


Investigating the Effects of Role Demands, Psychosocial Stress Symptoms and Safety Leadership on Mineworkers' Safety Performance

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Purpose: This study aimed to investigate the effects of role demands on safety performance in mining companies under the mediating role of psychosocial stress symptoms. Three dimensions of safety leadership were also tested as moderators on the relationship between psychosocial stress symptoms and safety performance.

Methods: To collect data to analyze the hypothesized relationships in the present study, a total of 850 questionnaires were distributed to mineworkers in Ghana. Hierarchical regression analysis was employed as the main statistical technique in analyzing the data using SPSS version 21 software.

Findings: Results from hierarchical regression analysis showed that psychosocial stress symptoms fully mediated the relationship between role demands and safety compliance but showed no mediation on role demands and safety participation. Also, only safety coaching from safety leadership demonstrated to have a moderating effect on the relationship between psychosocial stress symptoms and safety compliance of safety performance.

Conclusion: The study proposes that it is important to examine the effects of role demands on specific job performance. The importance of safety coaching as a key element of planning to improve safety performance should not be underestimated.

Keywords: psychosocial stress symptoms, role demands, safety compliance, safety participation

Introduction

Safety in the mines is a concern for everyone^{1,2} since the unsafe behaviour of someone can result in an accident that can affect operations for the whole day.^{3,4} In the unlikely event, lives may be lost as well as properties and equipment getting damaged.^{3,4} For satisfactory adherence to safety by employees, management must lead the way.⁵⁻⁷ Execution of roles must be done to meet certain expectations of management. However, most of these expectations are sometimes not met. One possible reason could be that the employee responsible for the execution of that role could not clearly understand the details of the role assigned to him or her by management. Another possible reason could be that the employee received other roles from several superiors and could not execute them all at the same time and with the same energy or ability. The former and the latter reasons could be termed as role ambiguity and role conflict respectively. These two components were conceptualized by Rizzo, House⁸ as role stressors because of their ability to induce stress symptoms. Sampson, DeArmond⁹ later termed them as safety role uncertainty

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since they were perceived to be detrimental to safety performance (safety compliance and safety participation) in construction companies. Wu, Li¹⁰ referred to them as role management and defined role management as “the job stress generated by the uncertainty of one’s job responsibilities or conflict due to different job requirements”. For the sake of this current study, we prefer to refer to role stressors or safety role uncertainties or role management as role demands for the sake of employees on the mine site. According to Quick and Quick,¹¹ role demands are similar in meaning to role stressors. Role demands comprise of role ambiguity and role conflict which are the major source of individual consequences (stress) such as behavioural (alcohol, drug abuse and violence), psychological (sleep disturbances and depression) and medical (heart diseases and headaches).¹¹ If employees perceive the demands of their roles as something they have little or no autonomy over, the impact on the firm’s wellbeing is negative.¹² Therefore, any study that aims to consider certain factors (e.g.role demands) that affect employee wellbeing and specific job performance (e.g.safety performance) will be fulfilling recommendations from previous studies.¹³

The mechanism by which role demands affect mineworker’s safety performance remains unclear although the intermediary role of stress has been reported in a plurality of studies.^{14,15} Stress comes in so many forms, one of which is psychosocial stress. Psychosocial stress as a form of stress is defined by Dean¹⁶ as “outcome of a cognitive appraisal of what is at stake and what can be done about it”. In this study, we define psychosocial stress symptoms as emotional and behavioural responses by an individual to conditions that require him or her to display abilities to overcome but he or she does not have the skills, knowledge and abilities to overcome such conditions. The two commonly known psychosocial stress symptoms include psychological stress and social behavioural stress. Psychological stress is caused by long-term uncertainties, unclear objectives and not enough or challenging work to do while social behavioural stress is caused by working alone (isolation), poor communication, and feeling of inequality.¹⁶ When organizations fail to have in place mechanisms to manage employees’ stress reactions, job performances will be crippled.¹⁷ Abbe, Harvey¹⁵ concluded in their study that employees who experience occupational stressors may record injuries through the psychological outcome of feeling tense. Leung, Liang¹⁴ further concluded that an employee who experiences stress especially psychological stress will be angry, anxious, moody and nervous and

these symptoms will not allow employees to have the best concentration to perform well. This current study will employ psychosocial stress symptoms as a mediator between role demands and safety performance.

Knowing that stress exists in organizations and it is detrimental to job performance, it will be prudent for organizations to have in place systems, programmes and policies to curtail stress.^{18,19} For the systems, programmes and policies implemented to effectively help manage stress will be dependent upon the kind of leadership existing in the organizations.²⁰ This condition inspires this current study to also set out to test the moderating effect of safety leadership on the relationship between psychosocial stress symptoms and safety performance. According to Lu and Yang,²¹ effective leadership is among the best ways to mitigate human error or incidents. Fernández-Muñiz, Montes-Peón²² even admit that firms that manage safety well also end up with well-managed operations.

On the premise of the issues raised so far, the study’s objectives include: (i) investigating the extent to which role demands influence safety performance; (ii) evaluating the mediating effect of psychosocial stress symptoms on the relationship between role demands and safety performance; and (iii) examining the moderating effect of safety leadership on the relationship between psychosocial stress symptoms and safety performance. The various relationships have been illustrated in [Figure 1](#).

Theoretical Background

Safety Performance

Measuring safety performance is also well known to be difficult since measures like employee fatality and failure seem to be reactive (after the event) and relatively infrequent.^{21,23} Studies have suggested self-report of safety behaviours and perceptions as the alternative criterion measures for evaluating safety at the workplace.^{21,24,25} Two safety behaviours namely safety compliance and safety participation have been suggested to measure employee performance at the workplace.^{9,26,27} Inness, Turner²⁸ describes safety compliance as work behaviours aimed at achieving the slightest safety standards at work. Examples of safety compliance behaviours include following standard operating procedures, safe-work procedures and using personal protective equipment. Vinodkumar and Bhasi²⁹ described safety participation as behaviours aimed at assisting the firm’s objectives and safety goals. Examples of safety participation behaviours include supporting workmates, encouraging safety programmes and taking part in voluntary safety

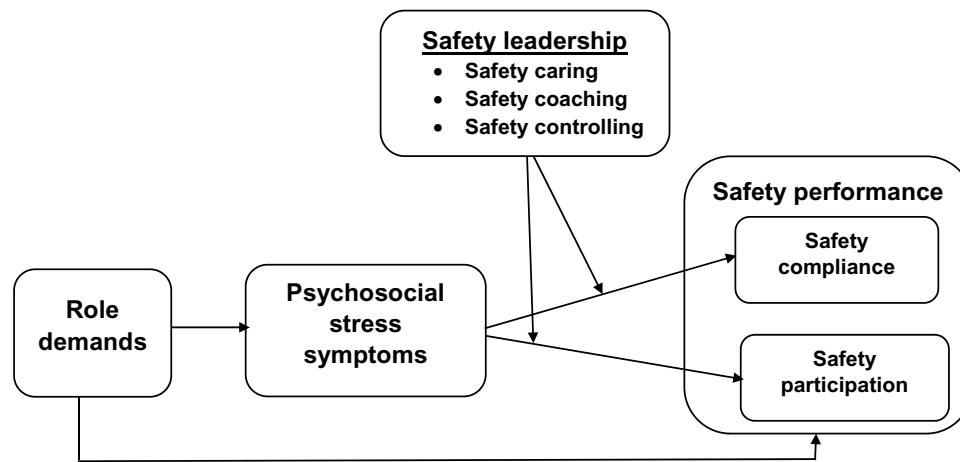


Figure 1 Conceptual framework.

