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Research Article

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Physical and Mental Health, Stress, and Resilience among Healthcare Workers during the Coronavirus Disease 2019 (COVID-19) Pandemic using a Regional Teaching Hospital as an Example

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Abstract

In this cross-sectional study, the subjects were medical staff caring for patients with confirmed or suspected coronavirus disease 2019 (COVID-19) in a regional teaching hospital. A total of 100 questionnaires were enrollment from 1 June 2021 to 30 July 2021. The study tool was a questionnaire containing physical and mental health, work stress, and resilience sub-scales. Study results were analyzed using descriptive statistics, independent sample t-test, and Pearson product-moment correlation coefficient and regression analysis. In medical staff, physical and mental health and work stress were negatively correlated with resilience ($r=-0.55$, $p<0.01$; $r=-0.61$, $p<0.01$). Furthermore, the main predictors affecting resilience in medical staff included: physical and mental health, education level, and resilience ($F=33.7$, $p<0.001$), which explained 52.0% of variation. The study results indicated the following: (1) a channel for relieving stress such as psychological assessment and care should be provided for medical staff; (2) a friendly team atmosphere should be created and the support system should be strengthened; and (3) complete and appropriate epidemic control training and sufficient protective equipment should be provided. This study can be used as a reference for formulation of relevant policies through hospital management.

Keywords: COVID-19; Medical staff; Resilience

Introduction

Since December 2019, when researchers in Wuhan conducted surveillance of respiratory and related illness, many cases of unknown viral pneumonia were discovered. The clinical manifestation of these patients was primarily fever. Few patients had dyspnea and chest X-ray showed infiltrative lesion in both lungs. A notification from mainland China on January 9, 2020, stated that the pathogen was initially determined as a novel coronavirus.

On 15 January 2020, the Ministry of Health and Welfare of Taiwan issued MOHW Tzu No. 1090100030, which listed COVID-19 as the 5th legally notifiable infectious disease. In February 2020, human-to-human COVID-19 transmission and infection in medical staff occurred in Taiwan. In March 2020, the number of confirmed COVID-19 cases rose drastically and sporadic community infections were reported.

The Central Epidemic Command Center proposed medical institution triage for infection control, established community sampling networks, and advocated that medical staff should wear high-efficiency mask (N95 or equivalent grade (inclusive) of masks), gloves, and waterproof isolation gown when performing endotracheal intubation, bronchoscopy, and pharyngeal swab or nasopharyngeal swab collection, and should wear a full face mask and cap to decrease the risk of infection.

According to statistics from the Taiwan Union of Nurses Association, 277,327 people were licensed nurse practitioners in March 2018 but only 163,231 nurses were practicing, and the practice rate was 58.9% (Taiwan Union of Nurses Association, 2018). In clinical practice, medical staff has experienced various emergencies in patients and have numerous sources of stress. This was compounded by the COVID-19 pandemic, thereby causing immense stress for medical staff. Although sufficient personal protective equipment has been provided, the stress relief faced by medical staff, conversion resistance to assistance, using resilience to overcome stress and challenges, and effects of physical and mental health are unknown. Therefore, the objective of this study was to examine the effects of COVID-19 on physical and mental health, work stress, and resilience in medical staff.

Literature review

Definition of stress

Stress is defined as a state of tension and unease induced by physiological or psychological threat, and this tense state causes unpleasantness or suffering (Revised Chinese Dictionary by the Ministry of Education, 2018). Wikipedia defined stress as a psychological and biological term, which refers to an inability to normally respond when a human or animal experiences a tangible or intangible emotional or physical threat. Stress sometimes has a positive warning function and is defined as a situation appraised by the individual as personally significant and as having demands that exceed the person's resources for coping and is a subjective feeling [1]. Merriam-Webster (1828) defines stress as follows: constraining force or influence; such as a force exerted when one body or body part tends to be compressed or twisted, a physical, chemical, or emotional factor that causes bodily or mental tension, and may be a factor that causes disease [2]. Selye [3] defines stress as a physiological or psychological response produced by an individual to adapt to needs and changes, emphasizes the physiological nature of stress, and defines stress as a nonspecific response of the body to any demand and is a defense process of the body.

