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The relationship between autonomy, optimism, work engagement, and organizational citizenship behavior among nurses fighting COVID-19 in Wuhan: A Serial Multiple Mediation

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Abstract

Objectives: High levels of organizational citizenship behavior can enable nurses to cooperate with co-workers effectively to provide a high quality of nursing care during the outbreak of COVID-19. However, the association between autonomy, optimism, work engagement, and organizational citizenship behavior remains largely unexplored. This study aimed to test if the effect of autonomy on organizational citizenship behavior through mediating effect of optimism and work engagement.

Study design: This was a cross-sectional study.

Setting: The study was conducted in the Wuhan jinyingtan hospitals in China.

Participants: In total, 242 nurses who came across China to work in Wuhan Jinyintan hospital during the COVID-19 epidemic participated in this study.

Methods: A serial mediation model (model 6) of PROCESS macro was adapted to test the hypotheses, and a 95% confidence interval for the indirect effects was constructed by using Bootstrapping.

Results: The autonomy–organizational citizenship behavior relationship was mediated by optimism and work engagement, respectively. In addition, optimism and work engagement mediated this relationship serially.

Conclusions: The findings of this study may have implications for improving organizational citizenship behavior. The effects of optimism and work engagement suggest a potential mechanism of action for the autonomy-organizational citizenship behavior linkage. A

multi-faceted intervention targeting organizational citizenship behavior through optimism and work engagement may help improve the quality of nursing care among nurses supporting patients with COVID 19.

Keywords: The Job Demands-Resources model; Autonomy; Optimism; Organizational citizenship behavior; Nurses; COVID-19

Strengths and limitations of this study

- This is the first study to test a serial mediation model among autonomy, optimism, work engagement, and organizational citizenship behavior.
- The findings of this study have provided a better understanding for policy makers and nursing management about improving nurses' organizational citizenship behavior.
- The measures used in this study were internationally recognized and appropriately standardized for the Chinese population.
- The results cannot be allow to confirm the causal directionality.

Word count: 3763.

Introduction

The coronavirus disease 2019 (COVID-19) began in Wuhan, in December 2019, and it rapidly spread in China and the globe, causing a worldwide pandemic. One of the first designated hospitals to treat the COVID-19 epidemic was the Wuhan Jinyintan Hospital. Due to Wuhan's shortage of health providers, the Chinese government mobilized qualified personnel from across China to aid local medical staff in the city to treat the health crisis [1]. As front line of health care providers, nurses play an important role as they spend the longest time caring for and have the most frequent interactions with patients. With a large number of nurses from across China coming to work with local medical staff in Wuhan Jinyintan Hospital, it is a necessity that they cooperate effectively with each other in order to deliver high quality medical care to patients with COVID-19. Cooperative behavior is important as it can increase the efficiency of an organization as a whole. However, some challenges and difficulties, such as diverse backgrounds, different work standards, and different level of hospital, may pose a threat to enacting cooperative behavior for nurses.

Organizational citizenship behavior is one type of cooperative behavior, which increases a person's tendency towards helping and sharing information, demonstrating integrity, and championing the institution [2]. Nurses with high levels of organizational citizenship behavior can cooperate with other medical staff effectively to deliver more efficient nursing care and increase organizational effectiveness [3]. Therefore, it is necessary to focus on nurses' organizational citizenship behavior during the COVID-19 epidemic in Wuhan Jinyintan Hospital.

Work engagement among nurses continues to attract considerable research attention due to its relationship with organizational citizenship behavior. For example, the study conducted by

Sulea et al. (2012) showed that nurses with a high level of work engagement are more likely have organizational citizenship behaviors [4]. Researchers and practitioners are increasingly recognizing that a clear understanding of antecedents for work engagement is in needed to inform intervention efforts to maximize organizational citizenship behaviors.

One of the antecedents to work engagement is autonomy. Mauno et al. (2010) in their longitudinal study demonstrated that autonomy can lead to work engagement [5]. Moreover, Bargagliotti (2012) found that autonomy can positively impact work engagement among professional nurses [6]. Studies also showed that optimism is positively associated with work engagement. For example, Nordin et al. (2019) found that optimism positively related to work engagement [7]. The positive relationship between optimism and work engagement could also be found among Chinese medical professionals[8].

Although previous studies have made valuable contributions to the topic of work engagement, the mechanism (e.g., how autonomy relates to organizational citizenship behavior) underlying the association between optimism and work engagement remains largely unexplored. The contributions of the present study are two-fold. First, it is the first time to examine the association between autonomy, optimism, work engagement, and organizational citizenship behavior, thus generating new insights on the mechanisms underlying the effect of autonomy on organizational citizenship behavior. Second, by utilizing a nurse sample, this study can help inform effective interventions to improve organizational citizenship behavior among nurses caring for patients with COVID-19.

Theory and hypotheses

The Job Demands-Resources (JD-R) model presents an understanding of organizational citizenship behavior within an occupational health psychiatry context. Job demands, such as workload or time pressure, can initiate a health impairment process, where emotional exhaustion can be predicted leading to job performance concerns. In contrast, job resources, such as autonomy or performance feedback, can initiate a motivational process, where work engagement can be predicted, resulting in positive employee behavior and job performance, including organizational citizenship behavior and creativity[9 10].

Autonomy is one type of job resources, and the extent to which the job provides discretion, freedom, and independence can be reflected by autonomy [11]. Autonomy can help individuals maintain positive learning through an intimate knowledge of their work, and during this process, employees become engaged [12]. Work engagement refers to, "a positive, fulfilling, work-related state of mind that is characterized by vigor, dedication, and absorption," [13]. When engaged individuals feel a high level of significance for their job, they are more likely to take pride in being assigned challenging tasks. Evidence has shown that the positive relationship between work engagement and important organizational outcomes and employee behavior [14].

In line with the JD-R model, the relationship between autonomy and employee behavior can be mediated by work engagement, which is supported in the literature. Surveys such as that conducted by Kwon et al. (2019) have shown that work engagement plays a mediating role in the relationship between autonomy and employee behavior [15]. Keyko et al. (2016) found that autonomy can predict work engagement, leading to positive outcomes among professional nurses [16]. Although extensive research has been carried out on work engagement , no single study exists

which test the mediating effect of work engagement in the relationship between autonomy and organizational citizenship behavior. Thus, this study proposes:

Hypothesis 1. Work engagement will mediate the association between autonomy and organizational citizenship behavior.

