The Impact of A Gross Anatomy Course on Medical Students' Emotional Reactions in Taiwan: The Role of High-Level Emotions

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Abstract

Background

A gross anatomy is an important course for medical students; however, seeing a cadaver often makes them feel uncomfortable. According to the broaden-and-build theory, the present study tried to reduce students' negative emotions by sequential activities, such as interviews and ceremony, which induced gratitude and other positive emotions.

Methods

One hundred and five medical students in their third year filled Emotional Reactions Towards Cadavers Scale for three times in one semester, and paired-sample *t*-tests and hierarchical regression analyses were conducted to examine the changes of emotional reaction.

Results

Three-wave data showed that participants' high-level emotions increased, negative emotions decreased, and the former simultaneously predicted the latter.

Conclusions

Combining dissection course with medical humanities helped students to successfully handle negative emotions during gross anatomy course.

Background

The gross anatomy course is an important learning subject for medical students, and how teachers prepare them for the emotional impacts before and during the class is a critical concern for medical education. Most young medical students have no experience with death of a close relative or their own near-death experience, so that when they go into a gross anatomy laboratory and see a cadaver, they usually have a lot of physiological and psychological symptoms.

Previous studies showed that medical students in a gross anatomy laboratory experience many things, such as feeling sick, nauseous, or dizziness, vomiting, trembling, sweating, and having heart palpitations, irritation of the eyes and throat, difficulty breathing, a dry mouth, and an impulse to leave the laboratory [1–10]. Psychological problems include nightmares, loss of appetite, psychological collapse, numbness to death, crying, a frequent recall of death thinking or a cadaver's image, and even self-doubt about whether they are fit for a medical career [1, 2, 11–19, 3–10]. Generally, about 30% of medical students' experience at least one of those adverse impacts when they take a gross anatomy laboratory course [20].

Researchers have tried to determine the reasons that medical students suffer so much. Previous studies showed that students who had no experience with the death of a friend or relative had higher fears when facing body donors [3], and students who were not prepared or had deep thoughts about life and death during dissection had higher death anxiety [6]. Therefore, helping students face life and death issues can be a good strategy to reduce students' negative emotions when they take a gross anatomy laboratory course.

There have been many attempts by teachers to lower psychological impacts on students of seeing a cadaver. In one attempt, teachers showed students a video about anatomical information before the class to lower students' anxiety level

[13, 21, 22]. Another intervention provided senior students' help with first year students, and fewer of them showed anxiety, light-headedness, headaches, and vomiting, and there was fewer reactions to the smell of cadavers and the laboratory [20]. In another study, students were guided in a group discussion to share their emotions and thoughts. Most of the participating students showed that they respected the body donors because donors were living persons before, or they treated donors as if they were their future patients [16].

Students also developed their own coping strategies including rationalization, focusing on tasks, talking to and staying with peers, religious praying, inspiring themselves with the vision of being medical doctors in the future, or taking a break during dissection [1, 2, 8, 14, 16–18]. Another interesting strategy is that students may name the body donors they were dissecting. Compared to those without naming the body donors, students who had named the body donors remembered the body donors' features better, thought of the body donors' lives when they were living, and were more welcoming to relatives' body donation decisions. Also, more than a half of participating students wanted to know the life stories of the dissecting body donors [23]. All such strategies helped students overcome the unpleasantness of cadaver dissection. It seems that inspiring students' humanistic spirit can reduce the impacts of seeing a cadaver.

Emotions in the Gross Anatomy Laboratory Course

When students see a cadaver in a gross anatomy laboratory course, they often feel strong negative emotions, such as being scared, anxious, uncertain, repulsive, worried, distasteful, fearful, loathing, upset, horrified, apprehensive, and confused, but also other more-positive emotions like being interested, excited, curious, calm, pleased, satisfied, happy, neutral, fascinated, and enthused [4–7, 12, 13, 21]. However, there was a study observed that students' high-level emotions like respect, gratefulness, and cherishing were aroused, and negative emotions were suppressed compared to those of Western students [24]. Under the Eastern culture, we believe that introducing students to know donors and their families could increase students' gratefulness, and decrease their negative emotions. Therefore, it is worth understanding the mechanism of medical students' emotional changes in a gross anatomy lab in an Eastern culture.