Physiological and psychological impact on medical staff

The severe acute respiratory syndrome outbreak in 2003 had an immense physiological and psychological impact on medical staff, which was mainly attributable to excessive workload, wearing cumbersome protective equipment, and exposure to a work environment at high risk for infection. The difficult epidemic control and care work increased their physiological burden and also affected sleep quality [4,5]. The main causes of psychological impact were the worries of quarantine, fear, being infected, and even passing on the disease to friends and family. Studies have pointed out that medical staff who had undergone quarantine or in such work environments tended to experience stress, frustration, mental exhaustion, or even breakdown [5,6]. Therefore, medical staff evidently experience high physiological and psychological stress when administering care for patients with highly contagious diseases and these sources of stress would deeply affect their clinical work.

Introduction to concept of resilience

Origin and development of resilience

Resilience mainly originated from the fields of psychiatry and psychological counseling in the 1950s. The subjects were mainly children, adolescents, and families, and researchers were searching for ways to help them face changes and successfully grow. During that time, owing to the absence of a term such as "resilience," researchers used words such as "invulnerability," "adaptation," and "stress resistance" to describe the concept of resilience [7].

The research on resilience began when Werner and Smith [8] conducted a 40-year longitudinal study on 505 children in Hawaii. The study reported that 72 children from poor family environments lacking complete care are a high-risk group at the age of 2 years. Furthermore, until they were aged 18 years, researchers found that

they have transformed into individuals that could love others and their job, enjoy life, possess the ability to overcome difficulties, adapt to the environment, and reduce the impact of adversity.

Resilience underwent 3 waves of evolution from 1950s to the present day as follows: (1) in the early years, resilience was considered the ability to successfully adapt to difficulties, where studies focused on examining the risk factors and protective factors of resilience. (2) In the middle stage, resilience was viewed as a process of adaptation to life and was expanded to environmental interactions between individuals and families, schools, and communities, where studies focused on the effector mechanism of risk factors and protective factors. (3) In the recent years, resilience was advocated as a dynamic interaction process between humans and the environment, where studies mainly focused on improving resilience through intervention measures.

This psychological viewpoint reveals that the concept of resilience is described as psychological characteristics that help an individual to adapt to stress or quickly recover from a pessimistic state when faced with changes and adversity or even positively overcome these situations. Therefore, resilience not only represents the ability to rebound but also is an energy and strength that helps an individual to become stronger, to grow, and to overcome, and allows them to overcome adversity and becomes stronger through encouragement [7, 9-12].

Definition of resilience

The term "resilience" originates from the Latin word "resilire," which means the ability to rebound. Merriam-Webster Dictionary (2016) defines resilience as an ability to adapt, that allows an individual to become stronger, healthier, or more successful when faced with difficulties and changes [13].

From the evolution of resilience and its diverse definitions, it is evident that many scholars have considered resilience as a characteristic and ability of an individual, or a process and effect of interacting with the environment. However, the rapid large environmental changes in recent years have transformed the entire society into a chaotic and unclear post-modern society, where ideas and concepts of resilience have started being used in various developmental stages of individuals and various fields. Resilience has even undergone continuous promotion to corporate culture, i.e., interactions between the individual and the organization and exchange of efforts between both parties allows rapid reconstruction and demonstrates vitality and transcendence.

Resilience theories

Patterson and Kelleher [14] proposed that resilience is composed of 6 stages (Figure 1), which is described as follows:

(1) **Impact of adversity:** An individual encounters various types of adversity or challenge and the adversity caused by crisis often poses an impact and challenge to the leader's resilience.

(2) **Interpretation of adversity:** The effects of past and present facts, including the cause of adversity and crisis induced by adversity, and its effects will change an individual's explanation and conclusion of adversity.

(3) **Resilience capacity:** Resilience is a dynamic process. When adversity occurs, it drives an individual to display resilience, such as the resilience capacity trough shown in Figure 1 to help an individual successfully and safely overcome adversity.