The aspects of the work environment were only considered in the early and revised versions of the JD-R model. However, personal resources should be integrated into the JD-R model, as human behavior can be explained by an interaction between personal and environmental factors based on psychological approaches [17]. Personal resources can be defined as, "the psychological characteristics or aspects of the self that are generally associated with resiliency and that refer to the ability to control and impact one's environment successfully" [17].

Personal resources have a similar function as job resources to improve personal growth and development. Optimism is an example of a personal resource. Seligman (2006) suggest that optimistic individuals consider that personal, permanent, and pervasive factors result in positive events, and negative outcomes can be interpreted in terms of temporary, external, and situation-specific factors [18]. Optimistic people often view an event positively and internalize the good aspects of their lives in the past, present, and future, thereby increasing their sense of self-esteem and morale [19].

Schaufeli (2017) suggested that though personal resources can be integrated and play an important role in the JD-R model, it is unclear where they act in the model [20]. Schaufeli and Taris (2014) stated that there were five places when considering personal resources in the JD-R model, and encouraged future research to collect more evidence to identify where and how personal resources act [17]. One possible place for personal resources is that the relationship between job

resources and work engagement can be mediated by personal resources [17]. For example, optimism plays a mediating role in the positive relationship between job resources and work engagement, which is suggested by cross-sectional studies [21 22]. Additionally, in a longitudinal study, Llorens (2007) found the association between job resources and work engagement can be mediated by personal resources [23]. In line with the JD-R model and the suggested place for optimism, optimism can be regarded as a mediator in the JD-R model. Thus, this study proposes:

Hypothesis 2. The relationship between autonomy and organizational citizenship behavior will be serially mediated by optimism and work engagement.

METHODS

Study units and participants

A convenience sample was used with nurses caring for patients with COVID-19 from the Wuhan Jinyintan Hospital, in March 2020. This study was conducted online via Wenjuanxing, which is the Chinese professional survey website (www.sojump.com). A two-dimensional code was sent to all potential participants, who can scan two-dimensional codes having access to the questionnaires through WeChat.

After obtaining agreement from head nurses, research team sent the two-dimensional code of the electronic questionnaire to head nurses through Wechat. The head nurses then assisted with recruitment by sending the two-dimensional code to their nurses through Wechat. The first page of electronic questionnaire provided information about this study and information to allow participants to provide informed consent. Participation was voluntary and participants decided on an individualized basis whether to take part in this study. The first page of electronic questionnaire also told participants that all data would be protected and the survey was

anonymous. A total of 305 nurses were invited and 242 nurses agreed to participate and completed the electronic questionnaire.

Measures

Autonomy

The autonomy subscale of the Job Diagnostic Survey was used to measure autonomy [24]. It comprises three items, and the Chinese version of this scale is widely used [11]. One example of an item on the questionnaire is: ‘‘My job gives me the chance to use my personal initiative and judgement in carrying out the work” [24]. A seven-point scale ranging from “very little” to “very much” was rated by participants.

Optimism

Optimism was assessed with a subscale of the Life Orientation Test [25]. The subscale comprised four items, and the Chinese version of this scale was used in this study [26]. One sample item in the short scale was, “In uncertain times, I usually expect the best”. A five-point scale ranging from “strongly disagree” to “strongly agree” was rated by participants.

Work engagement

Work engagement was measured with the Utrecht Work Engagement Scale-9 [27]. There are three dimensions in this scale: three items for vigor, three items for dedication, and three items for absorption. This scale has been widely used in China [28]. The items are “to my job, I feel strong and vigorous”, and “in the morning, I feel like going to work”. A seven-point scale ranging from “never” to “always” was rated by participants.

Organizational citizenship behavior

Organizational citizenship behavior was measured with organizational citizenship behavior scale [29]. There are two dimensions and ten items in this scale: seven items for helping and three items for civic virtue. Examples of the items are "attend and actively participate in team meetings" and "willingly share expertise with other members of the unit". A five-point scale ranging from "completely not true" to "completely true" was rated by participants.

Statistical analysis

This study used IBM® SPSS® Statistics, (Version 24, IBM Corporation, New York, NY) to calculate descriptive information and correlation matrix. A serial mediation model (model 6) of PROCESS macro was adapted to test the hypotheses [30]. Bootstrapping is used in the mediation analysis, because it is a non-parametric resampling technique involving random and repeated sub-sampling of data, and it does not need to satisfy the assumption of normally distributed data [30]. A 95% confidence interval for the indirect effects is constructed by using Bootstrapping. If the 95% confidence interval does not contain zero, it is considered to be significant for the indirect effects. In this study, the mediating results were based on 5,000 bootstrap samples.

A total effect, direct effect, and a total indirect effect can be provided in a serial mediation model. For a serial mediation model with two mediators (e.g., optimism and work engagement), there are three specific indirect effects, and the specific indirect effects can be compared. Control variables should be included in studies when there are theoretically based justifications rather than previous empirical relationships [31]. Therefore, control variables were not included in this study.

Results

Preliminary analyses

Table 1 presents means, standard deviations, the Cronbach's a, average variance extracted (AVE), and correlations of study variables. AVE for autonomy, optimism, work engagement, and organizational citizenship behavior was 0.71, 0.67, 0.50, and 0.63, respectively, which indicated that convergent validity was acceptable. The square of root of AVE values exceeded the construct correlation values suggesting that discriminant validity is satisfactory.

Table 1: Correlation coefficient, mean, standard deviation, and AVE

Variables	M	SD	The Cronbach's a	AVE	1	2	3	4
1 Autonomy	5.56	1.27	0.89	0.71	**0.84**			
2 Optimism	4.17	0.70	0.87	0.67	0.36**	**0.82**		
3 WE	4.83	1.01	0.92	0.50	0.49**	0.54**	**0.71**	
4 OCB	5.01	0.78	0.95	0.63	0.35**	0.47**	0.60**	**0.79**

Note: **Significant at the 0.01 level; the square of root of AVE values are bolded; WE: work engagement; OCB: organizational citizenship behavior; AVE: average variance extracted.

