888 (T1) 0.896 (T2) 0.850 (T3)
Safety participation behavior		
SPB1	I put in extra effort to improve the safety of the workplace.	0.805 (T1) 0.820 (T2) 0.865 (T3)
SPB2	I promote the safety program within the organization.	0.809 (T1) 0.779 (T2) 0.872 (T3)
SPB3	I voluntarily carry out tasks or activities that help to improve workplace safety.	0.734 (T1) 0.790 (T2) 0.799 (T3)

λ = factor loadings; T1, T2, T3 = Time 1, Time 2, Time 3, respectively.

Table 4
Discriminant validity (HTMT)

	1	2	3	4	5	6	7	8	9	10	11	12	13
1. Age													
2. Experience	0.096												
3. Gender	0.072	0.109											
4. T1-JS	0.461	0.271	0.131										
5. T1-LMX	0.167	0.130	0.047	0.148									
6. T1-PS	0.830	0.156	0.118	0.436	0.118								
7. T1-SCB	0.096	0.142	0.109	0.271	0.130	0.156							
8. T1-SPB	0.197	0.568	0.065	0.313	0.117	0.242	0.568						
9. T2-JS	0.564	0.319	0.073	0.736	0.297	0.661	0.319	0.274					
10. T2-SCB	0.437	0.702	0.012	0.110	0.085	0.629	0.702	0.384	0.343				
11. T2-SPB	0.255	0.406	0.058	0.213	0.175	0.397	0.406	0.828	0.445	0.477			
12. T3-SCB	0.141	0.821	0.056	0.171	0.100	0.265	0.821	0.495	0.452	0.854	0.571		
13. T3-SPB	0.520	0.303	0.031	0.192	0.155	0.639	0.303	0.599	0.362	0.667	0.735	0.450	

JS, job satisfaction; LMX, leader–member exchange; PS, psychological safety; SCB, safety compliance behavior; SPB, safety participation behavior.

significant impact on SPB leads to the rejection of H3. As control variables for regulating both components of SB, both age and experience were found to be significant, whereas gender was not significant, as presented in Table 6.

The analysis explores mediation and moderated mediation within the estimated longitudinal path model, taking into account variables such as respondents' age, gender, work experience, and work position. Additionally, the effects of the predictor variable on the outcome variable are examined with a two-unit time lag in this three-wave model, following the methodology recommended by Maxwell et al [66]. Utilizing two-unit time lag models circumvents the necessity for semi-longitudinal designs, where the impact of the independent variable on the mediator or the mediator's effect on the dependent variable is assessed simultaneously [48,67]. We investigated the mediation hypothesis by assessing whether Time 1 LMX influences Time 3 SCB and SPB through Time 2 JS, while controlling for prior levels of JS (T1-JS), SCB (T1-SCB, T2-SCB), and SPB (T1-SPB, T2-SPB).

Although the direct influence of T1-LMX on T3-SCB was deemed not significant ($\beta = 0.005$, $p > 0.05$), our findings indicated that T1-LMX positively and significantly influenced T3-SCB via its distinct indirect effect on JS at Time 2 ($\beta = 0.023$, $p < 0.05$), indicating full mediation, thus supporting **H4**. The lack of a significant p-value suggests that JS does not serve as a mediator in the LMX–SPB relationship (β = -0.012, $p > 0.05$). Thus, hypothesis **H5** was not supported.

The findings pertaining to the moderation mediation effect concerning **H6** and **H7** are as follows. Overall, the results suggest that the moderated mediation model was positively supported for the outcome variable SCB, with an index of 0.030 [95% confidence interval (CI) = 0.001; 0.056].