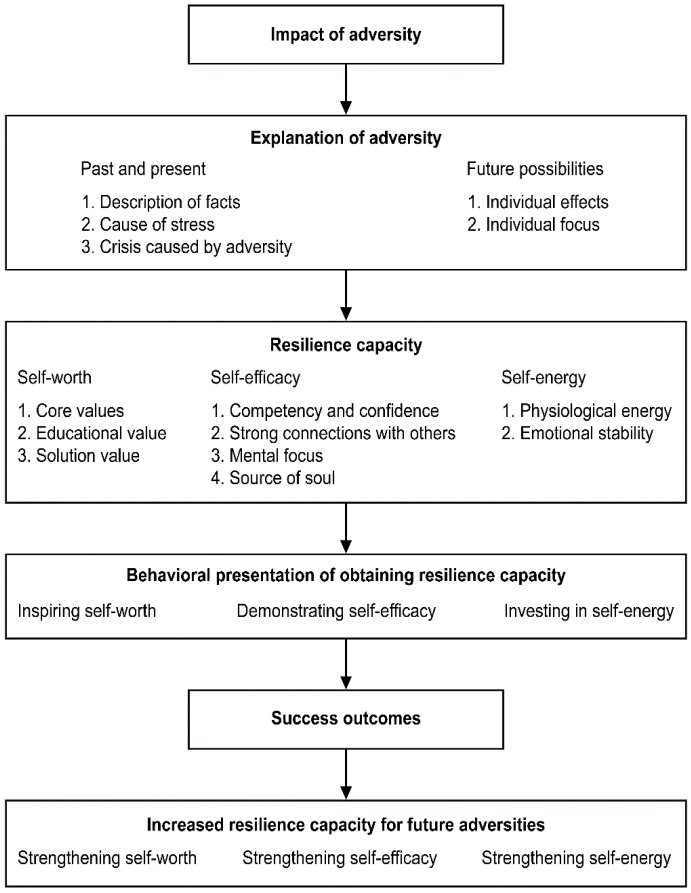

Figure 1: Resilience framework proposed by Patterson and Kelleher.

Resilience capacity mainly includes self-worth, self-efficacy, and self-energy, which are described as follows.

(1) There are 3 different levels of self-worth, namely core values, educational value, and solution value. These 3 levels are the sum of values constructed from deep to superficial and from inside to outside. The core value level is general ethics principles that reflect the most important beliefs of an individual's life. The educational

value level is a specific value that reflects the important beliefs of an individual in education and teaching. The solution value is a specifically proposition and direction endowed by corporate culture, i.e., when an individual encounters adversity, his/her behavior will be affected by individual values and not by the event.

(2) Self-efficacy refers to the control of an individual in completing a goal independently. Self-efficacy is composed of 2 components, i.e., an individual's self-confidence and competence, and connections between the individual and others. Better self-efficacy can encourage an individual to be bold in attempting challenging goals and can better affirm that himself/herself has greater competence after many successes. Therefore, an individual's efficacy and achievements appear to mutually affect and enhance each other.

(3) Self-energy can be viewed as an individual's ability to do whatever he/she wants, which is presented in 4 forms: physiology, emotions, mind, and spirit. The greater the physical, mental, and spiritual health an individual has, the more energy he/she has to face adversity and challenges in the external environment.

(4) Behavioral presentation of obtaining resilience capacity: Behavioral presentation is the specific external presentation and behavior of an individual, which is also an explicit presentation of internal status, i.e., a mechanism by which an individual communicates and interacts with the external environment. Behavioral presentation reflects an individual's efficacy status and is also an individual's clarification and belief of his/her values. Furthermore, this is also an overall presentation of an individual's energy levels. Therefore, resilience capacity in the previous stage may be the foundation of behavioral presentation. Resilience capacity can also affect the entire energy storage status due to the results of behavioral presentation.

(5) Success outcomes: This refers to successful experiences of an individual in overcoming adversity through actions.

(6) Increased resilience capacity for future adversities: This refers to the experience and feelings produced after an individual successfully solves a problem through actions, which increases resilience to face tougher challenges.

In summary, Patterson and Kelleher [14] considered the resilience formation mechanism to be as follows: explanation, competency, and action, where these 3 mechanisms dynamically interact with each other. An individual possess resilience capacity through continuous accumulation of successful experiences and is able to overcome adversity and failure to be successful in adversity.

