



Contents lists available at ScienceDirect

Safety and Health at Work

journal homepage: www.e-shaw.net

Original Article

Moderated Mediation Effect of Mindfulness on the Relationship Between Muscular Skeletal Disease, Job Stress, and Turnover Among Korean Firefighters

Jong-Hyun Lee¹, Jae-eun Lee², Kyung-Sun Lee^{3,*}

¹ Social Science Research Institute, College of Social Sciences, Ajou University, Yeongtong-gu, Suwon, Republic of Korea

² Department of Adult Learning and Counselling, Sangji University, Wonju-si, Gangwon-do, Republic of Korea

³ Department of Industrial Health, Catholic University of Pusan, Geumjeong-gu, Busan, Republic of Korea

ARTICLE INFO

Article history:

Received 9 April 2019

Received in revised form

14 October 2019

Accepted 27 March 2020

Available online 3 April 2020

Keywords:

Firefighter

Job stress

Mindfulness

Moderated mediation effect

Musculoskeletal disease

ABSTRACT

Background: This study investigated the effect of increased job stress, caused by musculoskeletal disease (MSD) among firefighters, on a firefighter's intention to leave the profession, henceforth referred to as "turnover intention," and verified the moderating effect of mindfulness on such a relationship.

Methods: A survey involving a total of 549 Korean male firefighters as participants was conducted herein, and the following results were obtained: the mediation effect of the MSD to turnover intention through job stress was confirmed, and the indirect effect of job stress was verified.

Results: We verified the moderated mediation effect of mindfulness on the relation:MSD, job stress, and turnover intention. The conditional indirect effect for middle and high levels of mindfulness is significant.

Conclusion: The result of this study is supported by proofs of the relationship between a firefighter's MSD, job stress, and turnover intention, and these case studies reveal the moderated mediation effect of dispositional mindfulness.

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1. Introduction

Firefighting is a classic occupation with a high incidence of musculoskeletal disease (MSD) because of the fact that this work involves prolonged physical activity and a high physical burden. A survey on firefighters' complaints of pain revealed that they experience severe pain in their necks, backs, and shoulders [1]. Firefighting work causes MSDs evenly across all age groups, and the length of time the firefighters can suffer from these disabilities increases with their age [2].

MSDs account for acute or chronic conditions involving the nerves, tendons, muscles, and supporting structures of the body and compromise the functions of these body systems [3]. MSDs are defined as the occurrence and accumulation of small damages in the muscle, joint, blood vessel, or nerve because of long-term repetitive motion and inadequate posture at work, and the development of an MSD by a person is dependent on various factors of the body, including psychological factors [4]. Previous literature has

suggested that job stress is a major causative factor for MSDs [5,6]. MSDs can occur in response to persistent physical and psychological stress, and MSDs can then themselves further act as a stressor [5].

Firefighters are considered to be at risk of work-related stress just from the nature of their job. According to a study by Moran and Colless [7] on Australian firefighters, firefighters rate their jobs as more stressful than other occupations and they rate their psychological work stress as the highest out of a set of other potential sources and types of stress.

Firefighters' job stress not only causes MSDs, but it also directly affects the likelihood of firefighters leaving their profession, known as turnover. Kim and Baek [8] asked 3,028 Korean firefighters for turnover intentions in a survey. Half of the firefighters responded that they considered changing their jobs. When asked the following question: "Have you looked for other kinds of work?" A total of 48% of the participants responded, "considered frequently," whereas 41% "considered once or twice." Despite these figures, the actual

* Corresponding author. Department of Industrial Health, Catholic University of Pusan, 57 Oryundae-ro, Geumjeong-gu, Busan, 46252, Republic of Korea.
E-mail address: sea4one@gmail.com (J.-H. Lee).

