

Multilevel Effects on Stress focused on Individual, Workplace, and Neighborhood factors
among 9-1-1 Telecommunicators

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Abstract

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About one in four 9-1-1 call center telecommunicators experienced post-traumatic stress disorder (Lilly & Allen, 2015). The evidence on stress associated with individual, institutional, and neighborhood levels are well known; however, comprehensive assessments of effects on stress have not been studied among 9-1-1 telecommunicators (TCs). This study aims to examine multilevel effects on stress regarding three factors: individual characteristics, workplace conditions, and neighborhood effects based on the socioecological model. A secondary analysis was conducted using data collected as part of a randomized controlled trial that evaluated a multilevel stress reduction intervention for 9-1-1 telecommunicators in call centers across the United States and Canada. The parent study collected the data on stress symptoms, resilience, mindfulness, overcommitment, job-demand, and social support at workplace. Neighborhood data (e.g. median household income) were collected from the U.S. Census Bureau. Mixed-effects logistic regressions were conducted to examine what effects were significantly associated with 9-1-1 TCs' stress. Results showed that all the individual characteristics (e.g. resilience, mindfulness, and overcommitment) and all of the workplace conditions (e.g. job-demand, social support at work, and mandatory overtime) were significantly associated with stress, whereas the neighborhood factor was not. Less resilience, less mindfulness, greater overcommitment, greater job-demand, less social support, and having mandatory overtime were all associated with greater stress. In the multivariable model, less mindfulness and greater overcommitment were significantly associated with greater stress controlling for all covariates (OR 0.17; 95%CI 0.10, 0.28; OR 1.19; 95%CI 1.07, 1.31). This study supports the importance of a multifaceted approach to improve stress reduction programs for 9-1-1 telecommunicators. Also, the inclusion of a neighborhood effect is a novel way of assessing stressors for 9-1-1 telecommunicators even though we did not find the evidence of neighborhood effects associated TCs' stress. This study highlights that mindfulness and overcommitment are critical predictors of stress among TCs.

Contents

I.	Introduction -----	page 1
II.	Literature Review & Conceptual Model -----	page 3
	1. Individual Characteristics Effects on Stress -----	page 4
	2. Workplace Condition Effects on Stress -----	page 6
	3. Neighborhood Context Effects on Stress -----	page 7
III.	Method -----	page 9
	1. Sampling and Data Collection -----	page 9
	2. Measurements -----	page 9
	3. Data Analysis -----	page 13
IV.	Result -----	page 15
	1. Descriptive Analysis for 9-1-1 Telecommunicators' characteristics -	page 15
	2. Multilevel Effects on Stress -----	page 19
V.	Discussion -----	page 20
	1. Comparison of 9-1-1 TCs to other Professionals regarding Stress and Multilevel Factors -----	page 21
	2. Support Literature for the Significant Associations between Individual and Institutional Effects and Stress -----	page 22
	3. Advantages and Limitations -----	page 24
	Reference -----	page 26

Figure and Table

Figure 1. Conceptual Model of Three Effects on Stress Symptoms -----	page 4
Table III-1. Validity of Instruments -----	page 12
Table III-2. Distributions of Potential Confounders -----	page 15
Table IV-1. Demographic Characteristics of Participants -----	page 17
Table IV-2. Descriptive Analysis of Stress and Multilevel Factors -----	page 18
Table IV-3. Categorical Information for Participants -----	page 18
Table IV-4. Multilevel Effects on Stress -----	page 20

Appendix

Appendix A. Questionnaires of Measurements -----	page 32
Appendix B. Call Center's Serving Area and its Socioeconomic Data -----	page 36
Appendix C. Distribution of Respondents by Call-center -----	page 38

I. Introduction

9-1-1 call center telecommunicators (TCs) are at high risk of exposure to traumatic events. 9-1-1 TCs are the first responders of emergency response system, and are often communicating with people in great distress, harm, fear, or injury. Lilly and Allen (2015) reported that 17.6% to 24.6% of 9-1-1 telecommunicators experienced probable post-traumatic stress disorder (PTSD). The continued exposure to vicarious traumatic events is likely to affect their psychological and physical health. For example, among other public safety workers such as law enforcement officers, long-term stress is associated with high rates of gastrointestinal disorders, high blood pressure, and coronary heart disease (Sheehan & Van Hasselt, 2003).

Three dimensions of effects on stress have been theoretically and practically studied in the field of public health: individual, institutional, and neighborhood factors. At the individual level, research shows that lower stress levels are associated with higher degrees of resilience (Babanataj, Mazdarani, Hesamzadeh, Gorji, & Cherati, 2018; Bibi, Kalim, & Khalid, 2018), higher degrees of mindfulness (Compen et al., 2015; H. Meischke et al., 2015; Schellekens et al., 2017), and lower degrees of overcommitment (Bellingrath & Kudielka, 2008; Bellingrath, Rohleder, & Kudielka, 2010; Eddy, Heckenberg, Wertheim, Kent, & Wright, 2016; Eddy, Wertheim, Kingsley, & Wright, 2017; J. Siegrist & Li, 2017). Some studies showed lower levels of mindfulness and greater overcommitment were associated with greater stress among TCs (H. Meischke et al., 2015), but the effects of resilience on stress among 9-1-1 TCs has not been reported yet.

At the organizational/institutional level, job demand-control and social support at workplace are primarily investigated based on a Job Demand Control Support model (JDCS). The JDCS model initially developed by Johnson and Hall (1988) (Johnson & Hall, 1988; Van

der Doef & Maes, 1999) suggests that work environment is associated with occupational stress (Akbari, Akbari, Shakerian, & Mahaki, 2017; Hirokawa, Miwa, Taniguchi, Tsuchiya, & Kawakami, 2016; O'Donnell, Landolt, Hazi, Dragano, & Wright, 2015; Palmer, 2014; Saijo et al., 2016; Shakespeare-Finch & Daley, 2017). Work environment, such as job demand, job control and social support, is significantly associated with workers' stress among firefighting dispatchers (Palmer, 2014), ambulance service personnel (Shakespeare-Finch & Daley, 2017), nurses (Saijo et al., 2016), medical workers (Hirokawa et al., 2016), and office workers (O'Donnell et al., 2015), but these workplace conditions associated with stress has not been reported among 9-1-1 TCs.