Mediation analyses

Model 6 of the PROCESS macro was adapted to test if the association between autonomy and organizational citizenship behavior can be mediated serially by optimism and work engagement. The results are presented in Figure1 and Table 2. The results of serial mediation analyses showed that a total effect of autonomy on organizational citizenship behavior was found to be significant (c= 0.21, SE = 0.04, t = 5.71, $p < 0.001$). The direct effect of autonomy on organizational citizenship behavior was not significant when optimism and work

engagement served as mediators (c′=0.03, SE = 0.04, t = 0.72, *p*= 0.47). The total indirect effect of autonomy on organizational citizenship behavior was found to be significant (ab=0.19, SE=0.03, CI=0.13 to 0.26). The indirect effect of autonomy on organizational citizenship behavior via optimism was significant (a_1b_1 =0.04, SE=0.02, CI=0.01 to 0.09). The indirect effect of autonomy on organizational citizenship behavior via work engagement was also significant (a_2b_2=0.10, SE=0.02, CI=0.06 to 0.15). The indirect effect of autonomy on organizational citizenship behavior was also found to be significant through both optimism and work engagement (a_1a_3 b_2=0.04, SE=0.01, CI=0.02 to 0.07).

All specific indirect effects were contrasted to determine whether one indirect effect is different than another (Table 2). Only one pair of contrasting findings were found to be statistically significant (effect =0.06, SE=0.02, CI=0.01 to 0.11). The results showed that the indirect effect was larger through work engagement only than the path through both optimism and work engagement.

Figure 1. should be inserted here.

Table 2: Serial mediation analyses

Effect	b	se	BootLLCI	BootULCI
ab	0.19	0.03	0.13	0.26
a_1 b_1	0.04	0.02	0.01	0.09
a_2 b_2	0.10	0.02	0.06	0.15
a_1 a_3 b_2	0.04	0.01	0.02	0.07
Contrasts				
a_1 b_1 minus a_2 b_2	-0.06	0.03	-0.13	0.01
a_1 b_1 minus a_1 a_3 b_2	0	0.02	-0.04	0.04

$a_2\ b_2$ minus $a_1\ a_3\ b_2$	0.06	0.02	0.01	0.11

Note. Bootstrap sample size = 5,000. a and b represent unstandardized regression coefficients: a_1= direct effect of autonomy on optimism; a_2 =direct effect of autonomy on work engagement; a_3=direct effect of optimism on work engagement; b_1=direct effect of optimism on organizational citizenship behavior; b_2=direct effect of work engagement on organizational citizenship behavior; ab=total indirect effect; a_1b_1 =specific indirect effect through optimism; $a_2\ b_2$ =specific indirect effect through work engagement; $a_1a_3b_1$ =specific indirect effect through optimism and work engagement; ULCI = Upper Limit of Confidence Interval, LLCI = Lower Limit of Confidence Interval.

Discussion

The present study contributes to integrate personal resources (e.g., optimism) as a mediator into the JD-R model.Through the sample of nurses in the study, it was found that autonomy was associated with organizational citizenship behavior through the following mechanisms: (i) indirectly through work engagement; (ii) indirectly through both optimism and work engagement; and, (iii) indirectly through optimism. This means that three specific indirect effects were found to be significant.

The findings suggest that a high level of autonomy was associated with a higher level of work engagement, and thus was associated with greater organizational citizenship behavior. This is consistent with earlier research, which showed that the relationship between job resources and performance was mediated work engagement [32]. Similarly, in a study among nurses, Maurits et al. (2015) found that work engagement served as a mediator in the relationship between

autonomy and intention to leave the health care sector [33]. In a motivational process described by JD-R model, the indirect effect of job resources on employee behavior can be mediated by work engagement [17]. When independence and freedom of a job were given to nurses, they will work in a positive affective-motivational state, which can help generate attitudes and behaviors that lead to achieve goals. In turn, nurses are more likely to have beneficial voluntarily behaviors at work, such as organizational citizenship behavior.

Despite the mediating role of optimism having been studied in the past, understanding of its connection to work engagement and employee behavior is still unclear. Early research shows that the relationship between job resources and motivation can be mediated by optimism [34]. Xanthopoulou et al., (2011) found that the relationship between day-level coaching and work engagement was mediated by optimism. However, this study suggested that an indirect effect of autonomy on organizational citizenship behavior among nurses through both optimism and work engagement. This serial mediation model has been demonstrated for the first time between these variables. Hobfoll (1989) proposes that resources intend to accumulate, which means that if employees work in an environment with rich resource, they are more likely to become optimistic and confident about career development [35]. These personal resources can be positively related to work engagement. Work engagement can not only enable employees to be goal-oriented and focus on their work tasks, but also provide the energy and enthusiasm to perform well. In other words, the mediating effect of personal resources suggests that existing resources can accumulate further resources, which are beneficial to job performance and employee behavior.

Interestingly, the findings also suggest that the relationship between autonomy and organizational citizenship behavior is mediated by optimism, which is not proposed in JD-R

model. However, this result was consistent with previous studies. For example, Le et al. (2018) suggested that the relationship between job resources and employee behavior was mediated by optimism [36]. Similarly, optimism has also been found to has a mediating effect on the relationship between job resources (e.g., salesperson knowledge) and salesperson performance [37]. The reason may be that autonomy as a job resource gives nurses authority to choose task distribution, work pace, work skills, and collaborators [38]. Therefore, nurses can use a resource rich working environment as an instrument to activate optimism, allowing them to have the ability to control their working environment and become confident, thus contributing to excellent job performance [35].

In this study, three mediation models were significant. However, comparing specific indirect effects of mediators, the findings indicated that the indirect effect was larger through work engagement only than the path through both optimism and work engagement. Meanwhile, effect sizes for optimism as mediator were small in the single mediator path and serial-multiple mediation, which limits practical significance of data. Therefore, the mediated capabilities of optimism should not be overestimated. Additionally, the other possible places for personal resources should be taken account. For example, Schaufeli (2017) suggested that the relation between job characteristics and wellbeing(e.g., work engagement) can be moderated by personal resources [20].

Implications

Since optimism and work engagement are significant mediators in the autonomy-organizational citizenship behavior linkage, a wide range of interventions should be adopted to improve optimism and work engagement among nurses fighting COVID-19. First, it is necessary

for nursing management to boost nurses' awareness of the underlying optimism by highlighting the concept of goals, as it allows nurses to set goals that were frustrated in the past and then design strategies to accept challenge and achieve goals [39]. For instance, Zhang et al. (2014) found that individuals can be taught about setting goals and developing measures to achieve them when facing adversity, thus leading to a forward-thinking, positive person [40].The findings also suggest that it is important for hospital administrators to focusing on improving work engagement. They should make an effort to provide an interesting and challenging work environment with sufficient job resources fitting nurses' role expectations. Moreover, supportive management also plays a vital role, as it provides a positive climate containing more job resources and endurable job demands for nurses, resulting in a higher level of work engagement [13].