Note: The conceptual framework summarizes the proposed relationship among various variables of the study. The model proposes that psychosocial stress symptoms mediate the relationship between role demands and the components of safety performance. The model also proposes that safety leadership (safety caring, safety coaching and safety controlling) moderates the effect psychosocial stress symptoms have on safety performance (safety compliance and safety participation).

activities. Griffin, Neal³⁰ demonstrated that safety compliance involves behaviours that reform the health and safety of workers while safety participation involves behaviours that encourage overall workplace safety. Clarke³¹ also adds that safety compliance consists of behaviours recognized as part of the job responsibilities of employees but safety participation consists of a huge voluntary component like behaviours outside the worker's official duties and it is similar to organizational citizenship behaviours.

Role Demands and Safety Performance

Role demands refer to conditions of uncertainties that confront an employee regarding his/her roles and the associated difficulty in dealing with such roles under a certain time frame. Role demand is contextually similar to role management. Role demands consist of role conflicts (occurs when the information and orders an employee receives to perform a role are contradictory or mutually exclusive) and role ambiguity (occurs when an employee's role is unclear).¹¹ Employees are expected to function according to the roles assigned to them by their superiors. These roles are sometimes transmitted formally or informally. Various employees are likely to see the role demands with different count of exactitude and then perform them. In this process, the possibility of errors creeping in can be inevitable thereby result in stress-inducing conditions³² such as role conflicts and role ambiguity.^{8,9,32} Previous studies suggest that roles full of conflicts and ambiguity will reduce employees' desire to follow standard operating procedures and this can negatively influence their behaviour towards safety compliance and participation.^{9,33} In the work of Wu, Li,¹⁰ evidence was

found for role management to negatively relate to safety performance, hence concluded that an employee with little information about his or her work and undefined roles will suffer from role comprehension thereby, choosing which safety procedure to comply with will be a challenge. Also, when employees receive different job requirements or assigned different positions at the same time, the tendency of such employees using short-cuts to perform their roles may be high and therefore can compromise workplace safety. This practice will harm workplace safety performance.³⁴ On this premise, we propose the following hypotheses:

H1: Role demands will have a negative significant influence on safety performance.

H1a: Role demands will have a negative significant influence on safety compliance.

H1b: Role demands will have a negative significant influence on safety participation.

Role Demands and Psychosocial Stress Symptoms

Role demands can also be a stress-inducing agent since every position within a working group or firm has related roles and expected behaviours in accomplishing such roles. Employees who perceive these roles as more demanding than their abilities to perform them are most likely to experience negative stress (distress). They may suffer from psychosocial stress as they perceive themselves as incompetent.^{14,35} Also, the fear of losing one's job may heighten thereby increasing their psychological stress.³⁶ On the other hand, employees who perceive themselves as possessing the abilities, skills, and knowledge to cope with any stressful event may experience

positive stress (eustress). Eustress can emotionally enhance positive feelings of self-satisfaction, motivation and influence. An individual who experiences positive stress can psychologically develop his or her self-efficacy, autonomy and toughness. In the work of Kemery, Bedeian,³² they concluded that role stress is related to job-related tension, job dissatisfaction and propensity to leave. Job-related attitudes and behaviours are suggested to be pervasive as a result of the impact of role conflict and role ambiguity.^{37,38} A study by Inoue, Kawakami³⁹ confirmed that role ambiguity is significantly related to psychological distress. Coverman⁴⁰ conducted a study on role demands and psychological well-being. She concluded that the stress level of individuals will increase with corresponding higher role demands and those with fewer role demands will have lower stress levels. Schmidt, Roesler⁴¹ confirmed this when they conducted a meta-analytic study that examined role conflict and role ambiguity, and their link to depression. They concluded that role conflict and role ambiguity are related to depression negatively. Surprisingly, most studies on role demands and work-related stress (e.g. psychosocial stress symptoms) have not considered employees in the mining industry. Conducting work in that regard will give a better picture of how role demands will relate to psychosocial stress symptoms from the perspective of the mining industry. From extant literature, we formulate the hypothesis that:

H2: Role demands could negatively relate to psychosocial stress symptoms.

Psychosocial Stress Symptoms and Safety Performance

According to Hofmann and Stetzer,⁴² job strains are related to workplace safety. Job strains are said to be the corrosive behaviours that employees show to occupational stressors,⁴³ one of which is psychosocial stress.¹⁶ Psychosocial stress is a cognitive reaction including psychological stress symptoms (worries, sadness, nervousness and depression) and social behavioural stress symptoms (fear of one's future and social rejection). Psychosocial stress is also caused by conditions of social threat such as social evaluation, social exclusion and achievement situations claiming goal performance.⁴⁴⁻⁴⁶ Empirical evidence suggests that studies on psychosocial stress and safety performance are fuzzy. For instance, Leung, Liang¹⁴ in their study found no evidence to support the relationship between psychological distress and components of safety performance. However, Siu, Phillips⁴⁷ found significant evidence

to support the relationship between psychological stress symptoms and workplace accidents. Several other studies^{15,36,48} have also found similar evidence suggesting that elements of psychosocial stress symptoms directly predict workplace injuries. Sobeih, Salem⁴⁸ concluded in their study that a worker who had a high level of psychological stress exhibited a higher risk of experiencing injuries. Also, employees who suffer from psychosocial stress are usually emotionally drained and may not be able to perform their work to the optimum.^{17,49} Performance may suffer due to this and safety performance is most likely to reduce.³³ Interestingly, most of these studies were done in construction companies. Extending the work of psychosocial stress and safety performance to other sectors (e.g. mining industry) will offer a broader understanding regarding the relationship between psychosocial stress symptoms and safety performance. Toward this light, we hypothesize that:

H3: Psychosocial stress symptoms will negatively relate to safety performance.

H3a: Psychosocial stress symptoms will have a negative significant influence on safety compliance.

H3b: Psychosocial stress symptoms will have a negative significant influence on safety participation.

Mediating Effect of Psychosocial Stress Symptoms

Stressors can induce stress and the induced stress can in turn influence job performance negatively. This makes the use of stress or strain as mediators attract more attention from researchers^{14,15} with regards to the link between role demands and safety performance. Role demands can influence safety performance, but it may affect the performance when the conflicting and ambiguous nature of the roles assigned to employees cause emotional trauma such as tension, anxiety, nervousness, etc that reduce employees' abilities to cope with the challenges and badly affect safety compliance and safety participation. On this premise, we propose the following hypotheses:

H4: Psychosocial stress symptoms will mediate the relationship between role demands and safety performance.

H4a: Psychosocial stress symptoms will mediate the relationship between role demands and safety compliance.

H4b: Psychosocial stress symptoms will mediate the relationship between role demands and safety participation.

Moderating Role of Safety Leadership

The interaction existing between leaders and followers, by which leaders can exercise their dominion on followers to attain workplace safety objectives under the affairs of organizational and individual factors could be termed as safety leadership.^{50,51} For mining companies to achieve an environment that promotes safety compliance, safety participation and behaviour that is less risky, a safety leadership style that is caring, controlling and coaching can be employed. Safety caring describes how firms pay attention to employees' welfare, provide assistance, establish a peaceful relationship with employees, effectively maintain channels of communication and offer benefits to employees when needed.²¹ Safety controlling emphasizes on the establishment of clear objectives, how to maintain performance at an acceptable level, how to encourage members to work while following standards and procedures and clarifying members' role, expectation, and duty.²¹ Lu and Yang²¹ further express that employees who experience safety caring and controlling are most likely to be effective in terms of working according to regulations and procedures. Wiegand⁵² described safety coaching to be efforts such as interpersonal interactions and communication by leaders to manage safety performance. The work of Wu, Chen⁵³ revealed that safety caring, safety coaching, and safety controlling as dimensions of safety leadership positively related to elements of safety performance. A study by Clarke³¹ also reveals that employees' safety compliance and safety participation are most likely to be promoted under the influence of safety leadership. With safety leadership, employees will perceive their organization as caring (e.g. their firm is interested in their wellbeing), coaching (e.g. their firm trains them to see old problems as new opportunities) and controlling (e.g. their firm is interested in monitoring the work they do to immediately correct any problem that arises to be able to improve performance). On this premise, we propose the following hypotheses:

H5: Safety leadership will moderate the relationship between psychosocial stress symptoms and safety performance.