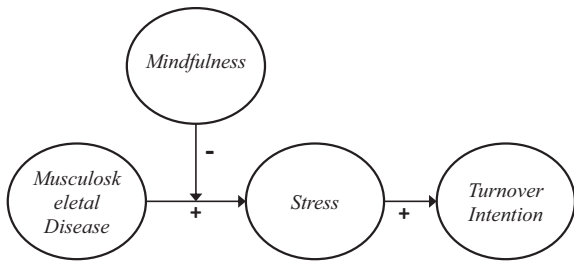


Fig. 1. Hypothetical model for the association of musculoskeletal disease, mindfulness, stress, and turnover intention.

turnover rate of Korean firefighters is not high because they are employed as public servants with good job security. However, many firefighters are actually considering turnover [8]. As of 2018, there is one firefighter in Republic of Korea for every 1,045 people [9]. This value is higher than in the United States (i.e., 911 per firefighter) and Japan (i.e., 779 per firefighter). Considering this relative shortage of firefighting personnel, efforts to reduce turnover intentions of firefighters are necessary.

The reduction of job stress is critical to reducing turnover. Previous studies mostly focused on the direct effect of mindfulness training on stress reduction [10]. For instance, according to a meta-analysis based on 29 existing studies, mindfulness training targeting healthy individuals proved sufficiently effective in reducing stress, depression, anxiety, and pain, which improved the quality of life [11]. Mindfulness is defined as holistic awareness without judgment and criticism achieved through intentional attentiveness to what is happening in the body and mind and also to what is happening in one's surroundings [12]. The term mindfulness can also be defined in many other ways. For example, it can be described as the process of escaping from fixed perception, of treating each event as the first experience, of facing a fact as it is in one's experience, and paying attention to our thoughts and feelings without judging them. It is the process of responding receptively to the inner experience rather than reflexively [13]. Alternatively, it can be defined as improving our attention and awareness of the present experience or existing reality [14].

Recent research on stress has focused on mindfulness, and its ability to cultivate equanimity—calmness and composure in the face of a difficult situation. One study has already reported that mindfulness can reduce stress [15]. Mindfulness is more broadly defined as awareness that arises through purposefully and non-judgmentally paying attention in the present moment, which requires curiosity, openness, and acceptance of the present moment [16]. Studies examining the stress reduction effect of mindfulness in patients have been active in the last 15 years [17]. Previous studies mostly focused on the direct effect of mindfulness training on stress reduction [11,18,19].

Several recent studies focused on the effect of mindfulness to firefighters. Smith et al. [20] validated that mindfulness relieves the physical and psychological symptoms of firefighters going through post-traumatic stress disorder. Setti and Argentero [21] demonstrated the efficacy of mindfulness in reducing firefighters' psychiatric disorders from a traumatic event. Studies suggesting that such mindfulness relieves physical and psychological symptoms mainly verified the effectiveness of mindfulness programs [e.g., mindfulness-based stress reduction (MBSR)]. To apply the various definitions and related concepts mentioned previously to the relief of pain, research conducted for professional practitioners with high level of mindfulness or ordinary people who participated in the program is important, but it is also important to investigate

Table 1
Scoring system of main body part and symptom body part

Criteria	Main body part and symptom body part		
	Agree	Adjacent body part (neck-shoulder, wrist-finger, shoulder-elbow)	Disagree
Symptom			
Criteria 3	5	4	0
Criteria 2	4	3	0
Criteria 1	3	2	0
etc	2	1	0
Non-symptom	0	0	0

*Criteria 1: Symptoms persist for at least 1 week or more than once a month for the past year; Criteria 2: Symptoms persist for at least 1 week or more than once a month for the past year (the degree of symptoms was "moderate"); Criteria 3: Symptoms persist for at least 1 week or more than once a month for the past year (the degree of symptoms was "severe").

whether the effect of dispositional characteristics shows on those who have no experience.

Therefore, in this study, based on the results of previous studies, we aimed to investigate whether dispositional mindfulness can reduce the stress of pain, and investigate in what manner such reduced stress affects the turnover intention of firefighters. This was performed by detailed measurements of MSDs, a frequent physical pain experienced by firefighters in particular, and not by examining the various symptoms (Fig. 1).