Limitations

When these finding were interpreted, some limitations should be considered. First, because it is was a cross-sectional study, the results cannot be interpreted with causal directionality. Longitudinal or experimental designs are encouraged to confirm the causal directionality. Second, common method variance may be a potential issue due to self-report questionnaires when interpreting the results. However, Harmon's single-factor test was performed, and the results revealed that the explained variance of the first factor was below 50%. Additionally, four factors had an eigenvalue greater than 1.0. Therefore, common-method bias may not be a major issue in our study. Third, other types of personal resources, like self-efficacy, may also mediat the relationship between autonomy and organizational citizenship behavior, so future studies are encouraged to adopt the different types of personal resources in this association. Lastly, the purposes of the study was tested among nurses came across china working in Wuhan Jinyintan

hospital fighting COVID-19 epidemic, so the results should not be generalized in other samples. However, as the COVID-19 epidemic has spread worldwide, nurses in other countries may also work temporarily with new colleagues to deliver treatment to patients with COVID-19. The findings of this study have provided a better understanding for policy makers and nursing management about improving nurses' organizational citizenship behavior.

Conclusion

Our framework aligns with the call (Schaufeli, 2017) to clarify the role of personal resources in the JD-R model [20]. In a sample of nurses who came from across China to work in Wuhan Jinyintan hospital during the COVID-19 epidemic, it was found that the relationship between autonomy and organizational citizenship behavior is influenced by the sequential effects of optimism and work engagement. A high level of organizational citizenship behavior can enable nurses to cooperate with other medical staff effectively to provide high quality of nursing care in this globe health emergency. Although future studies should focus on substantiating and improving the findings when considering the association between these important variables, nursing management and hospital administration should consider a multi-faceted approach to enhance optimism and work engagement among nurses fighting COVID-19.

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Authors contributions

HZ, YZ, and ZHY designed the study. HZ, SDL, DDC, PZ, and YZ analyzed the data, and drafted the manuscript and interpreted the data. HZ, LWT, JS, ZHY, LY and PZ revised the manuscript. YZ and LY participated in the data collection. All authors read and approved the

final manuscript.

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Competing interests

The authors declare that they have no competing interests.

Patient consent for publication

Not required.

Ethics approval and consent to participate

Ethical approval was obtained from ethics committee of the third People's Hospital of Hubei Province. The study was performed in accordance with the ethical principles set forth in Helsinki declaration. Informed consent was obtained from all participants.

Data availability statement

The datasets used and analyzed during the current study are available from the corresponding author on reasonable request.

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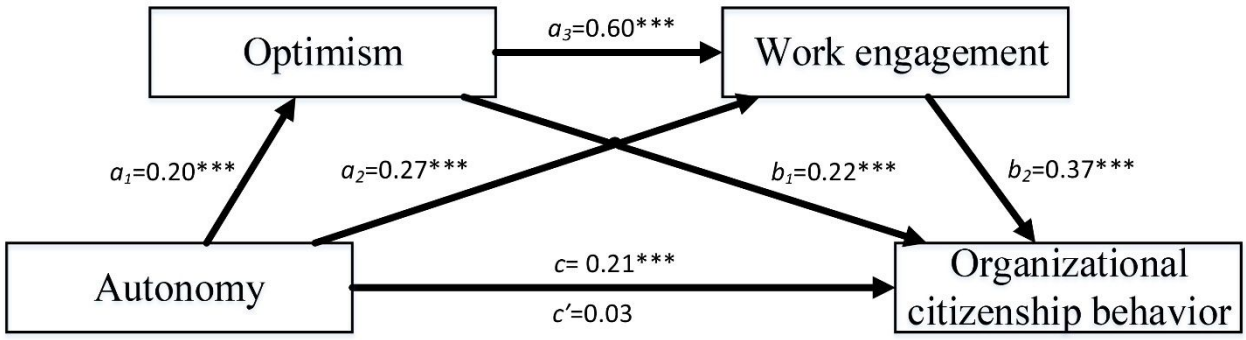
Figure 1. Three-path mediation model



Note. a_1= direct effect of autonomy on optimism; a_2 =direct effect of autonomy on work engagement; a_3 =direct effect of optimism on work engagement; b_1 =direct effect of optimism on organizational citizenship behavior; b_2 =direct effect of work engagement on organizational citizenship behavior; c=total effect of autonomy on organizational citizenship behavior, without accounting for optimism and work engagement; c′=direct effect of autonomy on organizational citizenship behavior when accounting for optimism and work engagement. ***p <0.001.

STROBE Statement—Checklist of items that should be included in reports of ***cross-sectional studies***

	Item No	Recommendation
Title and abstract **（page1-2）**	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found
Introduction		
Background **（page3-8）**	2	Explain the scientific background and rationale for the investigation being reported
Objectives **（page8）**	3	State specific objectives, including any prespecified hypotheses
Methods		
Study design **（page8）**	4	Present key elements of study design early in the paper
Setting **（page8）**	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection
Participants **（page9）**	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants
Variables **（page99）**	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable
Data sources/ measurement **（page8）**	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group
Bias **（page8）**	9	Describe any efforts to address potential sources of bias
Study size **（page8）**	10	Explain how the study size was arrived at
Quantitative variables **（page9）**	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why
Statistical methods **（page10-11）**	12	(*a*) Describe all statistical methods, including those used to control for confounding
		(*b*) Describe any methods used to examine subgroups and interactions
		(*c*) Explain how missing data were addressed
		(*d*) If applicable, describe analytical methods taking account of sampling strategy
		(*e*) Describe any sensitivity analyses
Results		
Participants **（page12）**	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed
		(b) Give reasons for non-participation at each stage
		(c) Consider use of a flow diagram
Descriptive data **（page12）**	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders
		(b) Indicate number of participants with missing data for each variable of interest
Outcome data **（page12）**	15*	Report numbers of outcome events or summary measures
Main results **（page13）**	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included
		(*b*) Report category boundaries when continuous variables were categorized
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a

		meaningful time period
Other analyses **（page13）**	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses
Discussion		
Key results **（page15-16）**	18	Summarise key results with reference to study objectives
Limitations **（page16）**	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias
Interpretation **（page15）**	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence
Generalisability **（page15-16）**	21	Discuss the generalisability (external validity) of the study results
Other information		
Funding **NONE**	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

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The relationship between autonomy, optimism, work engagement, and organizational citizenship behavior among nurses fighting COVID-19 in Wuhan: A Serial Multiple Mediation

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The relationship between autonomy, optimism, work engagement, and organizational citizenship behavior among nurses fighting COVID-19 in Wuhan: A Serial Multiple Mediation

Authors' information

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Abstract

Objectives: High levels of organizational citizenship behavior can enable nurses to cooperate with co-workers effectively to provide a high quality of nursing care during the outbreak of COVID-19. However, the association between autonomy, optimism, work engagement, and organizational citizenship behavior remains largely unexplored. This study aimed to test if the effect of autonomy on organizational citizenship behavior through the mediating effects of optimism and work engagement.