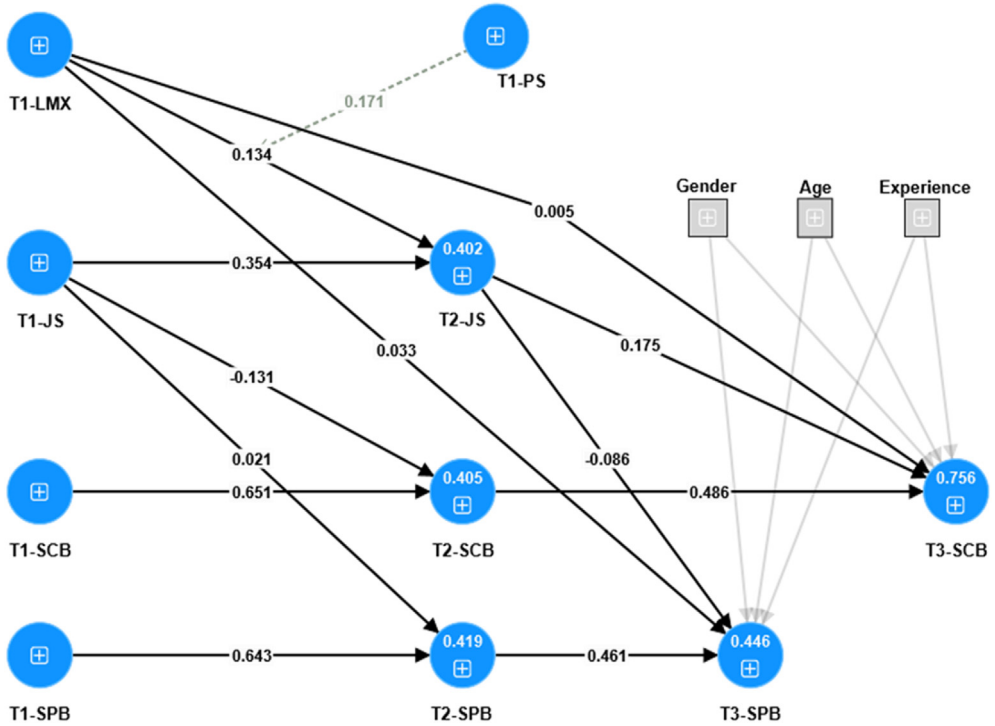

Fig. 2. Estimated longitudinal moderated mediation path models. JS, job satisfaction; LMX, leader–member exchange; PS, psychological safety; SCB, safety compliance behavior; SPB, safety participation behavior.

Table 5
Results of hypothesis testing

Path	Std. coeff	SD	t-value	CI (2.5%, 97.5%)	Accepted
T1-LMX - > T2JS	0.134***	0.129	0.046	(0.034, 0.217)	**H1: Yes**
T2-JS - > T3-SCB	0.175***	0.129	0.046	(0.090, 0.257)	**H2: Yes**
T2-JS - > T3-SPB	-0.086	0.129	0.046	(-0.269, 0.115)	**H3: No**
Mediation effect					
T1-LMX→T2-JS→T3-SCB					
Total effect	0.028	0.026	1.537	(-0.011, 0.092)	**H4: Fully mediation**
Direct effect	0.005	0.026	0.681	(-0.035, 0.070)	
Indirect effect	0.023**	0.010	2.314	(0.005, 0.044)	
T1-LMX→T2-JS→T3-SPB					
Total effect	0.021	0.049	0.271	(-0.082, 0.109)	**H5: No mediation**
Direct effect	0.033	0.043	0.566	(-0.060, 0.108)	
Indirect effect	-0.012	0.014	0.781	(-0.039, 0.017)	
Moderated mediation effect					
T1-PS x T1-LMX - > T2-JS - > T3-SCB	0.030**	0.014	2.018	(0.001, 0.056)	**H6: Yes**
T1-PS x T1-LMX - > T2-JS - > T3-SPB	0.015	0.020	0.715	(-0.017,0.069)	**H7: No**

***, $p < 0.001$; ** = $p < 0.01$.
JS, job satisfaction; LMX, leader–member exchange; PS, psychological safety; SCB, safety compliance behavior; SPB, safety participation behavior.