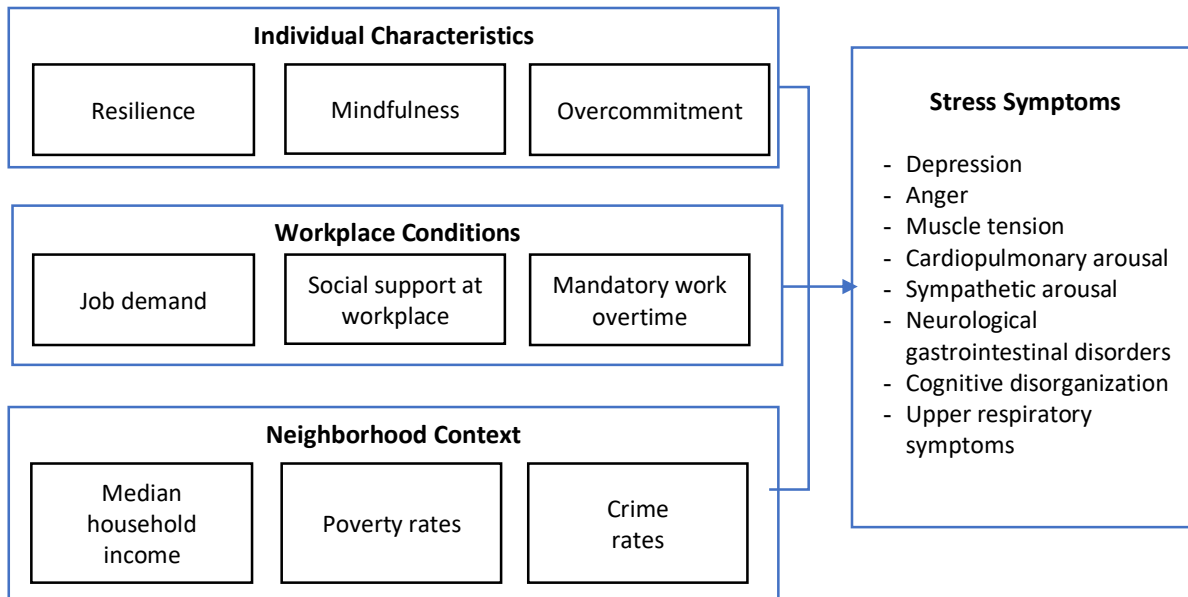
Lastly, neighborhood characteristics are increasingly recognized in public health research and their impact on health became more compelling based on social determinants of health perspectives (Braveman & Gottlieb, 2014; Diez Roux & Mair, 2010; Keyes & Galea, 2016). The term "social determinants" often relates to health-related features of neighborhoods (e.g. walkability and accessibility of healthful foods), as well as socioeconomic status (e.g. income and education). These conditions can greatly influence individual and group differences in health status as the fundamental causes of health outcomes (Braveman & Gottlieb, 2014; Diez Roux & Mair, 2010; Keyes & Galea, 2016). Several studies with large sample sizes showed adverse neighborhood effects on stress among adults, (Boardman, Finch, Ellison, Williams, & Jackson, 2001; Elliott, 2000), pregnant women (Giurgescu et al., 2015), adolescents (Ewart & Suchday, 2002), and ethnically diverse populations (Buschmann, Prochaska, Cutchin, & Peek, 2018). These studies show the direct association between neighborhood factors and residents' health; however, no research has been conducted to assess how adverse neighborhood characteristics can indirectly influence public safety employees who serve such communities.

To examine factors associated with 9-1-1 TCs' stress symptoms, using a multilevel perspective is new and critical because one or two individual-based explanations of stressors may be insufficient and may fail to capture important determinants of stress. By examining three different levels of effects, we may be able to gain a more comprehensive understanding of factors that are associated with stress. Therefore, the aim of this study is to examine that factors at the individual, institutional and neighborhood, are jointly associated with stress in TCs.

II. Literature Review & Conceptual Model

This study is guided by the social-ecological approach focusing attention on both individual and social environmental factors (McLeroy, Bibeau, Steckler, & Glanz, 1988). The conceptual framework describes how the multilevel factors influence 9-1-1 TCs' stress symptoms with respect to individual characteristics, workplace conditions, and neighborhood context (Figure 1).

Figure 1. Conceptual Model of Three Effects on Stress Symptoms



1. Individual Characteristics Effects on Stress

Resilience, mindfulness, and overcommitment have all been associated with stress symptoms. **Resilience** is defined as “the personal qualities that enable one to thrive in the face of adversity” by Connor and Davidson (2003). Resilience refers to personal competence and tenacity, trust in one’s instincts, tolerance of negative affect, strengthening effects of stress, and positive acceptance of change (Connor & Davidson, 2003). In general, resilience is considered as the ability to manage, recover effectively from stressful experience and adverse circumstances (Joyce et al., 2019). Resilience is significantly related to Post-traumatic stress disorder (PTSD). For example, among patients who experienced burn injuries, higher resilience was associated with lower PTSD symptoms from a cross-sectional study (Bibi et al., 2018). Resilience interventions have shown significant reduction of occupational stress among nurses working in the intensive care units (Babanataj et al., 2018) and law enforcement officers (Christopher et al.,

2018). Therefore, we will investigate if higher levels of resilience are associated with lower levels of stress among TCs.

Mindfulness has shown positive effects on psychosocial stress symptoms (Heckenberg, Eddy, Kent, & Wright, 2018; Piet, Würtzen, & Zachariae, 2012). Mindfulness refers to an enhanced *attention* to and *awareness* of current experience or present reality (Brown & Ryan, 2003). *Awareness* is “the background radar”, continually monitoring the inner and outer environment. *Attention* is a process of focusing conscious awareness, providing heightened sensitivity to a limited range of experience (Brown & Ryan, 2003). Mindfulness importantly links with health outcomes including stress. Two systematic review studies reported that mindfulness-based interventions were effective in reducing cortisol and improving autonomic balance measured by heart rate variability coherence (Heckenberg et al., 2018), as well as reducing anxiety and depression among cancer patients/survivors (Piet et al., 2012). Moreover, Dr. Meischke et al (2015) found that higher levels of mindfulness were associated with lower levels of stress among 9-1-1 TCs (H. Meischke et al., 2015).

Overcommitment is conceptualized as a personality trait mainly characterized by the inability to withdraw from work obligations (Bellingrath & Kudielka, 2008). Many researchers have conducted studies that used physiological indices and biomarkers to measure stress associated with overcommitment (Bellingrath & Kudielka, 2008; Bellingrath et al., 2010; Eddy et al., 2016; Eddy et al., 2017; J. Siegrist & Li, 2017; Wirtz, Siegrist, Rimmele, & Ehlert, 2008). Inconsistent results have been reported about the effects of overcommitment on these indicators. Wirtz et al. (2008) found that higher overcommitment was associated with lower physiological indices of stress (i.e. norepinephrine and cortisol) among medication-free non-smoking men aged between 20 and 65 years. However, meta-analysis studies reported that overcommitment was

associated with increased hypertension (Eddy et al., 2017), lower immunity (Bellingrath et al., 2010; Eddy et al., 2016) and hyperactivity of hypothalamus-pituitary-adrenal axis (Bellingrath & Kudielka, 2008). Furthermore, workers with higher overcommitment had a high prevalence of musculoskeletal pain (Joksimovic, Starke, v d Knesebeck, & Siegrist, 2002). Likewise, 9-1-1 telecommunicators with greater overcommitment reported significantly higher levels of stress symptoms than their counterparts with lower levels of overcommitment (H. Meischke et al., 2015). From systematic review, Siegrist and Li (2017) suggest that overcommitment with imbalanced effort-reward at work contribute to adverse health outcomes showing robust relationships with heart rate variability, altered blood lipids, and risk of metabolic syndrome (J. Siegrist & Li, 2017).

In summary, resilience, mindfulness, and overcommitment might be important individual characteristics that impact on stress symptoms among 9-1-1 telecommunicators. Thus, we will investigate whether greater resilience is associated with lower stress symptoms levels; greater mindfulness is associated with lower stress symptoms levels; greater overcommitment is associated with higher stress symptoms levels.

2. Workplace Condition Effects on Stress

Stress level is not only related to personal traits, but also influenced by external/extrinsic work environments. Researchers have observed two crucial aspects of psycho-mental and socio-emotional stressors at work: 1) job demand-control and 2) interpersonal conflict/support. Job demand-control refers to high psychological job demands in combination with a low degree of personal control and skill discretion (Karasek Jr, 1979). In other words, job overload and lack of decision latitude can lead to increased workers' stress (Akbari et al., 2017). A qualitative study

by Palmer (2014) showed that firefighting dispatchers explained that high job demands and lower decision latitude (job control) mostly contributed to their stress, whereas social support helped to deal with their stress.