Study design: This was a cross-sectional study.

Setting: The study was conducted in the Wuhan jinyingtan hospitals in China.

Participants: In total, 242 nurses who came from multiple areas of China to work at the Wuhan Jinyintan hospital during the COVID-19 epidemic participated in this study.

Methods: A serial mediation model (model 6) of PROCESS macro was adapted to test the hypotheses, and a 95% confidence interval for the indirect effects was constructed by using Bootstrapping.

Results: The autonomy–organizational citizenship behavior relationship was mediated by optimism and work engagement, respectively. In addition, optimism and work engagement mediated this relationship serially.

Conclusions: The findings of this study may have implications for improving organizational citizenship behavior. The effects of optimism and work engagement suggest a potential mechanism of action for the autonomy-organizational citizenship behavior linkage. A

multi-faceted intervention targeting organizational citizenship behavior through optimism and work engagement may help improve the quality of nursing care among nurses supporting patients with COVID-19.

Keywords: The Job Demands-Resources model; Autonomy; Optimism; Organizational citizenship behavior; Nurses; COVID-19

Strengths and limitations of this study

- This is the first study to test a serial mediation model among autonomy, optimism, work engagement, and organizational citizenship behavior.
- The findings of this study have provided a better understanding for policy makers and nursing management about improving nurses' organizational citizenship behavior during the outbreak of COVID-19.
- The measures used in this study were internationally recognized and appropriately standardized for the Chinese population.
- The results cannot confirm causal directionality.

Word count: 3763.

Introduction

The coronavirus disease of 2019 (COVID-19) rapidly spread across the globe causing a worldwide pandemic. In China, the Wuhan Jinyintan Hospital was the first designated hospital to treat the COVID-19 epidemic. Due to Wuhan's shortage of health providers, the Chinese government mobilized qualified personnel from across China to aid local medical staff in the city to treat the health crisis [1]. As front line of health care providers, nurses play an important role as they spend the longest time caring for and have the most frequent interactions with patients. With a large number of nurses from across China coming to work with local medical staff in the Wuhan Jinyintan Hospital, it is a necessity that they cooperate effectively with each other in order to deliver high quality medical care to patients with COVID-19. Cooperative behavior is important as it can increase the efficiency of an organization. However, some challenges and difficulties, such as diverse backgrounds, different work standards, and different level of original hospital, may pose a threat to enacting cooperative behavior for nurses.

Organizational citizenship behavior is one type of cooperative behavior, which increases a person's tendency towards helping and sharing information, demonstrating integrity, and championing the institution [2]. Nurses with high levels of organizational citizenship behavior can cooperate with other medical staff effectively to deliver more efficient care and increase organizational effectiveness [3]. Therefore, it is necessary to focus on nurses' organizational citizenship behavior during the COVID-19 epidemic in the Wuhan Jinyintan Hospital.

Researchers have shown an increased interest in work engagement among nurses due to its relationship with organizational citizenship behavior. For example, the study conducted by Sulea et al. (2012) showed that nurses with a high level of work engagement are more likely

have organizational citizenship behaviors [4]. A study in Thailand also showed that there were positive relationships between work engagement and organizational citizenship behavior [5]. Additionally, researchers and practitioners are increasingly recognizing that a clear understanding of antecedents for work engagement is in needed to inform intervention efforts to maximize organizational citizenship behaviors. One of the antecedents to work engagement is autonomy. Mauno et al. (2010) in their longitudinal study demonstrated that autonomy can lead to work engagement [6]. Moreover, Bargagliotti (2012) found that autonomy can positively impact work engagement among professional nurses [7]. Studies, such as the one by Nordin et al. (2019) found that optimism positively related to work engagement [8]. The positive relationship between optimism and work engagement was also shown in a study conducted in Korea [9].

Although previous studies have made valuable contributions to the topic about autonomy, optimism, work engagement, and organizational citizenship behavior, the mechanism (e.g., how autonomy relates to organizational citizenship behavior) underlying the association between optimism and work engagement remains largely unexplored. The contributions of the present study are two-fold. First, it is the first to examine the association between autonomy, optimism, work engagement, and organizational citizenship behavior, thus generating new insights on the mechanisms underlying the effect of autonomy on organizational citizenship behavior. Second, by utilizing a sample of nurses, this study can help inform effective interventions to improve organizational citizenship behavior among nurses caring for patients with COVID-19.

Theory and hypotheses

The Job Demands-Resources (JD-R) model can be used to present an understanding of organizational citizenship behavior within an occupational health psychiatry context. Job demands, such as workload or time pressure, can initiate a health impairment process, where emotional exhaustion is predicted to decrease job performance. In contrast, job resources, such as autonomy or performance feedback, can initiate a motivational process, where work engagement can be predicted, resulting in positive employee behavior and job performance, including organizational citizenship behavior and creativity[10 11].

Autonomy is one type of job resource, and the extent to which the job provides discretion, freedom, and independence can be reflected by autonomy[12]. Autonomy can help individuals maintain positive learning through an intimate knowledge of their work, and during this process, employees become engaged [13]. Work engagement refers to, "a positive, fulfilling, work-related state of mind that is characterized by vigor, dedication, and absorption," [14]. When engaged individuals feel a high level of significance of their job, they are more likely to take pride in being assigned challenging tasks performing better in the workplace [15].