As per the theoretical framework of the study, achieving moderated mediation involves the conditional indirect effect of LMX on SCB through JS differing across various levels of PS. For examining moderated mediation, Hernandez et al [68] outlined three conditions. Firstly, the indirect effect must be statistically significant. Secondly, an apparent interaction between the mediator and moderator must be present when predicting the outcome variable. Lastly, the predictor should exhibit varying conditional effects on the outcome at different levels of the moderator (one standard deviation above and below the mean). To fulfill this criterion for moderated mediation, the analysis investigated elevated and reduced levels of PS (1 ± SD). As outlined in Table 6, the indirect effect of LMX on SCB via JS was found to be strongest at the upper level of PS (+1 SD) (0.053) and weakest at the lowest level of PS (-1 SD) (0.006). This outcome is statistically significant, as indicated by bootstrap resampling with 5,000 iterations, where no overlap was observed between the CIs at the bottom and top limits. These findings provide support for **H6**. Additionally, the overall moderated mediation model for the outcome variable SPB was not supported, with an index of 0.015 (95% CI = −0.017; 0.069), and hence hypothesis **H7** was rejected.

4. Discussion

A three-wave study design was employed to explore the moderated mediating effect of JS and PS on the association between LMX and both SB components (SCB and SPB) among Algerian healthcare workers (HCWs).

Despite the limited number of longitudinal studies investigating the effect of LMX on JS in the healthcare sector, our findings demonstrate a positive link, consistent with previous research [69–72]. Several explanations in existing literature support this link: High-quality exchanges provide intrinsic (empowerment, decision-making) and extrinsic (salary, advancement) resources [22], fostering satisfaction. Additionally, members in such exchanges feel privileged and superior (Locke, 1976), further enhancing satisfaction. Employees in high LMX relationships enjoy enriched jobs with

Table 6
Conditional analysis of moderated mediation model

Type of effect		Coefficient	SD	95% CI	
				Lower	Upper
Conditional direct effect	**T1-LMX - > T2-JS**	0.037**	0.066	0.104	0.155
	High level of PS (T1-PS at +1 SD+)				
	Average level of PS (T1-PS at Mean)	0.134***	0.046	0.034	0.217
	Low level of PS (T1-PS at -1 SD)	0.306***	0.098	0.073	0.459
Conditional indirect effect	**T1-LMX - > T2-JS - > T3-SCB**	0.053**	0.012	0.010	0-.096
	High level of PS (T1-PS at +1 SD)				
	Average level of PS (T1-PS at Mean)	0.023**	0.010	0.005	0.044
	Low level of PS (T1-PS at -1 SD)	0.006**	0.022	0.030	0.017
	T1-LMX - > T2-JS - > T3-SPB	0.003	0.010	-0.009	0.031
	High level of PS (T1-PS at +1 SD)				
	Average level of PS (T1-PS at Mean)	-0.012	0.014	-0.039	0.017
	Low level of PS (T1-PS at -1 SD)	-0.026	0.032	-0.093	0.031
	Control variables				
	Age < - T3-SCB	-0.193***	0.053	-0.306	-0.096
	Age < - T3-SPB	0.394***	0.111	0.155	0.586
	Experience < - T3-SCB	0.465***	0.079	0.297	0.611
	Experience < - T3-SPB	0.089**	0.042	0.008	0.174
	Gender < - T3-SCB	-0.020	0.068	-0.079	0.037
	Gender < - T3-SPB	0.030	0.099	-0.058	0.114

***, $p < 0.001$; ** = $p < 0.01$.
CI, confidence interval; JS, job satisfaction; LMX, leader–member exchange; PS, psychological safety; SCB, safety compliance behavior; SD, standard deviation; SPB, safety participation behavior.

optimal characteristics (Lapierre et al, 2006), heightening satisfaction (Parker & Ohly, 2008).

Our findings revealed that hospital staff's SCB was predicted by JS. The result is coherent with other studies [24]. Good JS may promote compliance with safety protocols, influencing SCB. In light of the findings, it is reasonable to conclude that satisfied employees are more likely to proactively report safety concerns, identify hazards, and adhere to safety procedures, fostering a stronger sense of personal safety responsibility.