H5a₁: Safety caring minimizes the negative effects psychosocial stress symptoms have on safety compliance.

H5a₂: Safety caring minimizes the negative effects psychosocial stress symptoms have on safety participation.

H5b₁: Safety coaching minimizes the negative effect psychosocial stress symptoms have on safety compliance.

H5b₂: Safety coaching minimizes the negative effects psychosocial stress symptoms have on safety participation.

H5c₁: Safety controlling minimizes the negative effects psychosocial stress symptoms have on safety compliance.

H5c₂: Safety controlling minimizes the negative effects psychosocial stress symptoms have on safety participation.

Methodology

Sample Design and the Data Collection

Ghana is endowed with plenty of natural resources and the Western Region of Ghana is notably known for its mineral deposits such as gold, manganese, limestone bauxite and diamond, to mention but a few. It is not surprising that five major mining companies are located in Ghana's Western Region. These mining companies recognize the importance of safety, hence special and separate department has been allocated for occupational health and safety (OHS). To collect data for our study using employees of these mining companies, the authors first sent permission letters to five mining companies operating in Ghana's Western Region of which four out of the five responded "Yes" allowing us to use their companies for the study. The authors held meetings with the various heads of departments and the participants on different occasions. A cover letter that showed that their participation was voluntary and their responses would be kept confidential was offered them. A questionnaire containing items on role demands, psychosocial stress symptoms, safety performance and safety leadership was distributed to 850 participants. A total of 567 completed questionnaires representing 66.71% response rate was personally collected from the respondents by the authors out of which 482 (85%) responses were valid.

Out of the valid responses, 332 (68.90%) respondents were males and the female respondents were 150 (31.1%). The ages of the respondents ranging from 20–29 years were 148 (30.71%), 30–39 years were 62 (12.86%), 40–49 years were 181 (37.55%) and those who had attained 50 years or more were 91 (18.88%). All the respondents had attained a formal educational qualification with respondents having a university degree totalling 231 (49.93%), higher national diploma or diploma being 86 (17.84%), senior high school being 109 (22.61%) and 56 (11.62%) respondents either held junior high school or middle school leaving certificate. The department which recorded the highest number of respondents was the processing unit scoring 183 (37.97%) responses, followed by the mining department with 107

(22.20%) while 96 (19.92%) were responses each for the engineering and business support unit. Concerning the length of service of the respondents, there were more than half (242) of the respondents representing 50.21% who had worked for more than 8 years. There were 84 (17.43%), 65 (13.49%), and 91 (18.88%) of the respondents who had also worked from 4–8 years, 1–3 years and less than a year respectively.

Measurement Scales

Role Demands

This study defines role demands as role conflicts and role ambiguity. The role demands construct was assessed with 14 items from the role stress scale developed by Rizzo, House.⁸ The scale of Rizzo, House⁸ has received significant validity evidence.^{9,54} For instance, this scale has widely been used by scholars in measuring safety uncertainty of pipefitters in construction,⁹ role stress of accountants and hospital employees³² and role demands of a sales force of a national consumer goods manufacturer.⁵⁵ Even though the role stress scale has achieved good reliability and validity in previous studies, a few studies (e.g. Tracy and Johnson,⁵⁶ Howell, Bellenger⁵⁷ and Howell, Wilcox⁵⁸) suggest that the scale be tested in other fields to truly establish its reliability and convergent validity. Therefore, we adapted the role stress scale and used it in the mining industry. The 14-item scale had 6 items measuring role ambiguity (e.g. I know exactly what is expected of me) and 8 items measuring role conflicts (e.g. I receive incompatible requests from two or more people). The internal consistency and validity of the scale were checked. The Cronbach alpha values recorded for role conflict and role ambiguity were 0.966 and 0.874 respectively, hence showed that the two scales had excellent internal consistency. The average variance extracted (AVE) for role conflict (AVE = 0.784) and role ambiguity (AVE = 0.557) indicate good convergent validity. The confirmatory factor analysis (CFA values are reported under “Assessment of Measurement Validity” in this text) performed for the role demands construct also showed excellent goodness of fit to the data. Besides, the two scales together gave a Cronbach alpha value of 0.924 for the role demands construct indicating high internal consistency. The two subscales were also highly correlated with each other hence, the suggestion of Erdogan and Enders⁵⁹ was employed. A single mean score was found for role demands by averaging across the items of the subscales. All items were measured on a 4-point

Likert scale ranging from 1 = totally disagree; 2 = disagree; 3 = agree and to 4 = totally agree.

Psychosocial Stress Symptoms

The psychosocial stress symptoms construct was assessed with 13 items from the scale of Sheu, Lin.¹⁷ The 13-item scale has 7 items measuring emotional stress (e.g. I am not optimistic about my future) and 6 items measuring social behavioural stress (e.g. I feel blue and depressed). The scale of Sheu, Lin¹⁷ has received wider usage particularly in assessing the stress level of nursing students as well as employees in the health sector. To the best of our knowledge, Sheu and colleagues' scale has received limited consideration in other fields except in the health sector. Therefore, we saw this as a gap and decided to adapt their scale to measure the psychosocial stress of employees in different working environments such as the mining industry of Ghana. The reliability and validity of the scales were checked. The emotional stress symptoms scale had 0.932 as Cronbach alpha coefficient and 0.678 as AVE while the social behavioural stress symptoms scale had 0.881 as Cronbach alpha coefficient and 0.619 as AVE. The two scales showed good internal consistency and convergent validity. The CFA values for the psychosocial stress symptoms construct as presented under ‘Assessment of Measurement Validity’ in this text satisfied the various threshold for the goodness of fit to data. These two scales further gave an overall Cronbach alpha coefficient of 0.912 for psychosocial stress symptoms construct. Similar to the role demands scale, the two subscales of psychosocial stress symptoms scale were generally correlated. The single mean score was then employed by calculating the averages of the two subscales. All items were measured on a 5-point Likert scale ranging from 1 = never; 2 = almost never; 3 = some of the time; 4 = most of the time; and to 5 = almost always.

Safety Performance

The safety performance construct was assessed with two dimensions namely safety compliance and safety participation. A 10-item safety performance scale was adapted from the work of DeArmond, Smith.²⁷ The scale contains 4 items measuring safety compliance (e.g. I minimize exposure to hazards by using the appropriate work practices) and 6 items measuring safety participation (e.g. I help others to ensure they do their work safely). The

Cronbach alpha values for safety compliance ($\alpha = 0.818$) and safety participation ($\alpha = 0.811$) were very good and show that the scales had good internal consistency. All items were measured on a 4-point Likert scale ranging from 1, “totally disagree” to 4, “totally agree”.

Safety Leadership

The safety leadership construct was assessed with three dimensions namely safety caring, safety coaching and safety controlling. The 35-item safety leadership scale developed by Wu⁵⁰ and used by Wu, Chen⁵³ were employed for this study. The scale contains 12 items measuring safety caring (e.g. My boss handles safety business honestly), 11 items measuring safety coaching (e.g. He/she allocates safety resources fairly) and 12 items measuring safety controlling (e.g. He/she firmly orders employees to accomplish safety goals.). The Cronbach alpha values for safety caring ($\alpha = 0.939$), safety coaching ($\alpha = 0.883$) and safety controlling ($\alpha = 0.941$) also exhibited high internal consistency. All items were measured on a 4-point Likert scale ranging from 1, “totally disagree” to 4, “totally agree”.