Frontline medical staffs actively assist in difficult epidemic control and care with assistance from the government, hospital, and civil groups. They have to demonstrate perseverance and courage and shoulder social responsibility. The main purpose of this study was to examine the effects of COVID-19 on the physical and mental health, work stress, and resilience of medical staff. Furthermore, we hope that the findings of this study can provide an important reference for future plans for improving resilience, decreasing work stress, maintaining physical and mental health in medical staff, and also increasing the professional competency and retention willingness of medical staff.

Materials and Methods

Study design and study subjects

This study was a cross-sectional, correlational study, and was obtained by convenience sampling. The samples were obtained from medical staff caring for patients with confirmed or suspected severe COVID-19 in a regional teaching hospital in southern Taiwan. The inclusion criteria were as follows: (1) Nationality: Republic of China, age ≥20 years; (2) with clear consciousness, without diagnosis of mental illness or psychiatric disorder; and (3) able to communicate in Chinese and Taiwanese Hokkien. Subjects who expressed consent after the study objectives were explained to them and signed the informed consent form. The sample size was determined using [Means: difference from constant (one sample case)] in in G power software test family item (t-test). The minimum sample size required was 54. In consideration of the estimated dropout rate, 100 subjects were to be enrolled for data collection. Enrollment was performed from 1 June 2021 to 31 July 2021. A total of 100 questionnaires were distributed and 100 valid questionnaires were collected, with a recovery rate of 100%.

Study tool and reliability and validity

A structured questionnaire was used to collect data. The questionnaire content included sociodemographic data and the self-designed questionnaires, physical and mental health scale, work stress scale, and resilience scale. The content of the scales are described as follows.

Experts with health promotion knowledge and background provided professional guidance and tested the content validity of the questionnaire. The overall reliability Cronbach's α was 0.94.

Physical and mental health scale

There were 12 questions in the physical and mental health scale and a 4-point scoring system was used. Subjects who selected never and similar to usual were given 0 points, and subjects who selected slightly more than usual or more than usually were given 1 point. The higher the score, the more severe the physical and mental health. The CHQ included 4 dimensions: (1) somatic, which were questions 1, 2, 3, and 4; (2) anxiety and worry, which were questions 6, 9, and 11; (3) depression and poor relationship, which were questions 7, 8, 10, and 12; and (5) sleep problem, which was question 5. The internal consistency Cronbach's α of the scale was

0.79, and expert validity test found that CVI was 0.94.

Work stress scale

The scale content included: occupational hazard (7 questions), work conflict (4 questions), excessive work load (5 questions), labor shortage (2 question), for a total of 18 questions. There were 7 other questions that did not include these 4 factors, which were questions on common work stress in the nursing workplace, for a total of 25 questions. In which, 24 questions were negatively worded questions and 1 question was positively worded. Agreement (1-4) was used for scoring, where 1 point was given for strongly disagree and 4 points given for strongly agree. Reverse scoring for positively worded questions. The higher the score, the greater the stress from that source. The internal consistency Cronbach's α of the scale was 0.94, and expert validity test found that CVI was 0.94.

Resilience scale

The scale included 5 dimensions: (1) 6 personal strength questions, which were 2, 11, 17, 18, 26, 28; (2) 7 family unity questions, which were 3, 7, 12, 13, 16, 23, 27; (3) 8 social resource questions, which were 6, 8, 9, 10, 14, 15, 20, 25; (4) 4 social skill questions, which were 19, 21, 22, 24; and (5) 4 future organization style questions, which were 1, 4, 5, 29. A higher score indicated a greater resilience capacity. The internal consistency Cronbach's α of the scale was 0.73, and expert validity test found that CVI was 0.94.

Data collection and analysis process

After this study was reviewed and approved by the institutional review board, relevant units were contacted for data collection. Due to ethical considerations and protection of the study subjects' rights, the study content was first explained verbally to the subject. After confirming the subject's willingness to participate in the study, the participant completed the informed consent form. The contents of the consent form include study objectives, time spent and rights, and the subject's right to withdraw from the study at any time. A small gift was given after completion.

In this study, SPSS 22.0 for Windows was used for database construction and analysis. Descriptive statistics were described using frequency distribution, percentage, mean, and standard deviation. Independent t-test, Pearson's correlation coefficient, and multiple regressions were used for statistical analysis of inferential statistics.