Numerous studies have shown evidence for the associations between workers' stress and work environment with respect to job-demand, social support at work, and working hours. High job demands was positively associated with psychological stress responses, while support from colleagues had a significant effect on lower depression and anxiety for women medical workers (Hirokawa et al., 2016). Furthermore, both support from supervisors and support from co-workers were important in preventing intention to leave and in reducing depressive symptoms among nurses (Saijo et al., 2016). Importantly, working hours are highly related to workers' stress levels. For instance, working more than 60 hours per week had a significantly higher odds ratio of having depressive symptoms among nurses (Saijo et al., 2016). Therefore, long working hours would worsen stress levels when that are mandated for 9-1-1 TCs.

Consequently, in the proposed model for 9-1-1 TCs, workplace conditions consist of job-demand, social support at work, and mandatory overwork hours. We hypothesize that the telecommunicators' greater job-demand is associated with higher levels of stress symptoms; less social support at work is associated with higher levels of stress symptoms; and mandatory overtime work is associated with higher levels of stress symptoms.

3. Neighborhood Context Effects on Stress

Neighborhood is strongly patterned by socioeconomic status (SES) such as education, income, and social positions (Diez Roux & Mair, 2010). Neighborhood characteristics can be significant contributors to individuals' stress (Brenner, Zimmerman, Bauermeister, & Caldwell,

2013; Cutrona, Wallace, & Wesner, 2006). For example, African-American youth who lived in greater socioeconomically disadvantaged neighborhoods had higher baseline stress and a steeper increase in stress over time compared to than individuals in less disadvantaged neighborhoods (Brenner et al., 2013). Moreover, residents in neighborhoods with higher levels of poverty frequently experienced hate crimes (Dale et al., 2016). Abundant evidence indicates that the neighborhood socioeconomic disadvantage is significantly associated with higher levels of psychological distress among adults, (Boardman et al., 2001; Elliott, 2000), pregnant women (Giurgescu et al., 2015), adolescents (Ewart & Suchday, 2002), and ethnically diverse populations (Buschmann et al., 2018).

In addition to socioeconomic neighborhood disadvantage, neighborhood stressors have been conceptualized and examined in a variety of ways. In research examining sources of stress in neighborhoods and its effects on mental and physical health, neighborhood stressors generally refer to neighborhood disorder (Andrews et al., 2014; Gilster, 2014; Mair, Diez Roux, & Morenoff, 2010), neighborhood violence and crime (Andrews et al., 2014; Gilster, 2014), social cohesion (Andrews et al., 2014; Mair et al., 2010), and neighborhood safety and/or danger (Barajas-Gonzalez & Brooks-Gunn, 2014; Giurgescu et al., 2015). These studies show that neighborhood stressors were significantly associated with higher psychological distress (Bostean, Drumond Andrade, & Viruell-Fuentes, 2018), depressive symptoms (Mair et al., 2010), mastery (“how people perceive control over things that happen to them”) (Gilster, 2014), and smoking status (Andrews et al., 2014).

In this study, a call center’s neighborhood factors were included, instead of TCs’ individual neighborhood characteristics. This is because the study aims to examine how the service area of 9-1-1 call centers impacts TCs’ stress. One study showed that emergency medical

dispatchers' stress (cortisol levels) increased when they received a high acuity call (i.e. serious emergency) compared to a lower acuity call (less serious call) (Bedini et al., 2017). This implies that neighborhood context can be a considerable factor that links to emergency calls in service area.

III. Methods

1. Sampling and Data Collection

A secondary analysis was conducted to examine the associations between the multilevel effects and stress by using data collected from a randomized trial of a multi-level stress reduction intervention for 9-1-1 telecommunicators (Hendrika Meischke et al., 2018).

The parent study included three data collection points but only data from the baseline survey dataset, which was collected between June 2016 and March 2017, was used for this analysis. The 9-1-1 telecommunicators were recruited from 9-1-1 call centers across the United States and Canada through outreach campaign, staff announcement, recruitment flyers, email, and word-or-mouth. After participants finished electronic informed consent, they completed the baseline survey.

2. Measurements

Outcome variable. **Stress symptoms** were measured by the Calgary Symptoms of Stress Inventory (C-SOSI) (Linda E Carlson & Thomas, 2007). Participants responded to 56-item on a 5-point scale, ranging from 0 (never) to 4 (very frequently) regarding physical or psychological

symptoms that are named: Depression, Anger, Muscle tension, Cardiopulmonary arousal, Sympathetic arousal, Neurological/gastrointestinal disorders, Cognitive disorganization, and Upper respiratory symptoms. The C-SOSI has been widely used for cancer patients and families with cancer patients (Birnie, Garland, & Carlson, 2010; Sheila N. Garland, Tamagawa, Todd, Speca, & Carlson, 2013). Cronbach's alpha appeared 0.95 for 9-1-1 telecommunicators (H. Meischke et al., 2015) (Table III-1).

For this analysis a high stress symptoms group was defined as C-SOCI scores greater than or equal to 60 points. Studies using C-SOSI showed that distressed survivors of breast cancer had C-SOSI scores from 66 to 111 at baseline before a mindfulness intervention (Linda E Carlson et al., 2013), moreover cancer patients had C-SOSI scores of 98 at the baseline and the scores of 75 after a mindfulness stress reduction intervention (L. E. Carlson & Garland, 2005). Assuming that our participants may not currently experiences life-threatening diseases, we defined a high stress symptom group as C-SOCI scores greater or equal to 60.

Independent variables. **Resilience** was measured by the Connor-Davidson Resilience Scale (CD-RISC 10)(Connor & Davidson, 2003). Participants responded to 10-items on a 5-point scale, ranging from 0 (not true at all) to 4 (true nearly all of the time). The total score ranges from 0-40 with a higher score indicative of higher resilience. Previous studies showed good reliabilities indicating Cronbach alpha ranged from 0.82 to 0.88 among young adults (Aloba, Olabisi, & Aloba, 2016; Campbell-Sills & Stein, 2007). The example of questions were “I am able to adapt when changes occur”, and “Having to cope with stress can make me stronger.”

Mindfulness was measured by the Mindful Attention Awareness Scale (MAAS) (Brown & Ryan, 2003). Participants responded to 15-item on a 6-point scale, ranging from 0 (almost never) to 5 (almost always). Cronbach alpha was 0.84 for 9-1-1 telecommunicators (H. Meischke

et al., 2015). A higher score indicates higher mindfulness by reversing codes because the questionnaires are negatively worded (See Appendix A). For example, the questions were “I break or spill things because of carelessness, not paying attention, or thinking of something else”, and “I find it difficult to stay focused on what's happening in the present.”

Overcommitment was measured by a subscale from the Effort-Reward Imbalance scale (Lau, 2008). The overcommitment scale consists of 6-item with a 5-point scale, ranging from 0 (strongly disagree) to 4 (strongly agree), indicating a higher score indicative of higher overcommitment. The example questions were “I get easily overwhelmed by time pressures at work” and “As soon as I get up in the morning I start thinking about work problems.” Cronbach alpha of the overcommitment subscale was 0.85 in the original study (Lau, 2008).

Job-demand was measured by a subscale of Job Requirements from NIOSH Generic Job Stress Questionnaire (The National Institute for Occupational Safety and Health). Job Requirement consists of 10-item with a 5-point scale, ranging from 1 (rarely) to 5 (very often). The example questions were “How often does your job require you to work very hard?”, “How often does your job leave you with little time to get things done?” and “How often is there a marked increase in the work load?”