Control Variables

Gender, age, level of education, department, and length of service were used as control variables since they related to role demands, psychosocial stress symptoms, safety leadership and safety performance in one way or the other in the correlation matrix table.

Analyses and Results

Assessment of Measurement Validity

To check the reliability, validity, and unidimensionality of all the nine variables under study, exploratory factor analysis (EFA) using SPSS version 21 software and confirmatory factor analysis (CFA) using AMOS version 21 software were performed. The EFA led to deleting 10-items (thus, 4-items from the safety controlling, 3-items from safety caring, 2-items from safety coaching and 1-item from social behavioural stress scales) for inappropriate loadings while the CFA led to deleting 2-items (thus, “1-item each from safety coaching and safety caring scale”) to prevent negative variance. The CFA factor loadings, construct reliability (CR) and average variance extracted (AVE) are presented in Table 1. The CFA factor loadings of all the variables were greater than the 0.50 threshold and the construct reliabilities of the variables were also greater than the 0.70 and were statistically

significant at a 5% confidence level. For the AVE, except for safety participation that recorded 0.471 as AVE, the remaining variables had AVE ranging from 0.518 to 0.784 and were above the 0.50 threshold showing good convergent validity.⁶⁰ In addition to checking whether the variables were distinct from each other, the discriminant validity for all the variables was checked and the results are presented along the diagonal line of the inter-factor correlation analysis (See Table 2). The discriminant validity results show that the variables are distinct from each other since they are greater than the inter-factor correlation values.⁶⁰ The study also performed a unidimensionality test for all the variables and the results are also presented in Table 2. We found out that the comparative fit indices (CFI) and the standardized root mean residual (SRMR) for all the variables satisfy the threshold of $CFI > 0.90$ and $SRMR < 0.06$ and that unidimensionality and goodness of fit are obtained.⁶⁰⁻⁶² The CFA results for the model generally show a good fit to the data ($X^2 = 2996.611$, $df = 1674$, $X^2/df = 1.790$, $SRMR = 0.041$, $TLI = 0.94$, $CFI = 0.943$), most importantly the measurements' validity for the dimensions of role demands and psychosocial stress symptoms are $X^2 = 144.21$, $df = 76$, $X^2/df = 1.895$, $SRMR = 0.035$, $TLI = 0.987$, $CFI = 0.989$ and $X^2 = 234.585$, $df = 53$, $X^2/df = 4.436$, $SRMR = 0.057$, $TLI = 0.950$, $CFI = 0.960$, respectively. All measurements satisfactorily fit the data.

Means, Standard Deviation and Inter-Factor Correlation Analysis

The present study employed SPSS version 21 software to perform the descriptive statistics of the chosen sample and inter-factor correlations for all the variables considered for the study before estimating the various hypothesized relationships. The means, standard deviations and inter-factor correlation results are shown in Table 2.

Hierarchical regression analysis was then employed as the main technique to estimate the path analysis with the help of SPSS version 21 software.

Testing of Hypotheses

Model Testing of the Main Effect and Mediating Effect

To employ hierarchical regression analysis to test the main and the mediating effects based on control variables, SPSS version 21 software was used and the results are presented in Tables 3 and 4. From model 2

Table 1 Validation Factor Analysis and Reliability Output Results

Construct	Dimensions	Items	β	CR	AVE
Role Demands	Role Conflict	RC3	0.996	0.967	0.784
		RC1	0.905		
		RC2	0.891		
		RC7	0.88		
		RC5	0.867		
		RC6	0.864		
		RC8	0.851		
		RC4	0.82		
	Role Ambiguity	RA1	0.984	0.88	0.557
		RA5	0.753		
		RA3	0.655		
		RA2	0.638		
		RA6	0.699		
		RA4	0.692		
Psychosocial Stress Symptoms	Emotional Stress Symptoms	ES2	0.847	0.936	0.678
		ES1	0.99		
		ES3	0.802		
		ES5	0.734		
		ES6	0.724		
		ES4	0.823		
		ES7	0.816		
	Social Behavioural Stress Symptoms	SBS1	0.991	0.888	0.619
		SBS4	0.774		
		SBS2	0.707		
		SBS6	0.683		
		SBS5	0.74		
		SBS3	0.74		
	Safety Performance	Safety Compliance	SC2	0.984	0.841
SC1			0.719		
SC3			0.677		
SC4			0.608		
Safety Participation		SP1	0.965	0.837	0.471
		SP2	0.702		
		SP3	0.637		
		SP6	0.587		
		SP5	0.583		
		SP4	0.559		
Safety Caring	Care4	0.966	0.942	0.671	
	Care12	0.851			
	Care10	0.788			
	Care3	0.805			
	Care2	0.853			
	Care9	0.82			
	Care1	0.762			
	Care8	0.68			

(Continued)

Table 1 (Continued).

Construct	Dimensions	Items	β	CR	AVE
Safety Leadership	Safety Controlling	Cont1	0.993	0.942	0.673
		Cont2	0.828		
		Cont7	0.821		
		Cont3	0.808		
		Cont9	0.8		
		Cont4	0.779		
		Cont5	0.772		
		Cont8	0.738		
	Safety Coaching	Coach8	0.995	0.893	0.518
		Coach4	0.731		
		Coach6	0.745		
		Coach1	0.71		
		Coach3	0.656		
		Coach5	0.639		
Coach2	0.604				
Coach9	0.597				

Note: β Standardized factor loadings.

Abbreviations: CR, construct reliability, AVE, average variance extracted.

in Tables 3 and 4, role demands significantly predicted both safety compliance and safety participation positively, hence H1 was not supported. From model 3 in Tables 3 and 4, role demands had a positive significant influence on psychosocial stress symptoms hence failed to support H2. Also, from model 4 in Tables 3 and 4, using psychosocial stress symptoms as an independent variable and the two components of safety performance as dependent variables, psychosocial stress symptoms had a positive significant influence on both safety compliance and safety participation hence failed to support H3. Although these findings failed to support H1 (Role demands will have a negative significant influence on safety performance), H2 (Role demands will relate negatively to psychosocial stress symptoms) and H3 (Psychosocial stress symptoms will negatively relate to safety performance), the results provide us with a new sense of direction to ascertain the possible underlying factors that could have accounted for the positive effects.

It is worth stating that, in Table 3, the role demands and psychosocial stress symptoms were regressed in model 5. The outcomes suggest that role demands failed to have a significant influence on safety compliance but psychosocial stress symptoms still had a positive significant effect on safety compliance.

Table 2 Means, Standard Deviations, Dimensionality, Validity of Survey Instruments and Inter-Factor Correlation Analysis

Scale	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1. Gen	—													
2. Age	-0.229**	—												
3. Edu	-0.165**	0.280**	—											
4. Dept	0.127**	-0.115*	-0.100*	—										
5. LoS	-0.130**	0.814**	0.284**	-0.078	—									
6. RA	-0.055	-0.006	0.012	-0.043	-0.080	0.886								
7. RC	-0.216**	0.153**	-0.038	-0.027	0.001	0.307**	0.746							
8. ES	-0.192**	0.019	0.065	-0.102*	-0.111*	0.464**	0.600**	0.824						
9. SBS	-0.026	-0.052	0.059	-0.011	-0.105*	0.341**	0.262**	0.494**	0.787					
10. SC	0.086	0.180**	0.066	-0.110*	0.238**	0.055	0.164**	0.127**	0.086	0.761				
11. SP	-0.065	0.033	0.005	-0.070	0.018	0.118**	0.036	0.107*	0.080	0.039	0.686			
12. Care	-0.229**	0.127**	0.128**	-0.126**	0.013	0.318**	0.591**	0.580**	0.222**	0.121**	0.096*	0.819		
13. Coach	0.050	0.018	-0.006	-0.040	-0.035	0.220**	0.253**	0.504**	0.363**	0.179**	0.044	0.248**	0.72	
14. Cont	-0.019	-0.027	-0.017	0.001	-0.038	-0.013	0.091*	0.123**	0.085	0.144**	0.136**	0.085	0.134**	0.82
Mean	1.310	2.450	1.980	2.560	3.270	2.607	2.746	3.074	2.990	2.905	3.197	2.826	3.063	3.009
SD	0.463	1.114	1.083	1.045	1.473	0.995	0.580	0.774	0.792	0.652	0.584	0.855	0.591	0.947
CFI						0.996	0.987	0.989	0.996	0.990	0.990	0.911	1.000	0.992
SRMR						0.012	0.033	0.023	0.022	0.033	0.030	0.051	0.021	0.022

Note: *p < 0.05; **p < 0.01; Discriminant validity are presented in bold along the diagonal line of the inter-factor correlation matrix.