Studies conducted previously in healthcare have presented conflicting findings regarding the association between safety leadership and SB, with the majority of models suggesting mediation by one or more variables [27]. This study affirms JS's importance as a mediator between LMX and SCB. Incorporating JS into hospital safety management offers empirical support for its beneficial effects on compliance with safety, suggesting an individual's emotional state influences this link. Findings imply enhancing JS is more efficient in encouraging SCB among HCWs compared to SPB, perhaps due to HCWs' inherent pro-social characteristics. Several explanations could account for this result. First, SPB involves voluntary and discretionary actions that go beyond an employee's core job responsibilities, such as participating in safety initiatives or helping colleagues adhere to safety protocols. These behaviors may be more closely linked to intrinsic motivations or a strong commitment to safety culture rather than overall JS. It is possible that employees who are committed to their organization or have strong safety values are more likely to engage in SPB, regardless of how satisfied they are with their job in general. Second, the relationship between JS and SPB may be moderated by other factors, such as the organizational safety climate or the quality of leadership. For instance, a positive safety climate or supportive leadership may encourage SPB more effectively than JS alone. Employees might engage in SPB when they perceive strong support for safety from their leaders or when they believe that their efforts will be recognized and rewarded.

The present study deepens the understanding of the role of PS. Previous studies have not looked much into how LMX and SB are connected from a cognitive perspective. This research confirms that PS plays a key role in how LMX indirectly affects SCB through employee JS. In environments where employee PS is high, the positive effects of LMX on JS are expected to be strengthened, leading to enhanced worker SCB. Conversely, in environments characterized by low PS, the relationship between LMX and JS may be weakened, thereby diminishing the impact on worker SCB.

The present study offers healthcare managers and top management teams' valuable insights into the importance of monitoring employee levels of PS and JS to assess the potential positive impact of LMX quality on SB. The findings highlight that LMX enhances SCB by elevating employee levels of PS and JS. Thus, the levels of PS and JS serve as indicators to determine whether the quality of exchange, such as LMX, positively influences safety within healthcare organizations. Incorporating age and experience as control variables emerged as vital predictors, enriching and complicating our comprehension of the factors impacting SB in this context.

While the study contributes theoretically and offers practical implications, it also has limitations; however, it offers potential for future research. As it focused solely on Algeria's healthcare sector, this study could not fully account for cultural influences. Thus, we must interpret the study's results regarding SB phenomena in diverse cultures with caution. Regarding data collection, reliance on a single source highlights issues regarding common method variance [73]; a longitudinal survey design can help control this bias [74]. This study utilized a longitudinal design with three measurement points to reduce the chance of common technique bias [73], but complete elimination is difficult. Future researchers can enhance their results by gathering data from various sources. Additionally, this study collected data from public hospitals. Future investigations might delve into this matter within private hospital settings to verify the present findings and support the influence of LMX on both components of SB. Additionally, the LMX measure solely incorporated the viewpoint of the employee, providing insights into members' general perceptions of their association with a particular leader (supervisor), which could be considered a limitation. Perspectives from both employees and leaders seem to assess different facets of the relationship.

The previous study on LMX and SB overlooked situational factors. This study explores the variability in the association among LMX, e JS, and SCB, broadening the literature on PS and promoting the study of situational factors. Future research could identify additional moderators and mediators, enhancing the hypothesized model and clarifying the study's findings. By including employee perceptions and attitudes as mediators and moderators, researchers can better understand the extent of LMX's influence on worker SB, thus enriching the existing knowledge base.

Hospital senior management ought to adopt both formal and informal approaches to encourage social exchange. These could include conducting regular supervisor interviews, implementing communication training initiatives, establishing dispute resolution mechanisms, and providing leadership training for supervisors to enhance their leadership capabilities. By employing these management tactics, trust and loyalty between leaders and members can be fostered. Recognizing the significance of fostering LMX within a safe workplace, it is imperative for hospital senior management to engage in practices that cultivate an environment free from apprehensions and doubts. This can be achieved by adopting strategies that enhance employees' attitudes and perceptions, such as improving PS and JS, resulting in enhanced SB among HCWs.

CRediT authorship contribution statement

Aida Bennouna: Writing – review & editing, Writing – original draft, Validation, Software, Resources, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Salim Djabou:** Writing – review & editing, Writing – original draft, Validation, Software, Methodology, Formal analysis, Data curation, Conceptualization. **Assia Boughaba:** Writing – review & editing, Writing – original draft, Supervision, Project administration, Methodology, Investigation, Conceptualization. **Mohamed Mouda:** Writing – review & editing, Writing – original draft, Supervision, Project administration, Conceptualization.

Conflicts of interest

The researcher declares no conflict of interest.

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