Social support at work was measured by a Social Support subscale from Demand-Control-Support Questionnaire (DCSQ) (Sanne, Torp, Mykletun, & Dahl, 2005). This instrument includes social support from co-workers as well as supervisors at workplace consisting of 6-item ranging from 0 (strongly disagree) to 3 (strongly agree). The example questions were “There is a calm and pleasant atmosphere where I work”, “The others understand if I have a bad day”, and “I get on well with my supervisors.”

Mandatory work overtime was asked by a polar question, “In the past month, have you been REQUIRED to work overtime?” If a participant answered “Yes”, then was asked to answer a following question “Please enter the number of MANDATORY overtime hours you have worked in the past month”.

Table III-1. Validity of Instruments

Concept	Instrument	Source	Validity
Stress symptoms	Calgary Symptoms of Stress Inventory (C-SOSI) (56 items)	Linda E Carlson and Thomas (2007)	$\alpha = 0.9$ (H. Meischke et al., 2015)
Resilience	Subscale of Connor-Davidson Resilience Scale (CD-RISC) (10 items)	Connor and Davidson (2003)	$\alpha = 0.81-0.85$ (Aloba et al., 2016) $\alpha = .85$ (Campbell-Sills & Stein, 2007)
Mindfulness	The Mindful Attention Awareness Scale (MAAS) (15 items)	Brown and Ryan (2003)	$\alpha = 0.76$ (Brown & Ryan, 2003) $\alpha = 0.84$ (H. Meischke et al., 2015) $\alpha = 0.91$ (Smith et al., 2011)
Overcommitment	Overcommitment subscale from the Effort-Reward Imbalance (6 items)	Lau (2008)	$\alpha = 0.74$ (Hwang, Hong, & Kang, 2018) $\alpha = 0.85$ (Lau, 2008)
Job-demand	Job Requirements subscale from NIOSH Generic Job Stress Questionnaire (10 items)	The National Institute for Occupational Safety and Health	$\alpha = 0.75$ (The National Institute for Occupational Safety and Health)
Social support at work	Social Support Subscale from Demand-Control-Support Questionnaire (DCSQ) (6 items)	Sanne et al. (2005)	$\alpha = 0.83$ (Mauss, Herr, Theorell, Angerer, & Li, 2018)

A SES community indicator was collected from the median household income for each call-center serving area. The data on median household income were from 1-year Estimate 2016 datasets in the U.S. Census (Appendix B). Additionally, call-centers were recoded by high SES area, middle SES area, and low SES area depending on its average median household income

compared to the average U.S. median household income in 2016 of $\$57,167 \pm \115 (Low SES < $\$57,052$; $\$57,052 \leq$ Middle SES $\leq \$57,282$; High SES > $\$57,282$; Appendix B).

3. Data Analysis

First, we conducted descriptive statistics (frequency, proportion, mean, median, and standard deviation,) to describe the sample characteristics. Second, a mixed-effects logistic regression was conducted to examine the individual relationships between three different levels of effects and stress respectively and to jointly examine what individual, workplace, and neighborhood effects are most related to 9-1-1 telecommunicators' stress level.

The reason for using logistic regression is that a logistic regression can provide more intuitive interpretation that provides a relative percentage difference in higher level of stress symptoms in terms of individual characteristics, workplace conditions, and a neighborhood indicator.

Mixed effects models were used to include the call center as a random effect and the covariates as fixed effects. Random effects refer to an association with the particular experimental units – call centers here –, and observations in the same unit share the same random effect (Pinheiro & Bates, 2006). Fixed effects models eliminate time-invariant confounding, estimating an independent variable's effect using only within-unit variation (Mummolo & Peterson, 2018). Therefore, a mixed effect model was included in this analysis to test the effects of between-cluster variables, accounting for fixed effects. Mixed effect models have been widely used because of its flexibility and particularly they are useful in settings where measurements are made on clusters of units, or where repeated measurements are made on the same statistical units (Pinheiro & Bates, 2006).

The independent variables (i.e. resilience, mindfulness, overcommitment, job-demand, social support at workplace, median household income) were treated as continuous measures, except for mandatory overwork which was asked as yes/no question.

Job position, years of experience, and gender were included to control for potential confounding. Job position and years of experience would potentially influence 9-1-1 TCs' stress levels, as well as resilience, mindfulness, and overcommitment, job-demand, and social support at workplace. For instance, 9-1-1 telecommunicators, who have both roles of call-taker and dispatcher, could experience higher stress levels than TCs who have only one role; and heavy workload from two roles may influence their degrees of resilience, mindfulness and overcommitment. Also, employees with more years of work experience might have cumulative stress; on the other hand, be more likely to have more social support from their co-workers and supervisor at workplace.

Other demographic variables were not considered as confounders because the proportions of each category for the demographic variables were not significantly different between two groups of stress levels except gender (Table III-2). The proportion of females were higher than the proportion of male in both stress groups, meaning that the gender distribution was not balanced in this study population. Thus, gender was included in the models as a potential confounder.

Table III-2. Distributions of Potential Confounders

Demographics	Range	High stress (N=116) Frequency (%)	Low stress (N=203) Frequency (%)	p-value
Age	below 26	9 (7.8)	22 (10.8)	0.47 ^b
	26 - 35 years	35 (30.2)	71 (35.0)	
	36 - 45 years	38 (32.8)	68 (33.5)	
	46 - 55 years	26 (22.4)	32 (15.8)	
	56 - 64 year	8 (6.9)	22 (10.8)	
Gender	Female	102 (87.9)	159 (78.3)	0.03 ^b
	Male	13 (11.2)	44 (21.7)	
Ethnicity ^a	White	109 (94.0)	188 (92.6)	0.65 ^b
	Black	2 (1.7)	7 (3.5)	0.30 ^c
	Native American or Alaskan Native	4 (3.5)	5 (2.5)	0.43 ^c
	Asian	1 (0.9)	2 (1.0)	0.70 ^c
	Native Hawaiian or Pacific Islander	1 (0.9)	1 (0.5)	0.60 ^c
	Others	4 (3.5)	7 (3.5)	0.61 ^c
Education	High school/GED	18 (12.1)	24 (11.8)	0.50 ^b
	Some college	50 (43.1)	95 (46.8)	
	Associate's degree	14 (12.1)	14 (6.9)	
	Bachelor's degree	29 (25.0)	60 (29.6)	
	Post-graduate study or degree	5 (4.3)	9 (4.4)	

a: Each category of ethnicity was a yes/no question. Participants could select multiple categories.

b: p-values are from Chi-squared tests.

c: p-values from one-sided fisher exact tests.

IV. Results

1. Descriptive Analysis for 9-1-1 Telecommunicators' characteristics

The total number of active duty 9-1-1 telecommunicators who participated in the baseline survey was (N= 321). The majority of the participants was between 26 and 35 years of

age(33.6%) or 36 and 45 years of age (33%), female (82%), European Americans (89.8%), and had some college education (45%). The participants worked for at least two years, and participants with less than 2-year experience were 13.7 percent. Most of them had served as both call taker and dispatcher (79.1%). The summary table is shown below (Table IV-1).

The average stress symptoms score for the 9-1-1 telecommunicators was 55 (SD=29.1). Based on pre-defined levels of stress symptoms, 62 percent of the 9-1-1 telecommunicators experienced relatively high stress symptoms (n=199). Among the participants, 42 percent of them reported mandatory overtime (n=135) (Table IV-3), and of them, the average overtime hours were 15.67 hours in the past month (Table IV-2).

The mean resilience score for the 9-1-1 TCs was 29.0 points (SD=6.0); the mean score of mindfulness was 4.2 points (SD=0.9); and, the mean overcommitment score was 13.4 points (SD=3.8). For workplace conditions, the mean job-demand score was 3.7 points (SD=0.6) and, the mean score of social support at work for the 9-1-1 TCs was 17.5 points (SD=2.8).