Abbreviations: Gen, gender; Age, age of respondents; Edu, level of education; Dept, department; LoS, length of service; RA, role ambiguity; RC, role conflicts; ES, emotional stress; SBS, social behavioural stress; SC, safety compliance; SP, safety participation; Care, safety caring; Coach, safety coaching; Cont, safety controlling; SD, standard deviation; CFI, comparative fit index; SRMR, standardized root mean square residual; AVE, average variance extracted; CR, construct reliability.

Table 3 Hierarchical Regression Analysis Showing the Mediating Effect of Psychosocial Stress Symptoms on the Relationship Between Role Demands and Safety Compliance

Variables and Analysis Steps	SC	SC	Psychos	SC	SC
	Model 1	Model 2	Model 3	Model 4	Model 5
First step (Control variables)					
Constant	2.472***	2.078***	1.804***	1.906***	1.840***
Gender	0.186**	0.205***	-0.072	0.211***	0.215***
Age	-0.007	-0.029	0.022	-0.026	-0.032
Level of education	0.005	0.006	0.060*	-0.004	-0.002
Department	-0.067*	-0.065*	-0.020	-0.062*	-0.062*
Length of service	0.112***	0.131***	-0.071*	0.137***	0.140***
Second step (Main effect)					
Role demand		0.133**	0.537***		0.062
Third step (mediation analysis)					
Psychosocial stress symptoms				0.167***	0.132*
R2	0.082	0.101	0.585	0.110	0.336
ΔR2	0.082	0.019	0.284	0.028	0.031
F	8.534***	8.882***	41.114***	9.827***	8.646***

Notes: * p < 0.05; ** p < 0.01; *** p < 0.001.

Abbreviations: SC, safety compliance; Psychos, psychosocial stress symptoms.

This suggests that psychosocial stress symptoms fully mediated the relationship between roles demands and safety compliance, hence H4a was supported. On the contrary, after regressing role demands and psychosocial stress symptoms in Table 4 under model 5,

psychosocial stress symptoms could not mediate the relationship between role demands and safety participation since neither role demands nor psychosocial stress could predict safety participation, hence, H4b was not supported.

Table 4 Hierarchical Regression Analysis Showing the Mediating Effect of Psychosocial Stress Symptoms on the Relationship Between Role Demands and Safety Participation

Variables	SP	SP	Psychos	SP	SP
	Model 1	Model 2	Model 3	Model 4	Model 5
First step (Control variables)					
Constant	3.372	3.112***	1.804***	3.071***	3.010
Gender	-0.068	-0.055	-0.072	-0.055	-0.051
Age	0.014	0.000	0.022	0.004	-0.002
Level of education	-0.008	-0.007	0.060*	-0.012	-0.010
Department	-0.035	-0.034	-0.020	-0.032	-0.032
Length of service	-0.005	0.007	-0.071*	0.008	0.011
Second step (Main effect)					
Role demand		0.088*	0.537***		0.057
Third step					
Psychosocial stress symptoms				0.089*	0.057
R2	0.009	0.019	0.585	0.018	0.022
ΔR2	0.009	0.10	0.284	0.010	0.013
F	0.818	1.508	41.114***	1.492	1.490

Notes: * p < 0.05; *** p < 0.001.

Abbreviations: SP, safety participation; Psychos, psychosocial stress symptoms.

Model Testing of the Moderating Effect of Safety leadership on the Relationship Between Psychosocial Stress Symptoms and Safety Performance

In estimating the hypothesized moderating effects utilizing hierarchical regression analysis, the variables such as psychosocial stress symptoms, safety caring, safety coaching and safety controlling were mean centred. The variables

were mean centred to avoid multicollinearity. From Table 5 to Table 7, the results show that only safety coaching moderated the relationship between psychosocial stress symptoms and safety compliance. This is because, the unstandardized coefficient values of the interaction between psychosocial stress symptoms and safety coaching, the relationship between psychosocial stress symptoms and safety compliance and the relationship between coaching and safety compliance were significant in one

Table 5 Moderating Effect of Safety Caring on the Relationship Between Psychosocial Stress Symptoms and Safety Performance

Variables	Safety Compliance			Variables	Safety Participation		
	Model 1	Model 2	Model 3		Model 1	Model 2	Model 3
Constant	2.472***	1.808***	1.817***	Constant	3.372***	3.026***	3.082***
Gender	0.186**	0.227***	0.226***	Gender	-0.068	-0.047	-0.053
Age	-0.007	-0.035	-0.035	Age	0.014	0.000	-0.002
Level of education	0.005	-0.007	-0.007	Level of education	-0.008	-0.014	-0.016
Department	-0.067*	-0.059*	-0.059*	Department	-0.035	-0.031	-0.030
Length of service	0.112***	0.141***	0.141***	Experience	-0.005	0.010	0.010
Psychos		0.130**	0.133**	Psychos		0.072	0.088
Car		0.067	0.063	Car		0.031	0.006
Psychos x Car			-0.010	Psychos x Car			-0.064
R ²	0.082	0.116	0.116	R ²	0.009	0.020	0.022
ΔR ²	0.082	0.034	0.034	ΔR ²	0.009	0.011	0.003
F	8.534***	8.899***	7.774***	F	0.818	1.382	1.361

Notes: * p < 0.05; ** p < 0.01; *** p < 0.001.

Abbreviations: Psychos, psychosocial stress symptoms; Car, safety caring.

Table 6 Moderating Effect of Safety Coaching on the Relationship Between Psychosocial Stress Symptoms and Safety Performance

Variables	Safety Compliance			Variables	Safety Participation		
	Model 1	Model 2	Model 3		Model 1	Model 2	Model 3
Constant	2.472***	1.703***	1.702***	Constant	3.372***	3.086***	3.085***
Gender	0.186**	0.189**	0.205**	Gender	-0.068	-0.053	-0.056
Age	-0.007	-0.030	-0.027	Age	0.014	0.005	0.004
Level of education	0.005	-0.001	0.004	Level of education	-0.008	-0.013	-0.014
Department	-0.067*	-0.061*	-0.063*	Department	-0.035	0-0.033	-0.032
Experience	0.112***	0.136***	0.135***	Experience	-0.005	0.008	0.008
Psychos		0.103*	0.128*	Psychos		0.093*	0.089
Coach		0.139*	0.111*	Coach		-0.010	-0.005
Psychos x Coach			0.150*	Psychos x Coach			-0.026
R ²	0.082	0.122	0.131	R ²	0.009	0.019	0.019
ΔR ²	0.082	0.040	0.009	ΔR ²	0.009	0.010	0.000
F	8.534***	9.410***	8.916***	F	0.818	1.281	1.140

Notes: * p < 0.05; ** p < 0.01; *** p < 0.001.