In line with the JD-R model, the relationship between autonomy and employee behavior can be mediated by work engagement. Surveys such as that conducted by Kwon et al. (2019) have shown that work engagement plays a mediating role in the relationship between autonomy and employee behavior [16]. Keyko et al. (2016) found that autonomy can predict work engagement, leading to positive outcomes among professional nurses [17]. Although extensive research has been carried out on work engagement, no single study exists which test the mediating effect of work engagement in the relationship between autonomy and organizational citizenship behavior. Thus,

this study proposes:

Hypothesis 1. Work engagement will mediate the association between autonomy and organizational citizenship behavior.

As the aspects of the work environment were only considered in the early and revised versions of the JD-R model, recently personal resources are suggested to be integrated into the JD-R model, due to the fact that human behavior can be explained by an interaction between personal and environmental factors based on psychological approaches [18].Personal resources is defined as "the psychological characteristics or aspects of the self that are generally associated with resiliency and that refer to the ability to control and impact one's environment successfully" [18]. This kind of resources have a similar function as job resources to improve personal growth and development.

Schaufeli (2017) suggested that though personal resources can be integrated and play an important role in the JD-R model, it is unclear where exactly they act[19]. Schaufeli and Taris (2014) stated that there were five places when considering personal resources in the JD-R model, and encouraged future research to collect more evidence to identify where and how personal resources act [18]. One possible place for personal resources is that the relationship between job resources and work engagement can be mediated by personal resources [18]. Optimism is an example of a personal resource. Seligman (2006) suggest that optimistic individuals consider that personal, permanent, and pervasive factors result in positive events, and negative outcomes can be interpreted in terms of temporary, external, and situation-specific factors [20]. Optimistic people often view an event positively and internalize the good aspects of their lives in the past, present, and future, thereby increasing their sense of self-esteem and morale [21]. Studies have shown that

optimism plays a mediating role in the positive relationship between job resources and work engagement, which is suggested by cross-sectional studies [22] [23]. Additionally, in a longitudinal study, Llorens (2007) found the association between job resources and work engagement can be mediated by personal resources(e.g., efficacy) [24]. However, the mediating effect of optimism on the relationship between autonomy, work engagement, and organizational citizenship has not been investigated.

In line with the JD-R model and the suggested place for optimism, optimism can be regarded as a mediator in the JD-R model. Thus, this study proposes:

Hypothesis 2. The relationship between autonomy and organizational citizenship behavior will be serially mediated by optimism and work engagement.

METHODS

Study units and participants

A convenience sample was used with nurses caring for patients with COVID-19 from the Wuhan Jinyintan Hospital, in March 2020. This study was conducted online via Wenjuanxing, which is the Chinese professional survey website (www.sojump.com). A two-dimensional code was sent to all potential participants, who can scan two-dimensional codes having access to the questionnaires through WeChat.

After obtaining agreement from head nurses, the research team sent the two-dimensional code of the electronic questionnaire to head nurses through WeChat. The head nurses then assisted with recruitment by sending the two-dimensional code to their nurses through WeChat. The first page of electronic questionnaire provided information about this study and information to allow participants to provide informed consent. Participation was voluntary and participants

decided on an individual basis whether to take part in this study. The first page of electronic questionnaire also told participants that all data would be protected, and the survey was anonymous. A total of 305 nurses were invited and 242 nurses agreed to participate and completed the electronic questionnaire.

Measures

Autonomy

The autonomy subscale of the Job Diagnostic Survey was used to measure autonomy [25]. It comprises three items, and the Chinese version of this scale is widely used [12]. One example of an item on the questionnaire is: ‘‘My job gives me the chance to use my personal initiative and judgement in carrying out the work” [25]. A seven-point scale ranging from “very little” to “very much” was rated by participants.

Optimism

Optimism was assessed with a subscale of the Life Orientation Test [26]. The subscale comprised four items, and the Chinese version of this scale was used in this study [27]. One sample item in the short scale was, “In uncertain times, I usually expect the best”. A five-point scale ranging from “strongly disagree” to “strongly agree” was rated by participants.

Work engagement

Work engagement was measured with the Utrecht Work Engagement Scale-9 [28]. There are three dimensions in this scale: three items for vigor, three items for dedication, and three items for absorption. This scale has been widely used in China [29]. The items are “to my job, I feel strong and vigorous”, and “in the morning, I feel like going to work”. A seven-point scale ranging from “never” to “always” was rated by participants.

Organizational citizenship behavior

Organizational citizenship behavior was measured with organizational citizenship behavior scale [30]. There are two dimensions and ten items in this scale: seven items for helping and three items for civic virtue. Examples of the items are "attend and actively participate in team meetings" and "willingly share expertise with other members of the unit". A five-point scale ranging from "completely not true" to "completely true" was rated by participants.

Statistical analysis

This study used IBM® SPSS® Statistics, (Version 24, IBM Corporation, New York, NY) to calculate descriptive information and correlation matrix. A serial mediation model (model 6) of PROCESS macro was adapted to test the hypotheses [31]. Bootstrapping is used in the mediation analysis, because it is a non-parametric resampling technique involving random and repeated sub-sampling of data, and it does not need to satisfy the assumption of normally distributed data [31]. A 95% confidence interval for the indirect effects is constructed by using Bootstrapping. If the 95% confidence interval does not contain zero, it is considered to be significant for the indirect effects. In this study, the mediating results were based on 5,000 bootstrap samples.

A total effect, direct effect, and a total indirect effect can be provided in a serial mediation model. For a serial mediation model with two mediators (e.g., optimism and work engagement), there are three specific indirect effects, and the specific indirect effects can be compared. Control variables should be included in studies when there are theoretically based justifications rather than previous empirical relationships [32]. Therefore, control variables were not included in this study.

Patient and public involvement

Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research

Results

Preliminary analyses

Table 1 presents means, standard deviations, the Cronbach's a, average variance extracted (AVE), and correlations of study variables. AVE for autonomy, optimism, work engagement, and organizational citizenship behavior was 0.71, 0.67, 0.50, and 0.63, respectively, which indicated that convergent validity was acceptable. The square of root of AVE values exceeded the construct correlation values suggesting that discriminant validity is satisfactory.

Table 1: Correlation coefficient, mean, standard deviation, and AVE (N=242)

Variables	M	SD	The Cronbach's a	AVE	1	2	3	4
1 Autonomy	5.56	1.27	0.89	0.71	**0.84**			
2 Optimism	4.17	0.70	0.87	0.67	0.36**	**0.82**		
3 WE	4.83	1.01	0.92	0.50	0.49**	0.54**	**0.71**	
4 OCB	5.01	0.78	0.95	0.63	0.35**	0.47**	0.60**	**0.79**

Note: **Significant at the 0.01 level; the square of root of AVE values are bolded; WE: work engagement; OCB: organizational citizenship behavior; AVE: average variance extracted.