To see a trend of SES levels for call-centers' serving area, call-centers were recoded by high SES area, middle SES area, and low SES area depending on its average median household income compared to the average U.S. median household income in 2016 ($\$57,167 \pm 115$). Consequently, three in fourth call-centers were serving in high SES regions (75.4%; n= 242). Call-centers in median SES regions were not found in this study (Table IV-3). Additionally, the distribution of respondents by call-center is shown in Appendix C.

Table IV-1. Demographic Characteristics of Participants

Demographics	Range	Frequency	Percent
Age	below 26	31	9.66
	26 - 35 years	108	33.64
	36 - 45 years	106	33.02
	46 - 55 years	58	18.07
	56 - 64 year	18	5.61
	NA	0	0
	Total	321	100.00
Gender	Female	262	81.62
	Male	58	18.07
	NA	1	0.31
	Total	321	100.00
Ethnicity*	White	299	89.79
	Black	9	2.70
	Native American or Alaskan Native	9	2.70
	Asian	3	0.90
	Native Hawaiian or Pacific Islander	2	0.60
	Others	11	3.33
	Total	333	100.00
Education	High school/GED	43	13.40
	Some college	145	45.17
	Associate's degree	28	8.72
	Bachelor's degree	90	28.04
	Post-graduate study or degree	14	4.36
	NA	1	0.31
	Total	321	100.00
Years of Experience	Less than 2 years	44	13.71
	2 - 5 years	74	23.05
	6 - 10 years	67	20.87
	11 - 20 years	98	30.53
	21 - 30 years	27	8.41
	Over 30 years	10	3.12
	NA	1	0.31
	Total	321	100.00
Job Position	Both call taker and dispatcher	254	79.13
	Call taker only	22	6.85
	Dispatcher only	1	0.31
	Other	44	13.71
	NA	0	0
	Total	321	100.00

* Each category of ethnicity was a polar question (yes/no) and 12 participants reported multiple race/ethnicity categories.

Table IV-2. Descriptive Analysis of Stress and Multilevel Factors

Outcome variable		Observation	Mean	Median	SD	Min	Max
Outcome	Stress symptoms	319	54.95	72	29.12	0	158
Multilevel variables		Observation	Mean	Median	SD	Min	Max
Individual Characteristic	Resilience	318	28.97	29	6.02	13	40
	Mindfulness	318	4.15	4.2	0.90	1	6
	Overcommitment	317	13.39	13	3.82	6	23
Workplace Condition	Job-demand	317	3.74	3.7	0.60	1.9	5
	Social support	318	17.49	18	2.78	8	24
	Mandatory work overtime (hours)	128*	15.67	12	13.49	1	60
Community Indicator	Median household income	321	\$66,341.8	\$ 67,851	\$16,509.3	\$27,831	\$147,722

* The mandatory working hours was asked to only participants who had mandatory work over time.

Table IV-3. Categorical Information for Participants

Factor variable		Group	Frequency	Percent
Outcome	Stress symptoms	High stress symptoms	199	62.0
		Low stress symptoms	122	38.0
		Total	321	100.0
Workplace Condition	Mandatory work overtime	Yes	135	42.1
		No	179	55.8
		NA	7	2.2
		Total	321	100.0
Community Indicator	Number of the 9- 1-1 TCs	High SES	242	75.4
		Middle SES	0	0
		Low SES	79	24.6
		Total	321	100.0
	Number of the call-centers	High SES ^a	22	68.8
		Middle SES ^b	0	0
		Low SES ^c	10	31.3
		Total	32	100.0

a: > \$ 57,282

b: between \$57,052 and \$57,282

c: < \$57,052

2. Multilevel Effects on Stress

Individual relationships between individual, institutional, and community levels effects and stress. **All three individual characteristics** were significantly associated with stress symptoms (Table IV-4). Resilience and mindfulness had a protective effect on the 9-1-1 TCs' stress symptoms; however, greater overcommitment was positively associated with greater stress symptoms. Second, **all workplace condition variables** were significantly associated with stress symptoms. Social support at work had a protective effect on the 9-1-1 TCs' stress symptoms, while job-demand and mandatory overtime were positively associated with higher level of stress symptoms. Lastly, the serving areas' SES levels of the call-center was not significantly associated with 9-1-1 telecommunicators' stress symptoms.

At the individual level, each increased resilience score of 1 point was associated with 10 percent reduction in the odds of having high stress (95% CI: 6%, 14%); each increased mindfulness score of 1 point was associated with 87 percent reduction in the odds of having high stress (95% CI: 80%, 92%); while each increased overcommitment score of 1 point was associated with 34% increase in the odds of having high stress (95% CI: 24%, 46%). **At the workplace level**, each increased job-demand score of 1 point was associated with 84% increase in the odds of having high stress (95% CI: 21%, 281%); however, each increased social support score of 1 point was associated with 15 percent reduction in the odds of having high stress (95% CI: 7%, 23%). Moreover, if a 9-1-1 telecommunicator reported mandatory work overtime, the odds of having high stress greatly increased by 76 percent (95% CI: 11%, 280%). The SES community indicator was not significantly associated with 9-1-1 TCs' stress levels.

Multilevel effects on stress. In order to examine jointly what factors are most related to 9-1-1 TCs' stress, the mixed-effects logistic regression was conducted. The results show the

independent relationships between stress and each independent variable controlling for all covaries. As a result, less mindfulness and greater overcommitment was significantly associated with greater stress symptoms (OR [95% CI]; 0.17 [0.10, 0.28]; 1.19 [1.07, 1.31]).

Table IV-4. Multilevel Effects on Stress

Explanatory variables		Individual relationship ^a Odds Ratio (95% CI)	Multi-variable model ^b Odds Ratio (95% CI)
Individual Characteristic	Resilience	0.90*** (0.86, 0.94)	0.94 (0.88, 1.00)
	Mindfulness	0.13*** (0.08, 0.20)	0.17*** (0.10, 0.28)
	Overcommitment	1.34*** (1.24, 1.46)	1.19*** (1.07, 1.31)
Workplace Condition	Job-demand	1.84** (1.21, 2.81)	1.61 (0.84, 3.08)
	Social support	0.85*** (0.77, 0.93)	0.89 (0.78, 1.02)
	Mandatory overtime	1.76* (1.11, 2.80)	1.34 (0.68, 2.64)
Community Indicator	Median household income	1.21(0.69, 2.12)	1.06 (0.48, 2.34)

a: Mixed-effects logistic model for stress associated with each independent variable controlling for sex, job position and years of work experience

b: Mixed-effects logistic model which includes all of individual, workplace, and community variables and potential confounders (e.g. sex, job position, and years of work experience)

*** $p \leq 0.001$

** $p\text{-value} \leq 0.01$

* $P\text{-value} \leq 0.05$

V. Discussion

This study explored cross-sectional associations between three different levels of effects and stress symptoms among 9-1-1 telecommunicators. First, we examined the hypotheses: 1) each individual characteristic (i.e. resilience, mindfulness, and overcommitment) is associated with TCs' stress; 2) each workplace condition (i.e. job demand, mandatory overtime work, and

social support at work) is associated with TCs' stress; 3) a worse neighborhood factor in call-centers' serving area is associated with 9-1-1 telecommunicators' high stress levels. Second, we examine the association between stress and three main interested of effects jointly.