2. Materials and methods

2.1. Data collection

The present study surveyed firefighters employed at fire stations in Republic of Korea. The cooperation of the head of the fire department was requested with the help of outside personnel to ensure the anonymity of the collected data. Participants who expressed reluctance or hesitation in the course of the survey were excluded. The survey was conducted from March to May 2017 on a total of 610 male firefighters. Currently, there are about 50,000 firefighting officials in Republic of Korea, of which 8% are women. In addition, the proportion of women recruited in the last 5 years is 4–6%. It was not the researcher's intention, but because of the gender ratio of the population and the rarity of female firefighters, the collected samples purely by chance happened to be all male. The data of 549 respondents were included in the data analysis with the exclusion of insincere/incomplete responses. The survey questionnaire took approximately 10–15 minutes to complete, and each of the firefighters who participated in the survey was compensated with \$20.

2.2. Measures

2.2.1. MSD

The MSD score is calculated from the MSD symptom survey evaluation criteria based on various research reports at the National Institute for Occupational Safety and Health and developed by the Occupational Safety and Health Research Institute, a subsidiary of Korea Occupational Safety and Health Agency [22]. The criteria used a method in which scores are determined from danger grades by body part. In the method, a hazard factor survey by body part is first administered to determine the danger levels for each body part and quantifies the severity of symptoms by body parts in symptom survey results into grades. The survey consists of 36 items, including questions about pain or discomfort location in the body and the duration, strength, and frequency of the pain. The responses were coded and converted into scores by the participant using Excel formulae based on the scoring criteria (Table 1).

Subjective pain symptoms reported by firefighters in the Beaton et al.'s study [1] described earlier were found throughout the body, including the neck, back, shoulders, and limbs, and were consistent with the body parts measured on this scale. According to criteria 1–3, the scores for the duration and severity were summed for each body part and represented. For example, if the participant experiences severe (severity) pain for the duration of only 1 day to less than 1 week each in the neck and shoulder area only, and the frequency occurs once every 2–3 months out of 1 year, the neck and shoulder area are counted as two points each and in total, it is measured as a score of 4 points.

2.2.2. Job stress

Job stress was measured with the Korean Occupational Stress Score—Short Form (KOSS-SF), which is a standardized and simplified version of the scale developed by Chang et al. [23]. The scale consists of 24 items across the following seven subscales: Lack of Job Autonomy (5 items), Job Demands (8 items), Interpersonal Conflicts (4 items), Job Insecurity (6 items), Organizational Structure (7 items), Inadequate Compensation (6 items), and Workplace Culture (4 items). The scale's internal consistency reliability was demonstrated with a Cronbach α value of 0.924. The value for each subfactor was 0.602 for the four items in Lack of Job Autonomy (on elimination of one item with a low reliability), 0.837 for Job Demands, 0.869 for Interpersonal Conflicts, 0.624 for the four items in Job Insecurity (on elimination of one item with a low reliability), 0.904 for Organizational Structure, 0.828 for Inadequate Compensation, and 0.772 for Workplace Culture.

2.2.3. Mindfulness

Mindfulness was measured using the Korean Five Facet Mindfulness Scale [24], which is Baer et al.'s Five Facet Mindfulness Questionnaire [25] validated in the Korean language. The scale consists of a total of 39 items distributed across the following subfactors: Acting with Awareness (7 items), Non-judging of Experience (8 items), Observing (8 items), Non-reactivity (8 items), and Describing (8 items). The scale's overall internal consistency reliability was demonstrated with a Cronbach α value of 0.860. The value for each subfactor was 0.619 for the seven items in Describing (on elimination of one item with a low reliability), 0.944 for Acting with Awareness, 0.911 for Non-judging of Experience, 0.887 for Observing, and 0.901 for Non-reactivity.

2.2.4. Turnover intention

Turnover intention was measured with the three items developed by Hellgren et al. [26]. The internal consistency reliability of which was demonstrated with a Cronbach α value of 0.897.