Mediation analyses

Model 6 of the PROCESS macro was adapted to test if the association between

autonomy and organizational citizenship behavior can be mediated serially by optimism and work engagement. The results are presented in Figure 1 and Table 2. The total indirect effect of autonomy on organizational citizenship behavior was found to be significant (ab=0.19, SE=0.03, CI=0.13 to 0.26). The indirect effect of autonomy on organizational citizenship behavior via optimism was significant (a_1b_1 =0.04, SE=0.02, CI=0.01 to 0.09). The indirect effect of autonomy on organizational citizenship behavior via work engagement was also significant (a_2b_2=0.10, SE=0.02, CI=0.06 to 0.15). The indirect effect of autonomy on organizational citizenship behavior was also found to be significant through both optimism and work engagement ($a_1a_3b_2$=0.04, SE=0.01, CI=0.02 to 0.07).

All specific indirect effects were contrasted to determine whether one indirect effect is different than another (Table 2). Only one pair of contrasting findings were found to be statistically significant (effect =0.06, SE=0.02, CI=0.01 to 0.11). The results showed that the indirect effect was larger through work engagement only than the path through both optimism and work engagement.

Figure 1. should be inserted here.

Table 2: Serial mediation analyses (N=242)

Effect	b	se	BootLLCI	BootULCI
ab	0.19	0.03	0.13	0.26
$a_1\ b_1$	0.04	0.02	0.01	0.09
$a_2\ b_2$	0.10	0.02	0.06	0.15
$a_1\ a_3\ b_2$	0.04	0.01	0.02	0.07
Contrasts				
$a_1\ b_1$ minus $a_2\ b_2$	-0.06	0.03	-0.13	0.01

$a_1 b_1$ minus $a_1 a_3 b_2$	0	0.02	-0.04	0.04
$a_2 b_2$ minus $a_1 a_3 b_2$	0.06	0.02	0.01	0.11

Note. Bootstrap sample size = 5,000. a and b represent unstandardized regression coefficients: a_1= direct effect of autonomy on optimism; a_2 =direct effect of autonomy on work engagement; a_3=direct effect of optimism on work engagement; b_1=direct effect of optimism on organizational citizenship behavior; b_2=direct effect of work engagement on organizational citizenship behavior; ab=total indirect effect; a_1b_1 =specific indirect effect through optimism; a_2 b_2 =specific indirect effect through work engagement; $a_1a_3b_1$ =specific indirect effect through optimism and work engagement; ULCI = Upper Limit of Confidence Interval, LLCI = Lower Limit of Confidence Interval.

Discussion

The present study contributes to integrate optimism in the JD-R model as a mediator. Through the sample of nurses in the study, it was found that autonomy was associated with organizational citizenship behavior through the following mechanisms: (i) indirectly through work engagement; (ii) indirectly through both optimism and work engagement; and, (iii) indirectly through optimism. This means that three specific indirect effects were found to be significant.

These findings suggest that a high level of autonomy was associated with a higher level of work engagement, and thus was associated with greater organizational citizenship behavior. This is consistent with an earlier study published from Korea, which showed that the relationship between job resources and performance was mediated work engagement [33]. Similarly, in a study

among nurses, Maurits et al. (2015) found that work engagement served as a mediator in the relationship between autonomy and intention to leave the health care sector [34]. In a motivational process described by JD-R model, the indirect effect of job resources on employee behavior can be mediated by work engagement [18]. When independence and freedom of a job were given to nurses, they will work in a positive affective-motivational state, which can help generate attitudes and behaviors that lead to achieve goals. In turn, nurses are more likely to have beneficial voluntarily behaviors at work, such as organizational citizenship behavior.

Despite the mediating role of optimism having been studied in the past, understanding of its connection to work engagement and employee behavior is still unclear. Additionally, previous research shows that the relationship between job resources and motivation can be mediated by optimism [35]. Xanthopoulou et al., (2011) found that the relationship between day-level coaching and work engagement was mediated by optimism. However, this study suggested that an indirect effect of autonomy on organizational citizenship behavior among nurses occurs via both optimism and work engagement. This serial mediation model has been demonstrated for the first time between these variables. Hobfoll (1989) proposes that resources intend to accumulate, which means that if employees work in an environment with rich resource, they are more likely to become optimistic and confident about career development [36]. These personal resources can be positively related to work engagement. Work engagement can not only enable employees to be goal-oriented and focus on their work tasks, but also provide the energy and enthusiasm to perform well. In other words, the mediating effect of personal resources suggests that existing resources can accumulate further resources, which are beneficial to job performance and employee behavior.

Interestingly, the findings also suggest that the relationship between autonomy and organizational citizenship behavior is mediated by optimism, which is not proposed in JD-R model. However, this result was consistent with previous studies. For example, Le et al. (2018) suggested that the relationship between job resources and employee behavior was mediated by optimism [37]. Similarly, optimism has also been found to has a mediating effect on the relationship between job resources (e.g., salesperson knowledge) and salesperson performance [38]. The reason may be that autonomy as a job resource gives nurses authority to choose task distribution, work pace, work skills, and collaborators [39]. Therefore, nurses can use a resource rich working environment as an instrument to activate optimism, allowing them to have the ability to control their working environment and become confident, thus contributing to excellent job performance [36].

In this study, three mediation models were significant. However, in comparing specific indirect effects of mediators, the findings indicated that the indirect effect was larger through work engagement only, compared to the path through both optimism and work engagement. Meanwhile, effect sizes for optimism as mediator were small in the single mediator path and serial-multiple mediation, which limits practical significance of data. Therefore, the mediated capabilities of optimism should not be overestimated. Additionally, the other possible places for personal resources should be taken account. For example, Schaufeli (2017) suggested that the relation between job characteristics and wellbeing(e.g., work engagement) can be moderated by personal resources [19].