1. Comparison of 9-1-1 TCs to other Professionals regarding Stress and Multilevel Factors

The average **stress symptoms score for the 9-1-1 telecommunicators** was found to be 55 which is slightly lower than the averages for cancer patients from previous studies (i.e. 66-111) (Linda E Carlson et al., 2013; Sheila N Garland et al., 2014). However, given that cancer patients were facing life-threatening health issues, the 9-1-1 TCs' stress levels seem to be quite considerably high levels. Regarding individual characteristics and workplace factors, the magnitudes of these factors were similar between 9-1-1 TCs and other professionals except job-demand. For example, the mean score of **resilience for the 9-1-1 TCs** (mean=29.0; SD=6.0) was similar to that of full-time firefighters (mean=28.4, SD=5.3) (Joyce et al., 2019) and female nursing students (mean=27.6; SD=6.4) (Aloba et al., 2016). Also, the mean score of **mindfulness for the 9-1-1 TCs** (mean=4.2; SD=0.9) was similar to that of firefighters (mean=4.4; SD=0.9) (Smith et al., 2011). However, the mean score of **overcommitment for the 9-1-1 TCs** (mean=13.4; SD=3.8) was slightly higher than that of police officers (mean=12.4; SD=3.3) (Violanti et al., 2018). The reason for higher scores of overcommitment of 9-1-1 TCs than police officers might be related to gender differences since the majority of 9-1-1 TCs are female. Likewise, a study of healthcare personnel (e.g. physicians and nurses) showed that women reported higher levels of overcommitment than men (Birgit, Gunnevi, & Ann, 2013).

Conversely, the mean score of **job-demand for the 9-1-1 TCs** (mean=3.7; SD=0.6) was much lower than that of healthcare workers (mean=11.2; SD=3.4) (Yehya et al., 2018). This

might be because some questions of job-demand are less likely to link to the job roles of telecommunicators such as skill underutilization (i.e. How often does your job let you use the skills and knowledge you learned in school?) compared to the job roles of healthcare workers. Lastly, the mean score of **social support at work for the 9-1-1 TCs** (mean=17.5; SD=2.8) was similar to that of white-collar employees (mean=18.3; SD=2.7) (Mauss et al., 2018).

2. Support Literature for the Significant Associations between Individual and Institutional Effects and Stress

At the individual level, greater resilience and greater mindfulness were significantly associated with less stress, and greater overcommitment was significantly associated with greater stress in the 9-1-1 telecommunicators. These results support the previous studies that resilience is associated with reduced occupational stress for law enforcement officers (Christopher et al., 2018) and critical care nurses (Babanataj et al., 2018). In addition, a systematic review by Heckenberg et al. (2018) shows that greater mindfulness is associated with low levels of stress-related biomarkers. Another systematic review by Piet et al. (2012) reported that high levels of mindfulness in cancer patients was associated with decreased anxiety symptoms and depression symptoms. Based on the literature, this study suggests that resilience and mindfulness are determined as important factors in adapting to stress for 9-1-1 TCs who are at higher risk of developing adverse health outcomes including mental health and physical health (Joyce et al., 2019).

A majority of studies suggests that overcommitment adversely influences stress levels (Bellingrath & Kudielka, 2008; H. Meischke et al., 2015; Johannes Siegrist & Li, 2016). Furthermore, some studies of overcommitment focus on its association with burnout. For

example, overcommitment was associated with burnout among police officers in terms of professional efficacy components of burnout (“employee’s expectations of continued effectiveness at work”) and cynicism components of burnout (“indifference or a distant attitude toward one’s work in general”) and exhaustion components of burnout among police officers (Violanti et al., 2018). Since we found relatively high degrees of overcommitment among 9-1-1 TCs, these three burnout components may help to identify 9-1-1 TCs’ psychological distress.

For workplace conditions, we found that greater job-demand and having overtime work were significantly associated with greater stress, whereas greater social support at work was significantly associated with less stress in the 9-1-1 telecommunicators. This supports that previous studies that workplace stressors significantly influence workers’ health (Larsen, Ramstrand, & Fransson, 2018; Larson & Murff, 2006; Pozo-Antúnez, Ariza-Montes, Fernández-Navarro, & Molina-Sánchez, 2018). For instance, higher levels of job-demand were negatively associated with perceived health (Pozo-Antúnez et al., 2018) as well as physical health (Larsen et al., 2018). On the other hand, social support was positively associated with perceived health (Pozo-Antúnez et al., 2018) as well as physical health (Larsen et al., 2018). Therefore, workplace conditions in terms of job-demand, overtime work, and social support are important aspects in occupational health (Larsen et al., 2018; Larson & Murff, 2006; Pozo-Antúnez et al., 2018).

Recently, **neighborhood effects** have been considered as a crucial element for individuals’ health regarding heart failure (Akwo et al., 2018), death and disability (Makaroun et al., 2017), asthma and morbidity (Keet, Matsui, McCormack, & Peng, 2017), and psychological distress (Boardman et al., 2001; Buschmann et al., 2018; Elliott, 2000; Ewart & Suchday, 2002; Giurgescu et al., 2015). However, we didn’t find a significant association between communities’ median household income levels in call-center serving areas and 9-1-1 TCs’ stress. One

explanation is that a single indicator may not sufficiently reflect neighborhood characteristics and/or income levels may not appropriately link to the contents of 9-1-1 calls . Crime rates in call center service areas might be a better indicator for examining neighborhood effects associated with 9-1-1 TC's stress. Additionally, the fact that the majority of the 9-1-1 TCs served in high income areas could also be a reason for failing to detect differences in 9-1-1 TCs' stress levels based on neighborhood characteristics. Furthermore, we are focusing on neighborhood effects related to higher prevalence of traumatic events, but the 9-1-1 TCs' stress might be more likely to be related to their neighborhood effects where they live.

3. Advantages and Limitations

In the nature of a cross-sectional study, we can't assure the temporality between explored factors and stress. However, it is meaningful to observe which components are significantly associated with 9-1-1 telecommunicators' stress in terms of three different perspectives. These findings are credibly supported by literature on occupational stress, so it provides a profound understanding of 9-1-1 telecommunicators as emergency first responders who are at higher risk of developing adverse health outcomes.

Second, various unmeasured factors can contribute to 9-1-1 telecommunicators' stress. For example, the number of calls per 9-1-1 telecommunicator, the relationships between 9-1-1 TCs and their partners such as police officers, firefighters, and correctional officers, the variance of call-center's environment and structures, and new technologies on 9-1-1 system can be considerable aspects to examine their stress levels.

With facing more challenges to recruit new 9-1-1 operators across the country and the shortage of skilled workers (USA Today, 2018), supporting their psychological and physical stress management will be necessary.