2.2.5. Data analysis

For model verification, SPSS 25.0 PROCESS version 3 macro was implemented based on the conditional indirect effect verification by Hayes [27]. First, PROCESS MODEL 4 macro was used to verify the mediation effect and the indirect effect of MSD, stress, and turnover intention in Model 1. The indirect effect here is not the effect of MSDs directly on stress and turnover intention, but the effect of MSDs indirectly leading to turnover intention through stress. In addition, SPSS 25.0 hierarchical regression analysis was used in Stage 2 of the mediation effect analysis procedure to analyze the predicting power of independent variables on dependent variables. Second, we used PROCESS MODEL 7 macro to verify the moderation effect of mindfulness on the effect of MSD on stress. We then investigated the confidence intervals of conditional indirect effect for high, middle, and low moderator variable levels to verify the moderated mediation effect. Moreover, charts were presented in accordance with the Johnson–Neyman technique [28–30].

Table 2
Demographic characteristics

Variable	Category	N	%
Age	Under 29 y	79	14.4
	30–39 y	225	41.0
	40–49 y	182	33.2
	More than 50 y	61	11.1
	Non-response	2	0.4
Education	High school graduate	4	0.7
	College graduate	237	43.2
	University graduate	274	49.9
	Graduate school	12	2.2
	Non-response	22	4.0
Position	Fire fighter	132	24.0
	Senior fire fighter	110	20.0
	Fire sergeant	142	25.9
	Fire lieutenant	84	15.3
	Fire captain	11	2.0
	Fire chief	3	0.5
	Non-response	67	12.2
Work period	Less than a year	144	26.2
	1–3 y	268	48.8
	3–5 y	39	7.1
	More than 5 y	79	14.4
	Non-response	19	3.5
Division	Rescue and EMS	54	9.8
	Prevention	21	3.8
	Civil service	15	2.7
	Fire suppression and investigation	25	4.6
	Fire administration	60	10.9
	Equipment management	14	2.6
	Extinguishing the fire and emergency services (EMS)	330	60.1
	Rescue team	25	4.6
	Fire-fighting fleet	4	0.7
	Non-response	1	0.2

3. Results

3.1. Demographic characteristics

Table 2 summarizes the demographic characteristics of the survey responders. A total of 41% responders were in their 30s; 33.2% were in their 40s, and approximately 93% had at least an associate's degree. A uniform distribution by ranks exists, except for the Fire Marshall and the Fire Assistant Chief. Approximately, 50% had work experiences of 1–3 years, and 60.1% worked at the Fire Extinguishment and First Aid departments.

3.2. Correlation among variables

Table 3 shows the correlation analysis results between the variables involved in the study. The correlation between the mediation variables, namely mindfulness, MSDs, job stress, and turnover, was statistically significant.

3.3. Mediating effect

Table 4 describes the verification results for the mediation effect of job stress on the effect of MSD on the turnover intention. In Stage 1, after controlling the age, education level, rank, and work experience, the effect of MSD on job stress was found to be statistically significant ($B = 0.015, p < 0.001$). Similarly, in Stage 2, the effect of MSD on the turnover intention was also statistically significant ($B = 0.018, p < 0.05$). In the final stage, when MSD and job stress were both used as inputs, job stress had a statistically significant effect on the turnover intention ($B = 0.698, p < 0.001$). Meanwhile, MSD did not have a statistically significant effect on the turnover intention, indicating a complete mediation model in which MSD increases the turnover intention through job stress perception. In addition, the indirect effect verification of job stress perception by bootstrapping in the mediation model yielded a significant indirect

Table 3
Correlation among variables

	1	2	3	4	5	6	7	8
1. Age	—							
2. Education	-0.117**	—						
3. Position	0.794***	-0.147**	—					
4. Work period	0.202***	0.007	0.206***	—				
5. Mindfulness	-0.008	-0.023	0.025	-0.009	—			
6. MSDs	0.153***	-0.037	0.114*	0.086*	-0.004	—		
7. Job stress	0.054	0.111*	0.063	0.186***	-0.384***	0.178***	—	
8. Turnover	0.033	0.088*	0.057	0.084	-0.248***	0.105*	0.341***	—
M	—	—	—	—	2.661	1.990	2.249	1.600
SD	—	—	—	—	0.267	3.767	0.319	0.691

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

M, mean; MSD, musculoskeletal disease; SD, standard deviation.

effect because 0 was not contained in the 95% confidence interval of estimation, verifying the mediation model.