Abbreviations: Psychos, psychosocial stress symptoms; Coach, safety coaching.

model (ie model 3 of Table 6), hence provides support for H5b₁. Using Stats Tools Package developed by Gaskin,⁶³ a simple regression slope (Figure 3A) was plotted for the interaction effect of safety coaching and psychosocial stress symptoms on safety compliance. Figure 3A also predicted that safety coaching strengthens the positive effect of psychosocial stress symptoms on safety compliance. The remaining hypotheses (H5a₁, H5a₂, H5b₂, H5c₁ and H5c₂) stated for the moderating variables could not be supported. Details of the results provided in Tables 5, 6 and 7 and Figures 2A, B, 3B, 4A and B.

Discussion

Theories and research highlight that stressors have a significant influence on employee performance. The present study draws on the role of stress perspective within the context of the mining industry. Among the aims of this study included demonstrating the validity and reliability of role demands, psychosocial stress symptoms, safety leadership and safety performance. These have been proven successful to allow further data analysis to be performed. Another objective of this study included investigating the direct and mediating effects of psychosocial stress

Table 7 Moderating Effect of Safety Controlling on the Relationship Between Psychosocial Stress Symptoms and Safety Performance

Variables	Safety Compliance			Variables	Safety Participation		
	Model 1	Model 2	Model 3		Model 1	Model 2	Model 3
Constant	2.472***	1.657***	1.675***	Constant	3.372***	2.869***	2.891***
Gender	0.186**	0.213***	0.213***	Gender	-0.068	-0.053	-0.051
Age	-0.007	-0.024	-0.023	Age	0.014	0.006	0.003
Level of education	0.005	-0.002	-0.003	Level of education	-0.008	-0.011	-0.010
Department	-0.067*	-0.063*	-0.062*	Department	-0.035	-0.033	-0.035
Experience	0.112***	0.137***	0.136***	Experience	-0.005	0.008	0.010
Psychos		0.151***	0.152***	Psychos		0.076	0.073
Cont		0.096***	0.095**	Cont		0.078**	0.080**
Psychos x Cont			-0.020	Psychos x Cont			0.056
R ²	0.082	0.129	0.130	R ²	0.009	0.034	0.026
ΔR ²	0.082	0.047	0.000	ΔR ²	0.009	0.038	0.004
F	8.534***	10.067***	8.819	F	0.818	2.389*	2.325*

Notes: * p < 0.05; ** p < 0.01; *** p < 0.001.

Abbreviations: Psychos, psychosocial stress symptoms; Cont, safety controlling.

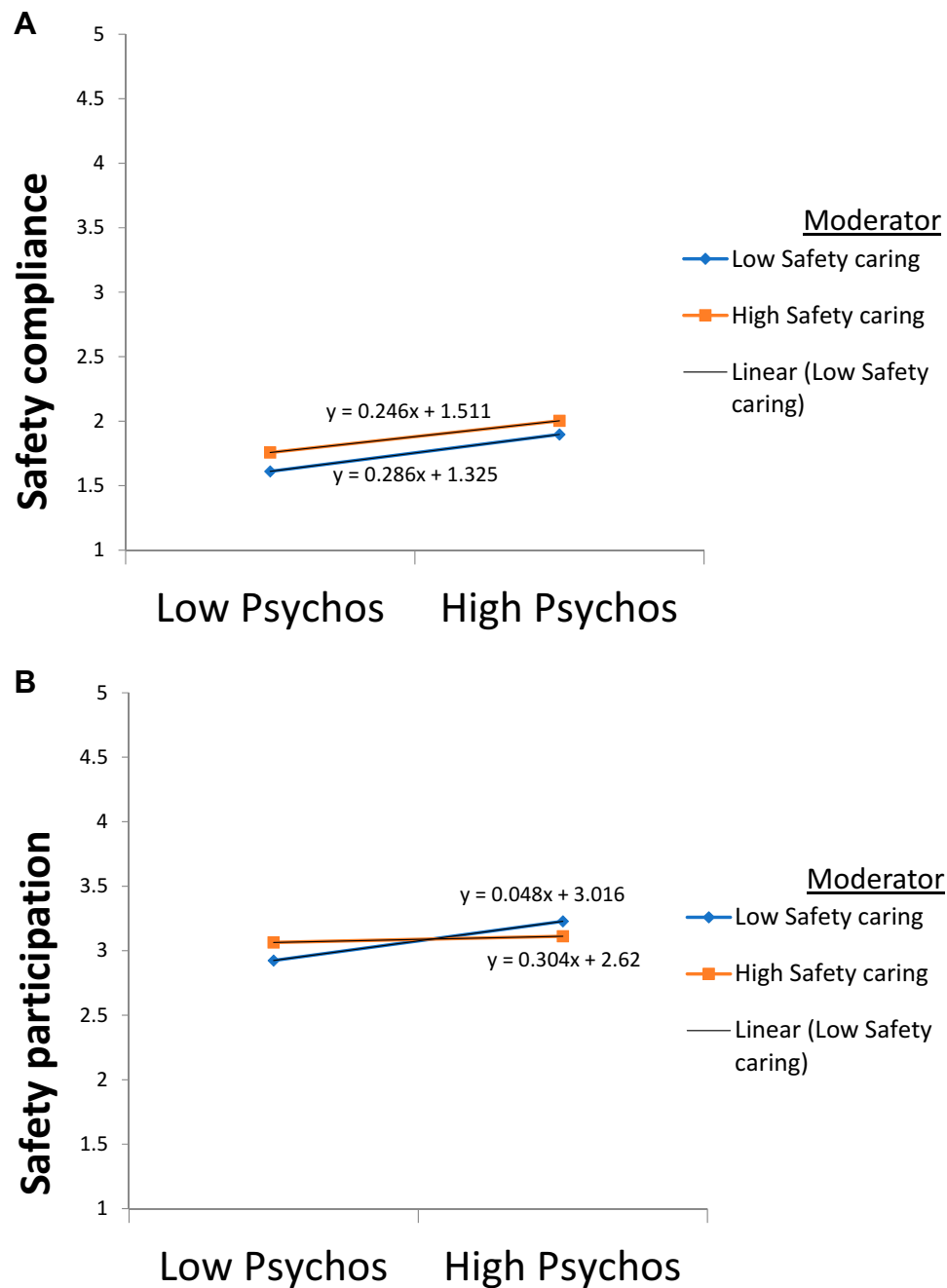


Figure 2 (A) Moderating effect of safety caring on psychosocial stress symptoms (Psychos) and safety compliance relationship. **(B)** Moderating effect of safety caring on psychosocial stress symptoms (Psychos) and safety participation relationship.

symptoms on the relationship between role demands and the dimensions of safety performance. Another purpose of the study was to analyze the moderating effect of three dimensions of safety leadership on the relationship between psychosocial stress symptoms and the two dimensions of safety performance. Results from the hierarchical regression analysis provided partial support of the hypothesized relationships. Since existing literature has focused on different effects of role conflicts and role

ambiguity on employee performance, a study that examines the combined effect of these two dimensions as role demands on specific job performance such as employee safety performance will provide great insight into occupational stress and safety performance.