Implications

Since optimism and work engagement are significant mediators in the autonomy-

organizational citizenship behavior linkage, a wide range of interventions should be adopted to improve optimism and work engagement among nurses fighting COVID-19. First, it is necessary for nursing management to boost nurses' awareness of the underlying optimism by highlighting the concept of goals, as it allows nurses who were frustrated in the past, to design and implement strategies to achieve their goals [40]. For instance, Zhang et al. (2014) found that individuals can be taught about setting goals and developing measures to achieve them when facing adversity, thus leading to a forward-thinking, positive person [41]. The findings of this present study also suggest that it is important for nursing management to focusing on improving work engagement. They should make an effort to provide an interesting and challenging work environment with sufficient job resources fitting nurses' role expectations. Moreover, supportive management also plays a vital role, as it provides a positive climate containing more job resources and endurable job demands for nurses, resulting in a higher level of work engagement [14]. For example, a study published from Japan has shown that psychological demands and decision latitude can increase work engagement [42].

Limitations

When these finding were interpreted, some limitations should be considered. First, the results cannot be interpreted with causal directionality as the study had a cross-sectional design. Longitudinal or experimental designs are encouraged to confirm causal directionality. Second, common method variance may be a potential issue due to self-report questionnaires when interpreting the results. However, Harmon's single-factor test was performed, and the results revealed that the explained variance of the first factor was below 50%. Additionally, four factors had an eigenvalue greater than 1.0. Therefore, common-method bias may not be a major issue in

our study. Third, other types of personal resources, like self-efficacy, may also mediate the relationship between autonomy and organizational citizenship behavior, so future studies are encouraged to adopt the different types of personal resources in this association. Lastly, the purposes of the study was tested among nurses came across china working in Wuhan Jinyintan Hospital fighting COVID-19 epidemic, so the results may not be generalizable to other samples. However, as the COVID-19 epidemic has spread worldwide, nurses in other countries may also work temporarily with new colleagues to deliver treatment to patients with COVID-19. The findings of this study have provided a better understanding for policy makers and nursing management about improving nurses' organizational citizenship behavior.

Conclusion

Our framework aligns with the call (Schaufeli, 2017) to clarify the role of personal resources in the JD-R model [19]. In a sample of nurses who came from across China to work in Wuhan Jinyintan Hospital during the COVID-19 epidemic, it was found that the relationship between autonomy and organizational citizenship behavior is influenced by the sequential effects of optimism and work engagement. A high level of organizational citizenship behavior can enable nurses to cooperate with other medical staff effectively to provide high quality of nursing care in this globe health emergency. Although future studies should focus on substantiating and improving the findings when considering the association between these important variables, nursing management and hospital administration should consider a multi-faceted approach to enhance optimism and work engagement among nurses fighting COVID-19.

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Authors contributions

HZ, YZ, and ZHY designed the study. HZ, SHL, DDC, PZ, and YZ analyzed the data, and drafted the manuscript and interpreted the data. HZ, LWT, JS, ZHY, LY and PZ revised the manuscript. YZ and LY participated in the data collection. All authors read and approved the final manuscript.

Funding statement

Not applicable.

Competing interests

The authors declare that they have no competing interests.

Patient consent for publication

Not required.

Ethics approval and consent to participate

Ethical approval was obtained from ethics committee of the third People's Hospital of Hubei Province. The study was performed in accordance with the ethical principles set forth in Helsinki declaration. Informed consent was obtained from all participants.

Data availability statement

The datasets used and analyzed during the current study are available from the corresponding author on reasonable request.

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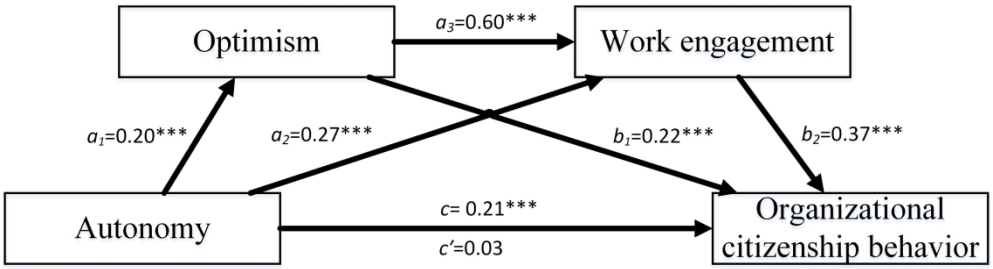
Figure 1. Three-path mediation model

Note. a_1= direct effect of autonomy on optimism; a_2 =direct effect of autonomy on work engagement; a_3 =direct effect of optimism on work engagement; b_1 =direct effect of optimism on organizational citizenship behavior; b_2 =direct effect of work engagement on organizational

citizenship behavior; c=total effect of autonomy on organizational citizenship behavior, without accounting for optimism and work engagement; c′=direct effect of autonomy on organizational citizenship behavior when accounting for optimism and work engagement. ***p <0.001.



Three-path mediation model

254x72mm (300 x 300 DPI)

STROBE Statement—Checklist of items that should be included in reports of ***cross-sectional studies***

	Item No	Recommendation
Title and abstract **（page1-2）**	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found
Introduction		
Background **（page3-8）**	2	Explain the scientific background and rationale for the investigation being reported
Objectives **（page8）**	3	State specific objectives, including any prespecified hypotheses
Methods		
Study design **（page8）**	4	Present key elements of study design early in the paper
Setting **（page8）**	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection
Participants **（page9）**	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants
Variables **（page99）**	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable
Data sources/ measurement **（page8）**	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group
Bias **（page8）**	9	Describe any efforts to address potential sources of bias
Study size **（page8）**	10	Explain how the study size was arrived at
Quantitative variables **（page9）**	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why
Statistical methods **（page10-11）**	12	(*a*) Describe all statistical methods, including those used to control for confounding
		(*b*) Describe any methods used to examine subgroups and interactions
		(*c*) Explain how missing data were addressed
		(*d*) If applicable, describe analytical methods taking account of sampling strategy
		(*e*) Describe any sensitivity analyses
Results		
Participants **（page12）**	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed
		(b) Give reasons for non-participation at each stage
		(c) Consider use of a flow diagram
Descriptive data **（page12）**	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders
		(b) Indicate number of participants with missing data for each variable of interest
Outcome data **（page12）**	15*	Report numbers of outcome events or summary measures
Main results **（page13）**	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included
		(*b*) Report category boundaries when continuous variables were categorized
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a

		meaningful time period
Other analyses **（page13）**	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses
Discussion		
Key results **（page15-16）**	18	Summarise key results with reference to study objectives
Limitations **（page16）**	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias
Interpretation **（page15）**	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence
Generalisability **（page15-16）**	21	Discuss the generalisability (external validity) of the study results
Other information		
Funding **NONE**	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.