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Appendix A. Questionnaires of Measurements (NG911_Aim2 Baseline)

Outcome variable	Indicator	Questionnaire	
Stress symptoms (C-SOS)	Anger	<p>Section Header: In the past week, does it seem:</p> <p>You become mad, or anger easily When you feel angry, you act angrily toward most everything You are easily annoyed and irritated That little things get on your nerves Angry thoughts about an irritating event keep bothering you You let little annoyances build up until you just explode Your anger is so great that you want to strike something</p> <p>Section Header: In the past week, have you noticed any of the following symptoms when not exercising:</p> <p>Thumping of your heart Rapid or racing heart beats Rapid breathing Irregular heart beats Difficulty breathing Pains in your heart or chest</p>	<p>0 =Never 1= Infrequently 2= Sometimes 3= Often 4= Very Frequently</p>
	Cardiopulmonary arousal	<p>Section Header: In the past week, does it seem:</p> <p>You must do things very slowly to do them without mistakes You get directions and orders wrong Your thinking gets completely mixed up when you have to do things quickly You have difficulty in concentrating You become suddenly frightened for no good reason You become so afraid you can't move</p>	<p>0 =Never 1= Infrequently 2= Sometimes 3= Often 4= Very Frequently</p>
	Cognitive disorganization	<p>Section Header: Stress is often accompanied by a variety of emotions. In the past week, have you felt:</p> <p>Like life is entirely hopeless Unhappy and depressed Alone and sad That worrying gets you down Like crying easily That you wished you were dead Frightening thoughts keep coming back You suffer from severe nervous exhaustion</p>	<p>0 =Never 1= Infrequently 2= Sometimes 3= Often 4= Very Frequently</p>
Depression	<p>Section Header: Muscle tension is a common way of experiencing stress. In the past week, have you noticed excessive tension, stiffness, soreness or cramping of the muscles in your:</p> <p>Shoulders Neck Back Jaw Forehead</p>	<p>0 =Never 1= Infrequently 2= Sometimes 3= Often 4= Very Frequently</p>	
Muscle tension			

		<p>Eyes</p> <p>Hands or arms</p> <p>Have you experienced tension headaches?</p> <p>Section Header: In the past week, have you experienced:</p> <p>Feeling faint</p> <p>Feeling weak</p> <p>Spells of severe dizziness</p> <p>Nausea</p> <p>Blurring of your vision</p> <p>Severe pains in your stomach</p>	<p>0 =Never</p> <p>1= Infrequently</p> <p>2= Sometimes</p> <p>3= Often</p> <p>4= Very Frequently</p>
	Neurological/gastrointestinal disorders	<p>Section Header: In the past week, have you experienced:</p> <p>A cold</p> <p>Hoarseness</p> <p>Colds with complications (e.g. bronchitis)</p> <p>Nasal stuffiness</p> <p>Having to clear your throat often</p> <p>Sinus headaches</p>	<p>0 =Never</p> <p>1= Infrequently</p> <p>2= Sometimes</p> <p>3= Often</p> <p>4= Very Frequently</p>
	Upper respiratory symptoms	<p>Section Header: Do you experience:</p> <p>Difficulty in staying asleep at night</p> <p>Hot or cold spells</p> <p>Having to get up at night to urinate</p> <p>Sweating excessively even in cold weather</p> <p>Having to urinate frequently</p> <p>Early morning awakening</p> <p>Flushing of your face</p> <p>Difficulty in falling asleep</p> <p>Breaking out in cold sweats</p>	<p>0 =Never</p> <p>1= Infrequently</p> <p>2= Sometimes</p> <p>3= Often</p> <p>4= Very Frequently</p>
	Sympathetic arousal		
Independent Variable	Indicator	Questionnaire	
Individual Capability	<p>Resilience (Subscale of CD-RISC)</p> <p>1) I am able to adapt when changes occur.</p> <p>2) I can deal with whatever comes my way.</p> <p>3) I try to see the humorous side of things when I am faced with problems.</p> <p>4) Having to cope with stress can make me stronger.</p> <p>5) I tend to bounce back after illness, injury, or other hardships.</p> <p>6) I believe I can achieve my goals, even if there are obstacles.</p> <p>7) Under pressure, I stay focused and think clearly.</p> <p>8) I am not easily discouraged by failure.</p> <p>9) I think of myself as a strong person when dealing with life's challenges and difficulties.</p> <p>10) I am able to handle unpleasant or painful feelings like sadness, fear, and anger.</p>	<p>0=Not true at all;</p> <p>1=Rarely true;</p> <p>2=Sometimes true;</p> <p>3=Often true;</p> <p>4=True nearly all the time</p>	
	Mindfulness (MAAS)	<p>1) I could be experiencing some emotion and not be conscious of it until sometime later.</p> <p>2) I break or spill things because of carelessness, not paying attention, or thinking of something else.</p> <p>3) I find it difficult to stay focused on what's happening in the present.</p>	<p>0=Almost never;</p> <p>1=Very infrequently;</p>

Workplace Conditions	Job-demand (Subscale of NIOSH)	<p>4) I tend to walk quickly to get where I'm going without paying attention to what I experience along the way.</p> <p>5) I tend not to notice feelings of physical tension or discomfort until they really grab my attention.</p> <p>6) I forget a person's name almost as soon as I've been told it for the first time.</p> <p>7) It seems I am "running on automatic," without much awareness of what I'm doing.</p> <p>8) I rush through activities without being really attentive to them.</p> <p>9) I get so focused on the goal I want to achieve that I lose touch with what I'm doing right now to get there.</p> <p>10) I do jobs or tasks automatically, without being aware of what I'm doing.</p> <p>11) I find myself listening to someone with one ear, doing something else at the same time.</p> <p>12) I drive places on "automatic pilot" and then wonder why I went there.</p> <p>13) I find myself preoccupied with the future or the past.</p> <p>14) I find myself doing things without paying attention.</p> <p>15) I snack without being aware that I'm eating.</p>	<p>2=Somewhat infrequently;</p> <p>3=Somewhat frequently;</p> <p>4=frequently;</p> <p>5=Very frequently; Almost always</p>
	Overcommitment (Subscale of ERI)	<p>1) I get easily overwhelmed by time pressures at work.</p> <p>2) As soon as I get up in the morning I start thinking about work problems.</p> <p>3) When I get home, I can easily relax and "switch off" work.</p> <p>4) People close to me say I sacrifice too much for my job.</p> <p>5) Work rarely lets me go, it is still on my mind when I go to bed.</p> <p>6) If I postpone something that I was supposed to do today I'll have trouble sleeping at night.</p>	<p>1=Strongly disagree;</p> <p>2=Somewhat disagree;</p> <p>3=Somewhat agree;</p> <p>4=Strongly agree</p>
Workplace Conditions	Support at workplace	<p>1) How often does your job require you to work very fast?</p> <p>2) How often does your job require you to work very hard?</p> <p>3) How often does your job leave you with little time to get things done?</p> <p>4) How often is there a great deal to be done?</p> <p>Variance in workload</p> <p>5) How often is there a marked increase in the work load?</p> <p>6) How often is there a marked increase in the amount of concentration required on your job?</p> <p>7) How often is there a marked increase in how fast you have to think?</p> <p>Skill underutilization</p> <p>8) How often does your job let you use the skills and knowledge you learned in school?</p> <p>9) How often are you given a chance to do the things you do the best?</p> <p>10) How often can you use the skills from your previous experience and training?</p>	<p>1=Rarely;</p> <p>2=Occasionally;</p> <p>3=Sometimes; 4=Fairly often; 5=Very often</p>
	Mandatory overtime hours	<p>1) There is a calm and pleasant atmosphere where I work.</p> <p>2) We get on well with each other where I work.</p> <p>3) My co-workers support me.</p> <p>4) The others understand if I have a bad day.</p> <p>5) I get on well with my supervisors.</p> <p>6) I enjoy working with my co-workers.</p>	<p>0=Strongly disagree;</p> <p>1=Disagree; 2=Agree;</p> <p>3=Strongly agree</p>
Demographic variable		<p>In the past month, have you been REQUIRED to work overtime? Please enter the number of MANDATORY overtime hours you have worked in the past month</p>	<p>Yes; No () hours</p>
Age		<p>Questionnaire</p> <p>Please select your age range</p>	<p>1= below 26 2= 26 - 35 years</p>