The present study revealed that role demands had a positive significant influence on the two components of safety performance. These results contradict the findings of extant literature.^{9,37,54} Sampson, DeArmond⁹ asserted

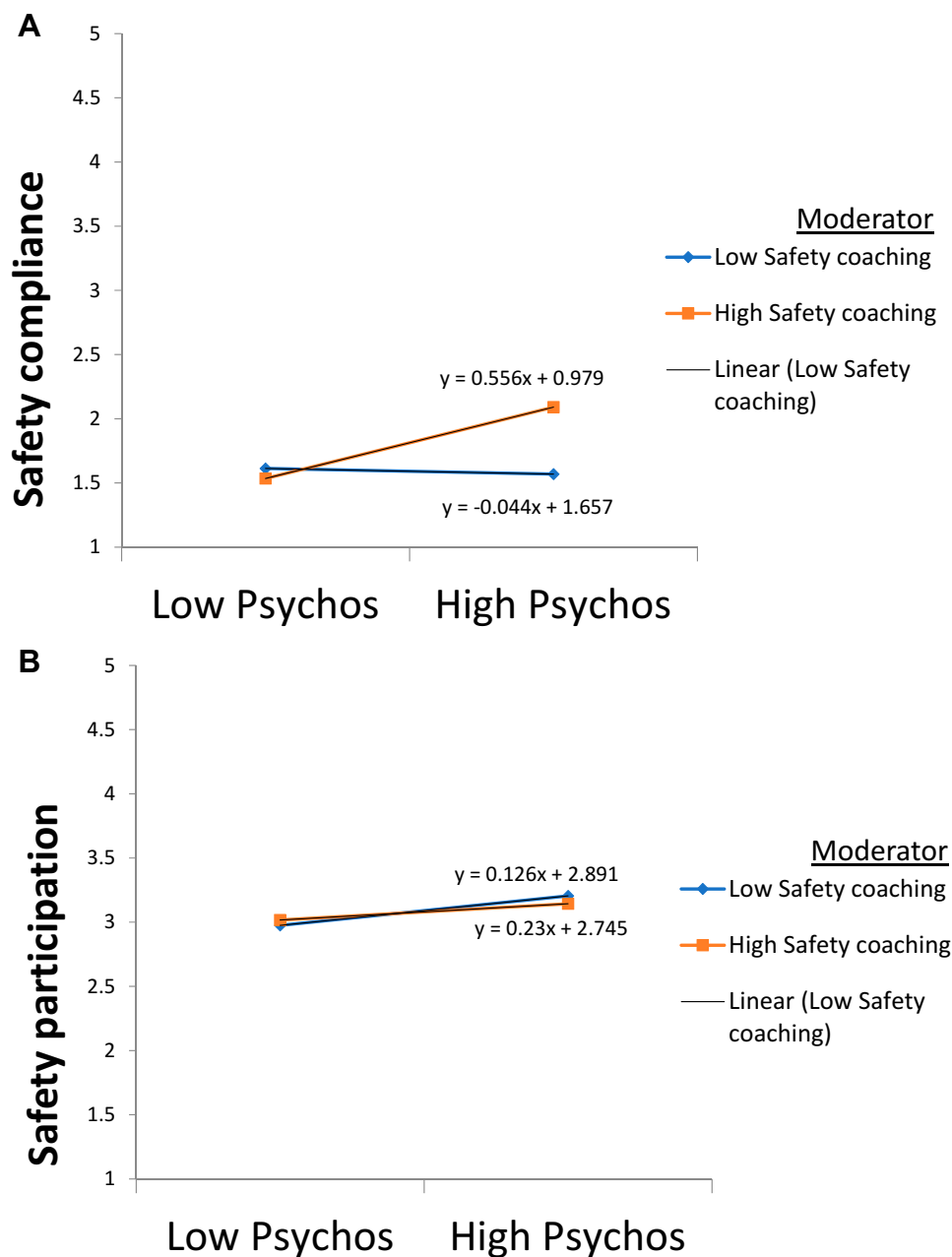


Figure 3 (A) Moderating effect of safety coaching on psychosocial stress symptoms (Psychos) and safety compliance relationship. **(B)** Moderating effect of safety coaching on psychosocial stress symptoms (Psychos) and safety participation relationship.

that stressors should have a negative significant influence on safety performance. This could be possible if employees have little or no control over the occupational stressors^{64,65} such as role demands. When employees have the ability or skills to handle any form of stressors⁶⁶ such as performing tasks differently, working with two or more groups who operate quite differently, working under no incompatible policies and guidelines, etc. safety performance is expected to be improved.^{67,68} Moreover, when employees feel certain about the

authorities they have, know what is expected of them exactly, work under well-expressed directives etc., safety performance will be improved. This could be the reason why role demands had a positive significant influence on safety compliance and safety participation.

Also, from the results of this study, role demands had a positive significant influence on psychosocial stress symptoms. This result is inconsistent with studies like Leung, Liang¹⁴ and Abbe, Harvey¹⁵ that have established a negative relationship between variables of stressors and

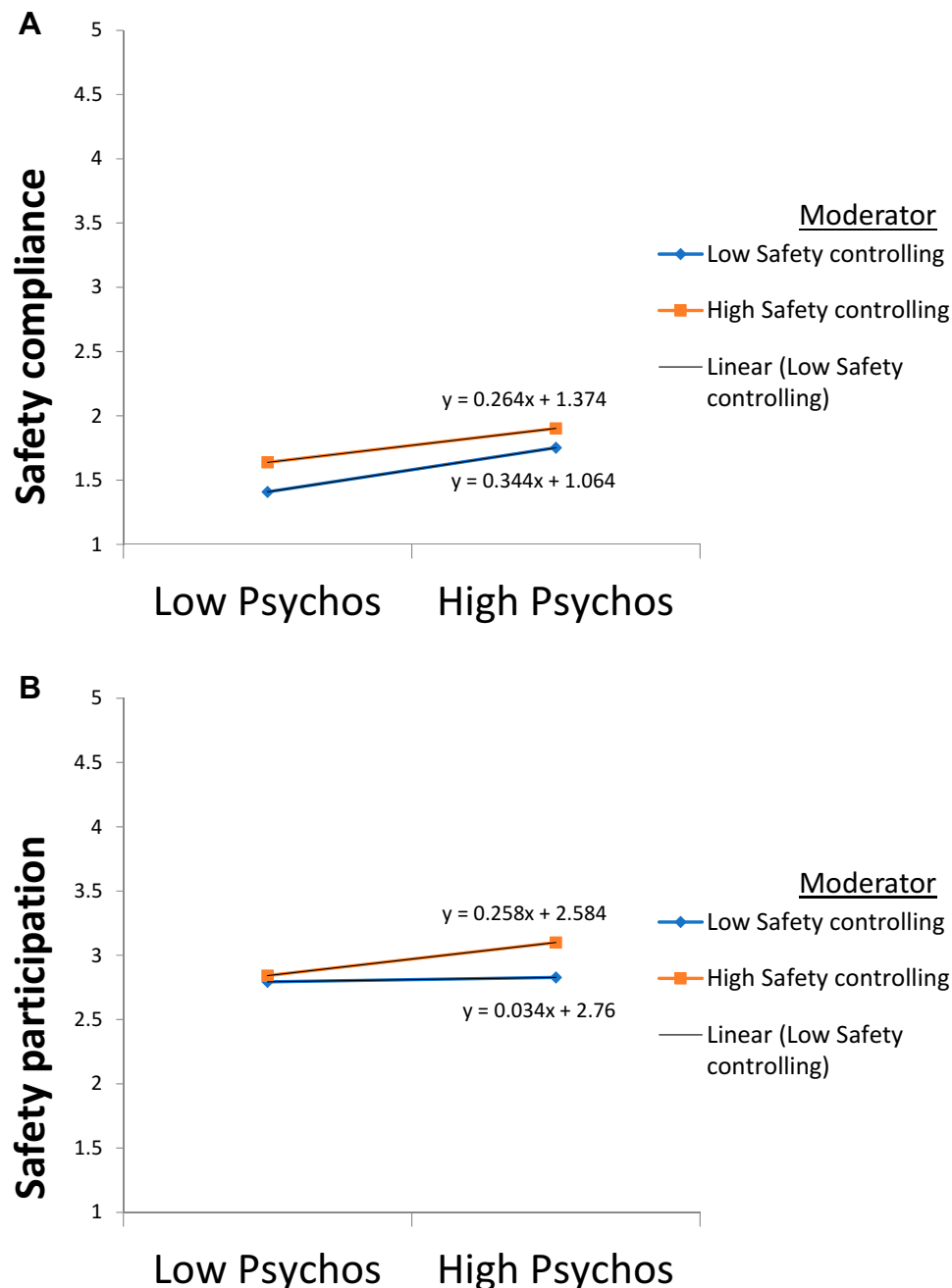


Figure 4 (A) Moderating effect of safety controlling on psychosocial stress symptoms (Psychos) and safety compliance relationship. **(B)** Moderating effect of safety controlling on psychosocial stress symptoms (Psychos) and safety participation relationship.