Results

Sociodemographic data

From Table 1, we can see that there were 100 study subjects, which were mostly female (84%) while males accounted for 16%. Most subjects had an education level of bachelor (69%), followed by graduate degree (18%), and junior college had the lowest proportion (13%). Most subjects had a marital status of married (68%), followed by unmarried (28%), and divorced had the lowest proportion (4%). Most subjects were religious (60%), followed by free-thinkers (40%). Among these religious subjects, Buddhists accounted for 26%, Taoists accounted for 26%, Christians accounted for 26%, and other folk religions accounted for 13%. Most subjects had an occupation of nurses (70%), of which 25% worked in the emergency department and 45% worked in the wards, followed by administrative staff (17%), and physicians had the lowest proportion (13%), of which 5% worked in the emergency department and 8% worked in the wards. Most subjects had contact with (suspected) COVID-19 patients (58%) followed by those without contact with (suspected) COVID-19 patients (26%) and 16% were uncertain. Most subjects had contact with used materials from (suspected) COVID-19 patients (58%), subjects who did not contact with used materials from (suspected) COVID-19 patients accounted for 25%, and uncertain subjects accounted for 17%. Most subjects did cared for (suspected) COVID-19 patients (56%), followed by those who cared for (suspected) COVID-19 patients (35%), and 9% were uncertain (Table 1).

Variable	n	(%)	Variable	n	(%)
Sex			Type of occupation		
Male	16	(16)	Registered nurse	70	(70)
Female	84	(84)	Emergency Department	25	(25)
Education level			Ward	45	(45)
Junior college	13	(13)	Physician	13	(13)
Bachelor	69	(69)	Emergency department	5	(5)
Graduate degree	18	(18)	Ward	8	(8)
Marital status			Administrative staff	17	(17)
Unmarried	28	(28)	Contact with (suspected) COVID-19 patients		
Married	68	(68)	Yes	58	(58)
Divorced	4	(4)	No	26	(26)
Religious beliefs			Not sure	16	(16)
Buddhism	26	(26)	Contact with used materials from (suspected) COVID-19 patients		
Taoism	16	(16)	Yes	58	(58)
Christianity	5	(5)	No	25	(25)
Folk religion	13	(13)	Not sure	17	(17)
None	40	(40)	Cared for (suspected) COVID-19 patients		
Variable	Mean ± SD		Yes	35	(35)
Number of years of work experience in hospital	13.6 ± 9.6		No	56	(56)
Age (years)	40.1 ± 9.7		Not sure	9	(9)
Mean number of work hours per week	42.1 ± 5.5				
Mean daily sleep duration (hours)	6.5 ± 1.1				
Work satisfaction	7.3 ± 1.4				

Table 1: Distribution of demographic variables (N=100)

From Table 1, it can be seen that there were 100 study subjects. The mean number of years of work experience in hospital was 13.6 ± 9.6 years; mean age was 40.1 ± 9.7 years, mean weekly working hours was 42.1 ± 5.5 hours, mean daily sleep duration was 6.5 ± 1.1 hours, and job satisfaction was 7.3 ± 1.4 points (Table 1).

Physical and mental health, work stress, and resilience distribution in medical team members

The physical and mental health score of medical team members was 23.6 ± 4.8 (out of 48), with a higher score indicating more severe physical and mental health; the work stress score was 58.9 ± 14.4 (out of 100), with a higher score indicating greater stress; the resilience score was 154.9 ± 30.5 (out of 203), with a higher score indicating greater resilience (Table 2).

Variable	**Mean ± SD**
Physical and mental health scale	23.6 ± 4.8
Work stress scale	58.9 ± 14.4
Resilience scale	154.9 ± 30.5

Table 2: Physical and mental health, work stress, and resilience distribution of medical team members (N=100).

Correlation analysis of factors affecting resilience in medical team members

Correlation of resilience in medical team members

The physical and mental health scale score was negatively correlated with resilience scale score in medical team members ($r=-0.55$, $p<0.01$), i.e., higher physical and mental health scale score means severer physical and mental health and poorer resilience. The work stress scale score was negatively correlated with resilience scale score in medical team members ($r= -0.61$, $p<0.01$), i.e., greater work stress scale score means greater stress and poorer resilience (Table 3).