		<p>3= 36 - 45 years 4= 46 - 55 years 5= 56 - 64 years 6= 65 years or above</p>
Gender	What is your gender?	1=male 2=female
Education	Please select your highest educational level	<p>1= High school/GED 2= Some college 3= Associate's degree 4= Bachelor's degree 5= Post-graduate study or degree</p>
Ethnicity	What is your race? (Select all that apply)	<p>1= White 2= Black/African American 3= Native Hawaiian/Pacific Islander 4= Asian 5= American Indian/Alaska Native 6= Other</p>
Years of experience	How many years have you worked as a telecommunicator? Please include years worked outside of this call center.	<p>1= Less than 2 years 2= 2 - 5 years 3= 6 - 10 years 4= 11 - 20 years 5= 21 - 30 years 6= Over 30 years</p>
Job position	What is your job position or role at the call center?	<p>1= Call taker only 2= Dispatcher only 3= Both call taker and dispatcher 4= Other</p>

Appendix B. Call Center's Serving Area and its Socioeconomic Data

Call Center	Service Area	Poverty Rate ¹ (% of residents whose incomes falls below the poverty line)	Median Household Income ¹	SES level ² US MHI \$57,052 to \$57,282 (2016) ³
1 AMR-Independence ⁴ - MARC ⁵	Independence, KS	22.7%	\$39,271	Low
2 Alachua County Comm	Alachua County, FL	23.5%	\$45,304	Low
3 Belton PD- MARC	Belton, MO	10.6%	\$60,405	High 1
4 CENCOM	Kitsap County	10% (2016)	\$69,171 (2016)	High 2
5 ESMO PD- MARC	City of Excelsior Springs, MO	15.9%	\$48,523	High 3
6 GrandviewMO PD- MARC	Grandview, MO	17.1%	\$42,626	Low
7 JCSO (KS)- MARC Johnson County KS Sheriff's Office	Johnson County, KS	5.61%	\$80,553	High 4
8 Jackson County SO (MO)- MARC	Jackson County, MO	15.6%	\$50,815	Low
9 JoCoECC- MARC Johnson County Emergency Communications Center	Johnson County, KS	5.61%	\$80,553	High 5
10 KCMOPD- MARC	Kansas City, MO	16.4%	\$51,235	Low
11 LFD Comm- MARC	Lee's Summit, MO	5.87%	\$80,494	High 6
12 LSPD- MARC	Lee's Summit, MO	5.87%	\$80,494	High 7
13 Leavenworth County Sheriff's Office- MARC	Leavenworth County, KS	9.9%	\$66,046	High 8
14 Leawood Police Department- MARC	City of Leawood, KS	2.59%	\$147,722	High 9

¹ US Census Bureau, ACS 1-year Estimate, 2016 (<http://datausa.io>)

² US 2016 median household income (MHI) is \$57,167 ± 115 (margin of error), so a call-center in a high SES region was coded as High SES > \$57,282, \$57,052 < Middle SES ≤ \$57,282; low SES < \$57,052.

³ Guzman, G. G. (2017). *Household Income: 2016 American Community Survey Briefs*. Retrieved from

<https://www.census.gov/content/dam/Census/library/publications/2017/acs/acsbr16-02.pdf>

⁴ AMR Independence Communications Center serves multiple bases in Kansas and Western Missouri (including Independence, Southern Platte County, Mission/Johnson County, KS, and Linn County, KS). Additionally they provide dispatch services under contract for Intercity Fire Protection District of Blue Summit, MO.

⁵ Call centers in the Kansas City (Kansas or Missouri) area are followed by "MARC"

	Call Center	Service Area	Poverty Rate ¹ (% of residents whose incomes falls below the poverty line)	Median Household Income ¹	SES level ² US MHI \$57,052 to \$57,282 (2016) ³
15	Lenexa Police Department- MARC	Lenexa, KS	6.01%	\$78,798	High 10
16	Liberty Police- MARC	Liberty, MO	7.31%	\$68,480	High 11
17	Lycoming County 911	Lycoming County, PA	14.4% (2016)	\$48,731	Low
18	OPPD- MARC	City of Overland Park, Kansas	5.87%	\$74,789	High 12
19	PENCOM	Clallam County, WA	15.7% (2016)	\$47,180	Low
20	Pleasant Hill Police Department- MARC	Pleasant Hill, Missouri	11.7%	\$62,065	High 13
21	Prairie Village- MARC	<i>City of Prairie Village, KS</i>	4.16%	\$83,200	High 14
22	Raymore Police Department- MARC	Raymore, MO	4.36%	\$76,699	High 15
23	Raytown Police Communications- MARC	Raytown, Missouri	15.5%	\$48,565	Low
24	SFDEM	San Francisco, CA	10.1%	\$103,801	High 16
25	Secomm the Southeast Communications Center	Benton County and Franklin County, WA	13.9% 16.4%	\$61,147 \$58,284	High 17
26	Shawnee Police- MARC	City of Shawnee, KS	7.39%	\$79,048	High 18
27	Skagit 911	Skagit County, WA	15% (2016)	\$56,433	Low
28	TCOMM	Thurston County, WA	10.5% (2016)	\$65,783	High 19
29	WCC - Waukesha County	Waukesha County, WI	5.15% (2016)	\$81,878	High 20
30	WFPS- Winnipeg Winnipeg Fire Paramedic Service	The city of Winnipeg, Manitoba CANADA	16.5% (2015) ⁶	CAD 89,133 (2015) (US \$67,851)	High 21
31	WHITCOM	City of Pullman city, WA	40.8% (2016)	\$27,831	Low
32	WPS-D36- Winnipeg Winnipeg Police Service	The city of Winnipeg, Manitoba, CANADA	16.5% (2015)	CAD 89,133 (2015) (US \$67,851)	High 22

¹ US Census Bureau, ACS 1-year Estimate, 2016 (<http://datausa.io>)

² US 2016 median household income (MHI) is \$57,167 ± 115 (margin of error), so a call-center in a high SES region was coded as High SES > \$57,282, \$57,052 ≤ Middle SES ≤ \$57,282; low SES < \$57,052.

³ Guzman, G. G. (2017). *Household Income: 2016 American Community Survey Briefs*. Retrieved from <https://www.census.gov/content/dam/Census/library/publications/2017/acs/acsbr16-02.pdf>

⁶ Prevalence of low income based on the low-income measure, after tax (LIM-AT) (%). The proportion or percentage of units whose income falls below a specified low-income line.

Appendix C. Distribution of Respondents by Call-center

Call Center	Frequency	Percent
AMR-Independence- MARC	2	0.6
Alachua County Comm	18	5.6
Belton PD- MARC	7	2.2
CENCOM	6	1.9
ESMO PD- MARC	3	0.9
GrandviewMO PD- MARC	3	0.9
JCSO (KS)- MARC	3	0.9
Jackson County SO (MO)- MARC	11	3.4
JoCoECC- MARC	8	2.5
KCMOPD- MARC	8	2.5
LSFD Comm- MARC	4	1.3
LSPD- MARC	7	2.9
Leavenworth County Sheriffs Office- MAR	4	1.3
Leawood Police Department- MARC	2	0.6
Lenexa Police Department- MARC	3	0.9
Liberty Police- MARC	1	0.3
Lycoming County 911	7	2.2
OPPD- MARC	9	2.8
PENCOM	4	1.3
Pleasant Hill Police Department- MARC	5	1.6
Prairie Village- MARC	3	0.9
Raymore Police Department- MARC	6	1.9
Raytown Police Communications- MARC	2	0.6
SNOPAC	15	4.7
Secomm	9	2.8
Shawnee Police- MARC	10	3.1
Skagit 911	12	3.7
TCOMM	24	7.5
WCC - Waukesha County	15	4.7
WFPS-Winnipeg	27	8.4
WHITCOM	12	3.7
WPS-D36-Winnipeg	71	22.1
Total	321	100.0