3.4. Moderating effect

Table 5 shows the moderation effect verification results of mindfulness on the effect of MSD on job stress. In Stage 1, we controlled the age, education level, rank, and work experience. In Stage 2, the main effect analysis of the MSD and mindfulness on job stress perception showed statistically significant results ($B = 0.016$, $p < 0.001$ for MSD; $B = -0.426$, $p < 0.001$ for mindfulness). In the final stage, the interaction effect of the MSD and mindfulness predicted job stress with significance ($B = 0.028$, $p < 0.05$). Therefore, mindfulness was proven to moderate the positive effect of the MSD on the job stress.

3.5. Moderated mediation

Table 6 describes the comprehensive verification of the MSD and mindfulness on the increased turnover intention by the job stress. First, we examined the moderation effect of mindfulness in the sequence of the MSD affecting the turnover intention through the job stress perception. The MSD predicted the job stress with significance in the mediator variable model ($B = 0.014$, $p < 0.001$), whereas its effect on the turnover intention was not significant in the dependent variable model. Second, investigations on the index of the moderated mediation revealed a statistically significant moderated mediation effect (Index = 0.020; Boot LLCI = 0.007 – Boot ULCI = 0.040). Furthermore, the indirect effect of different levels of mindfulness, namely low, middle, and high, on the chain of MSD–job stress–turnover intention was significant for the middle and high levels. Fig. 2 depicts the results using the Johnson–Neyman technique.

Table 4
Mediation and indirect effects

	MSD–stress–turnover intention						Indirect effect of stress				
	Stress		Turnover intention				Indirect effect	Se	95% CI (bias-corrected)		
	1st (B/SE)	2nd (B/SE)	2nd (B/SE)	3rd (B/SE)	3rd (B/SE)	LLCI			ULCI		
Age	0.002	0.028	-0.028	0.062	-0.029	0.059	Stress	0.010	0.002	0.006	0.016
Education	0.102***	0.027	0.125*	0.061	0.054	0.060					
Position	0.000	0.021	0.040	0.046	0.040	0.044					
Tenure	0.061***	0.016	0.028	0.035	-0.014	0.034					
MSD	0.015***	0.004	0.018*	0.009	0.007	0.008					
Stress					0.698***	0.100					
F	9.600***		4.171		10.033***						
R ²	0.097***		0.023		0.119***						

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

CI, confidence interval; LLCI, lower level confidence interval; MSD, musculoskeletal disease; SE, standard error; ULCI, upper level confidence interval.

4. Discussion

This study was performed to verify the mediated moderating role of mindfulness in the relationship between the MSD, job stress, and the turnover intention among Korean firefighters. The discussion based on the findings of this study is described below. First, the MSD increases the job stress and affects the turnover intention by complete mediation through the job stress. The focal point of the previous studies was mainly on the occurrence of MSD in response to the job stress. However, this study achieved a distinction in its actual verification of the effect of MSD on job stress and the subsequent relationship with the turnover intention. This result is in line with the view of Carayon et al. [5], who contended that negative physical symptoms after stress can be a cause of stress. This suggests a need to decrease the job stress of firefighters to curb their turnover intention, and that measures are necessary to tackle

Table 5
Moderation effect

	Criterion: Stress					
	1st (B/SE)		2nd (B/SE)		3rd (B/SE)	
Age	0.014	0.028	-0.022	0.026	-0.020	0.026
Education	0.104***	0.028	0.090***	0.026	0.083**	0.026
Position	-0.002	0.021	0.016	0.019	0.013	0.019
Tenure	0.064***	0.016	0.060***	0.015	0.060***	0.014
MSD			0.016***	0.004	0.014***	0.004
Mindfulness			-0.426***	0.052	-0.434***	0.052
MSD × mindfulness					0.028*	0.012
F	8.151***		20.563***		18.517***	
(Δ)R ²	0.068***		0.149***		0.009*	

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

MSD, musculoskeletal disease; SE, standard error.