Item	Physical and mental health	Work stress	Resilience
Physical and mental health	1		
Work stress	0.59**	1	
Resilience	−0.55**	−0.61**	1

Table 3: Correlation analysis of physical and mental health, work stress, and resilience of medical team members(N=100); Note: Pearson correlation was used, *p<0.05, **p<0.01.

Important predictors of resilience in medical team members

Regression analysis was carried out on sociodemographic variables, physical and mental health, work stress, and resilience, and stepwise selection was used to identify predictors. After collinearity test was used to prove that collinearity was absent, and the main predictors were: physical and mental health, education level junior college, and work stress ($F = 33.7$, $p<0.001$) which explained 52.0% of variation in resilience ($\triangle R^2=0.52$, 95%CI= −224.3–269.6) (Table 4).

Variable	**Non-standardized β-value**	**Standardized β-value**	**t-value**	**Tolerance**	**VIF**	**R^2**	**$\triangle R^2$**	***F-value***
Constant	246.9		21.6.3***			0.52	0.50	33.7***
Work stress	−0.83	−0.39	−4.36***	0.637	1.569			
Education level (junior college)	−26.5	−0.29	−4.01***	0.945	1.058			

Physical and mental health	−1.7	−0.27	−3.04**	0.651	1.537			

Table 4: Stepwise multiple regression of resilience in medical team members (N=100); Note: (1)*p<0.05 ** p<0.01 *** p<0.001 (2).

Discussion

This study found that the important predictors of resilience in medical staff who care for confirmed or suspected COVID-19 patients include physical and mental health, education level junior college, and work stress, of which physical and mental health and work stress were negatively correlated with resilience (r=−0.55, p<0.01 ; r=−0.61, p<0.01), showing that physical and mental health and work stress are negative predictors.

This study found that the important predictors of resilience in medical staff who care for confirmed or suspected COVID-19 patients include physical and mental health, education level junior college, and work stress. From the study results, we recommend that: (1) A channel for relieving stress such as psychological assessment and care should be provided for medical staff; (2) A friendly team atmosphere should be created and the support system should be strengthened; and (3) Complete and appropriate epidemic control training and sufficient protective equipment should be provided. The results of this study can be used as a reference for formulation of relevant policies by hospital management.

The results of this study were only limited to those measured using the study tools, which were self-reported assessment tools. Due to differences between Chinese and Western cultures, the study subjects may be worried about revealing their actual thoughts and are unwilling to report their actual opinions. In addition, the study was only conducted in a regional teaching hospital in southern Taiwan and the generalizability of the study results is limited. Thirdly, this is a cross-sectional study and we were unable to investigate changes in resilience with time. Based on the limitations of this study and the current COVID-19 pandemic status, we recommend the following future research directions: (1) Adding the protective equipment allocation system of the hospital for examination; (2) adding a qualitative study in the future to examine resilience; (3) expanding the sample size and region to prove our study results; (4) including the family members of medical staff who care for confirmed or suspected COVID-19 patients to examine the factors affecting resilience in-depth; and (5) performing a longitudinal study to examine changes in resilience.

Disclosure

Author Contributions

Conceptualization, L.V. and M.S.A.; methodology, A.S., V.R.A.S, and R.A.C; software, A.S.; validation, C.A.B.L, R.L.V, M.S.A.; formal analysis, L.V.; investigation, M.S.A; resources, L.V, A.S., V.R.A.S.; data curation, B. K.; writing—original draft preparation, L.V.; writing-review and editing, K.W, B. K. and M.S.A; supervision, B.K. and M.S.A.

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Institutional Review Board Statement

All experimental procedures were approved by the Human Research Ethics Committee of the Kaohsiung Armed Forces General Hospital and conformed to the principles outlined in the Declaration of Helsinki (approval number KAFGHIRB 109-027, approval date 31. July. 2020). This study was guided by ethical standards and national and international laws. All athletes signed the consent form after receiving instructions regarding the possible risks and benefits and were granted privacy, confidentiality, and anonymity rights. The participants were free to stop participating any stage of the experiment without giving reasons for their decision.

Informed Consent Statement

Informed consent was obtained from all subjects involved in the study. Written informed consent has been obtained from the patient(s) to publish this paper.

Data Availability Statement

Data supporting the study results can be provided followed by request sent to the corresponding author's e-mail.

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