occupational stress symptoms but confirms studies like Selye,⁶⁹ Simmons⁷⁰ and Brulé and Morgan¹³ that concluded that stressors in organizations could sometimes cause occupational stress to turn positive (eustress). Previous studies suggest that stressors could be either a challenge (stressors that result in positive stress and outcomes) or hindrance (stressors that result in distress and negative outcomes).^{12,71} When employees perceive their roles as a challenge, they employ enough energy to

accomplish them without regards to the threats the demands will pose on their emotional and social wellbeing.¹² Role demands such as role ambiguity and role conflict require a lot of carefulness, time, effort, energy, discipline and emotional toughness, but effectively and efficiently executing them can lead in growth, learning and goal attainment.⁷² The potential gains and accomplishment for completing demanding roles can encourage mastery and competence. It will also bring happiness and

inspires employees to approach any new demands with a positive mentality.^{13,73-75} These could have been the reasons why role demands influenced employee's psychosocial stress positively.

Similarly, the results of this study showed that psychosocial stress symptoms had a positive significant influence on safety compliance and safety participation. Employees who experience positive stress will be able to increase performance since they always show resilience in overcoming stressors related to their roles.^{68,70} Employees with a high ability to cope with stressors⁶⁸ like role demands will display very little psychosocial stress symptoms at a point thereby increasing their safety performance. Moreover, a low level of psychosocial stress symptoms allows employees the opportunity to be happy, worry less about their roles, display a positive attitude towards work etc., thereby encouraging and improving safety compliance and participation at work. This could have been the reason why role demands had a positive significant influence on psychosocial stress symptoms and psychosocial stress symptoms, in turn, had a positive significant influence on both safety compliance and safety participation.

Role demands had a significant influence on psychosocial stress symptoms and psychosocial stress symptoms had a significant influence on both safety compliance and safety participation offering some support for previous studies.^{9,32,76} Asumeng, Asamani⁷⁷ highlights that stressors have short-term effects such as psychological and behavioural stress symptoms and long-term effects such as poor workplace safety performance. By effect, our findings show that psychosocial stress symptoms fully mediate the relationship between role demands and safety compliance.

The presence of safety leadership in the workplace could help promote the safety performance of employees.⁷⁸ The outcome of our study revealed that safety coaching noticeably moderated the relationship between psychosocial stress symptoms and safety compliance. Employees who enjoy safety coaching from their organizations are most likely to be equipped with the right attitude, skills and ability to overcome any condition (e.g. psychosocial stress symptoms) they perceive as threatening to their performance. It was quite surprising that safety caring which is expected to consider employee welfare could not moderate the relationship between psychosocial stress symptoms and safety compliance and safety participation. Another incongruity in our study was the failure of safety controlling to moderate the

relationship between psychosocial stress symptoms and safety compliance and safety participation. This could indicate that even if safety caring or safety controlling interact with psychosocial stress symptoms, the effect of psychosocial stress symptoms on safety performance might be minimal.

Conclusions

The results of the study provide empirical support for the theoretical model that role demands, psychosocial stress symptoms, safety leadership and safety performance are closely related. The study proved the validity and reliability of role demands, psychosocial stress symptoms, safety leadership and safety performance. The predictive capacity of role demands on psychosocial stress symptoms and the predictive capacity of role demands and psychosocial stress symptoms on the two components of safety performance (safety compliance and safety participation) were proven. The study also proved that role demands influenced only safety compliance of safety performance through their effects on psychosocial stress symptoms. The study also demonstrated that one out of the three dimensions of safety leadership interacted with psychosocial stress symptoms to have a significant influence on safety compliance. The present study's results emphasize the importance of safety coaching in mining companies. The results of this study also emphasize the importance of recognizing the mechanisms by which occupational stressors and stress can be managed to ennoble workplace safety performance.

Implications of the Study

This present study has both theoretical and practical contributions. The study contributes to literature since it has shown that role conflicts and role ambiguity can be combined into role demands and estimated their effects on safety performance. The study did not only find a single measure for role conflicts and role ambiguity but also tested the mediating effect of psychosocial stress symptoms on the relationships between role demands and safety compliance and safety participation which revealed that (i) psychosocial stress symptoms fully mediate the relationship between role demands and safety compliance and (ii) psychosocial stress symptoms could not mediate the relationship between role demands and safety participation. The study established that safety coaching is the most key moderator among the three elements of safety leadership on the relationship between psychosocial stress symptoms

and safety compliance. Therefore, it helps answer the question asked by Wu, Chang⁷⁸ when they recommended future researchers to consider conducting studies that will help know which of these three dimensions of safety leadership has the most influence on safety performance. Also, safety compliance is the most vulnerable aspect of safety performance to be affected if there are the presence of stressors or stress.

The practical implications of the present study include the following: Firstly, stress is not entirely a bad thing. It has benefits for both the employee and the employer. According to Kaufer,⁷⁹ intermittent stressful events are probably what keeps the brain more alert, and individuals perform better when they are alert. Some level of stress enables the organization to ascertain the skill strengths within the mines. These skill strengths determine one's ability to overcome role challenges. Employees who lack the skills and abilities to cope with the demands of their roles will require training to handle these challenges. Training managers or superintendents can base on this skill gap to develop appropriate training programmes for affected employees. Secondly, roles assigned to mineworkers should be void of conflicts and ambiguity as this reduces the psychosocial stress level and allows employees to work with joy and improve safety at the workplace. Thirdly, supervisors must also understand the types of safety leadership and know-how to apply them in managing stress at the workplace. This can help improve safety compliance and encourage safety participation behaviours. Most especially, safety coaching must be given a top priority since it equips employees with the right skills, right mentality and the right information to enable employees to identify and cope with stress immediately when they face one.

Limitations and Suggestions for Future Research

Besides the contributions of this current work, our study only tests the mediating role of psychosocial stress symptoms and the moderating role of safety leadership. Other variables such as job dissatisfaction and supportive superior behaviour as a mediator and moderator respectively warrant future investigation. Furthermore, the average variance extracted (AVE) for safety participation was 0.47 and it was lower than the threshold of 0.50. The predictability of role demands, psychosocial stress symptoms and safety leadership could have been affected by the lower AVE. It may be possible that the items failed to extract their intended purposes. This could in part be due to the

fact the study is the first of its kind concerning the population under study.

Ethical and Consent Statement

In carrying out this research work, the Ethical Code of Conduct of American Psychological Association (APA) was complied with. A cover letter suggesting the willingness of respondents' participation and confidentiality of their responses were given to respondents after we had taken permission from the board of directors. Participation was voluntary and respondents were free to quit at any point in time. All respondents willingly partook in the study. Also, the study was in accordance with the Declaration of Helsinki and written informed consent was provided by the participants. This research work was supervised by a professor from Jiangsu University and the study was approved by the Institutional Review Board of Jiangsu University.

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Author Contributions

All authors contributed to data analysis, drafting or revising the article, gave final approval of the version to be published, and agree to be accountable for all aspects of the work.

Disclosure

The authors declare that they have no conflicts of interest in this research work.

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