Table 6
Conditional indirect effect of mindfulness in the mediation effect of stress between musculoskeletal disease and turnover intention

Variables	Mediation model (stress)		Criterion model (turnover intention)	
	B/SE		B/SE	
Age	−0.020	0.026	−0.029	0.059
Education	0.083**	0.026	0.054	0.059
Position	0.013	0.019	0.040	0.044
Tenure	0.060***	0.014	−0.014	0.034
MSD	0.014***	0.004	0.007	0.008
Mindfulness	−0.434***	0.052		
MSD × mindfulness	0.028*	0.012		
Stress			0.697***	0.100
F	18.517***		10.033***	
R ²	0.226***		0.119***	

	Turnover intention				
		Indirect effect	SE	95% CI (bias-corrected)	
				LLCI	ULCI
Mindfulness	L	0.006	0.003	0.000 ^a	0.011
	M	0.008	0.002	0.004	0.013
	H	0.015	0.003	0.010	0.022

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$; ^a -0.0004 .

CI, confidence interval; H, high level; L, low level; LLCI, lower level confidence interval; M, middle level; MSD, musculoskeletal disease; SE, standard error; ULCI, upper level confidence interval.

the MSDs they encounter daily. These results suggest that there is a need to reduce the job stress of firefighters to reduce the degree of turnover intention, and to cope with MSDs that firefighters routinely experience. This study also advances the measurement method for physical pain (i.e., MSD by self-report). The lack of objectivity in the self-report type of pain evaluation carried out was complemented by measuring the duration, severity, and frequency of pain for each part.

Second, mindfulness turned out to be negatively correlated with job stress and turnover intention. Coffey and Hartman [31] provided three explanations on the mechanism of dispositional mindfulness affecting psychological distress, which are emotion regulation, reduction in rumination thoughts, and non-attachment. To describe this further, individuals with a high level of mindfulness regulate their emotions in such a way that negative emotions do not surface; they stop the repetitive recollection of negative thoughts, and they liberate themselves from the obsession that one has to have positive emotions, thereby freeing themselves from psychological stress. The result also showed that individuals with high levels of mindfulness had low levels of job stress and turnover intention, confirming once again the adaptive effects of mindfulness reported in the previous study [11,15,17–19].

Meanwhile, mindfulness was shown to moderate the effect of the MSD on the job stress. Although no large differences were observed in the negative effect of the MSD on the job stress at low mindfulness levels, the negative effect of the MSD on the job stress was larger at high mindfulness levels. In other words, the buffering effect of mindfulness on the job stress was high when the pain associated with the MSD was low, but the mindfulness level did not make a large difference when the pain worsened. This result appears to contradict those of the previous studies [32–34], in which MBSR alleviated physical pain and negative psychological state. However, note that this study measured dispositional mindfulness, as opposed to conducting an MBSR program. Mindfulness is defined as “moment-by-moment” awareness and a non-judgmental and accepting attitude [35]. Hence, a highly mindful individual is keenly aware of one’s status of self, which can be considered as a rationale for the strong correlation between MSD and job stress.

Lastly, mindfulness mediated the moderation effect of the MSD on turnover intention through the job stress. That is, a high mindfulness level led to a higher mediation effect of job stress in the relationship between the MSD and turnover intentions. These results raised doubts on the effect of mindfulness for reducing turnover intentions of firefighters. Then, does mindfulness increase the turnover intention of firefighters? If we interpret the plot describing the moderation effect of mindfulness on the effect of MSD on job stress, higher MSD causes higher job stress, and job stress is lower for high mindfulness compared to low mindfulness, albeit with a higher slope (Fig. 3). Mindfulness also had a significant negative correlation with job stress and turnover intention. From this, we can assume that dispositional mindfulness makes us more sensitive to the negative stimulus of MSD and its result of high job stress and makes us think about solutions in stress situations (e.g., turnovers), thereby serving an adaptive function. Nevertheless, additional studies are needed to verify these assumptions.

This study did not explain the causative relationships because the three variables (MSD, job stress, and turnover intention) were simultaneously measured in this cross-sectional study. What was measured herein was dispositional mindfulness, and the moderation effect of the MBSR in the relationship between the MSD and

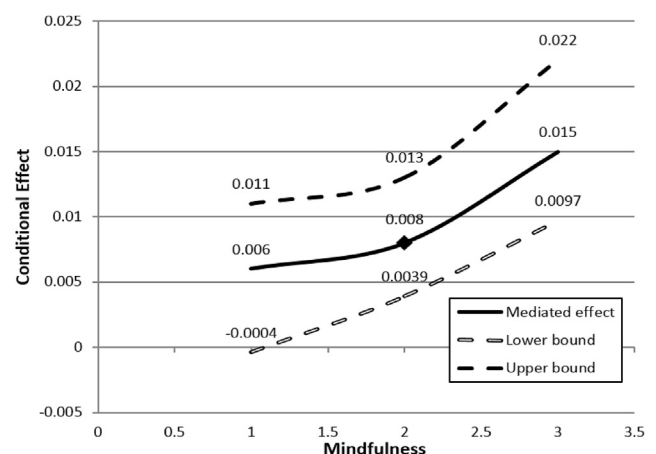


Fig. 2. Conditional indirect effect of mindfulness.

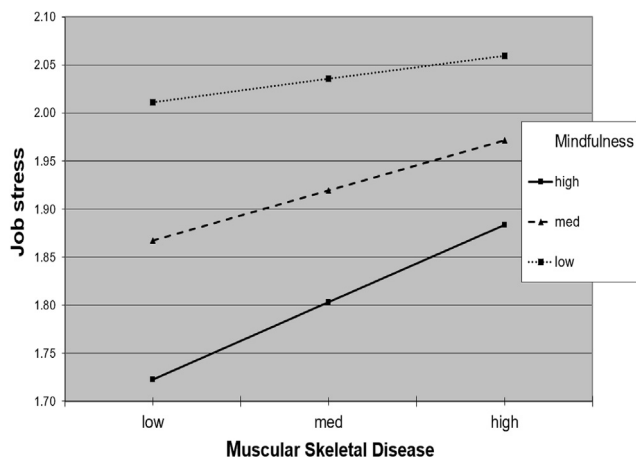


Fig. 3. Moderation effect of mindfulness between musculoskeletal disease and job stress.

job stress could have different consequences. Thus, additional verification in further studies is needed to measure the effect of actual intervention. This study was implicative for providing an empirical result about the relationship of firefighters' MSD, job stress, and turnover intention and for unveiling the moderation effect and moderated mediation effect of dispositional mindfulness. However, attention should be paid in interpreting and generalizing from these results because the study has been conducted only for a specific occupation of a specific country (firefighter in Republic of Korea) and for a particular gender. However, it shows there is a strong need to develop proper intervention strategies to lower the job stress and the turnover intention of firefighters. These interventions will reduce the turnover intention of firefighters and ultimately contribute to ensuring public safety.

Through this study, it was confirmed once again that actual physical pain could be reduced by the mindfulness of a person, and in this study, we demonstrated that mindfulness producing such a pain reduction effect can be solely because of the personal characteristics (disposition) of the person alone. In addition, the study results indicated that firefighters suffering from stress arising from physical pain because of the nature of their work could reduce their stress through such personal dispositional mindfulness and this could in turn intervene in the high level of workplace turnover behavior occurring in that profession. Based on the study results, if an MBSR-related program is introduced for firefighters, it is thought that we can expect more effective intervention in this phenomenon.

Conflicts of interest

None.

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