Gratitude is a kind of virtue of positive psychology, such as wisdom, knowledge, courage, humanity, justice, and temperance. According to the broaden-and-build theory, positive emotions broaden thought-action mechanisms, whereas negative emotions narrow thought-action mechanisms [25]. Positive emotions can make an individual expand their personal cognition and encourage an individual to have novel, varied, exploratory thoughts and actions. They also have lasting benefits. On the other hand, negative emotions are viewed as an adaptation when an organism faces danger. They narrow thought-action to let an organism focus on attack or escape for survival. Researchers suggested that gratitude has three moral functions: as a moral barometer, moral motivator, and moral reinforcement [25, 26]. Previous research pointed out that positive emotions undo the effects of negative emotions [27]. Research on positive psychology also found that through direct thanks and positive reframing, people who feel gratitude showed fewer depressive symptoms [28]. Another study with an experimental and control group design showed that inducing gratitude can decrease death anxiety [29].

Gratitude can be conceptualized on two levels: state and trait. State gratitude is an effect immediately after an event, while trait gratitude is more like a personal characteristic [30]. State gratitude might have a meaningful effect on decreasing medical students' death anxiety and related negative emotions by inducing gratitude toward the body donors.

Our Intervention

We instituted a series of activities to accompany our gross anatomy course at an university of northern Taiwan. Since 2010, teachers and students conduct face-to-face interviews with the relatives of body donors. Students can then

practically understand that body donors are not just teaching instruments in a laboratory but were previously living persons. Through the interviews, students can also understand that the relatives of a body donor would expect them to be excellent medical practitioners. After the interviews and during the gross anatomy course, the medical department organizes an initiation ceremony with medical students, teachers, and relatives of the body donors. Students show their appreciation to the relatives, and promise that they will do their best to be good medical doctors in the future. In Taiwan, students and faculty of medical schools often call a body donor a “silent mentor,” who teaches students through donating his or her body. Therefore, students are working with a teacher who does not speak just about a dead body. We expected that our intervention might substitute students’ negative emotions or psychological impacts with respect for the silent mentors. On the other hand, based on feedback from our interviews, an initiation ceremony might fortify students’ serious attitudes towards the gross anatomy course, as well as foster a thankful attitude to the body donors and their relatives.

Variables Related to Adverse Effects

In terms of potential factors of the aforementioned impacts, research has shown that female students reported more threatened feelings [12] and greater reluctance to cut open a cadaver [4]. When students were asked to express their feelings about dissection, male students reported more anxiety and excited feelings, whereas females reported more uncertainty and worry [4]. It was also reported that female students showed more mental distress than males did before and after they contacted a cadaver [31]. In short, female students have more physiological and psychological impacts than do male students, and take more time to recover. In terms of religious influence, a qualitative study showed that students with religious beliefs were able to endure the impact of dissection with help from their beliefs [14]. Other research pointed out that some students pray or meditate as their coping strategy [1, 16]. It is plausible that religious beliefs can help a medical student get through the adverse effects of a gross anatomy laboratory. In addition, when students feel exhausted, their emotions become more negative [32, 33]. As we mentioned in the third paragraph, having experienced the death of a friend or relative is also a variable that influences students’ reactions to cadavers [3]. Therefore, variables such as gender, religious beliefs, experience of death of others, and the exhaustion level should be controlled for to execute an accurate study.

Based on the above inferences, we hypothesized the following: 1. An initiation ceremony after an interview with the relatives should have a positive influence on students’ emotions after they contact a cadaver; 2. Guiding students to have thankful thinking towards the “silent mentors,” actually increases students’ high-level emotions; and 3. High-level emotions decrease students’ negative emotions. According to previous studies, we controlled for the following factors: age, gender, religion, death experience, and burnout level.

Materials And Methods

Participants

Participants were 105 medical students (60 males and 45 females) in their third year in a medical university in northern Taiwan. The average age of participants was 20.81 (range, 20 ~ 27; standard deviation (SD), 1.10) years. In total, 46 participants had religious beliefs, and 68 of them had had an experience of the death of a friend or family member.

We collected data in their third year, however, these students had gradually received teaching about gratitude toward silent mentors since the start of their year 2 curriculum in the medical school. Their lecturers had instructed them to think of the contribution of silent mentors and the knowledge that they would gain from the silent mentors. During the gross anatomy course, students spent 8 hours a week in dissection room for 18 weeks. They spent extra 8 hours reviewing body structures in the dissection room before midterm and final exam.

Measures

Emotional Reactions Towards Cadavers Scale (ERTCS).

Based on students' descriptions after the first time they saw a cadaver and their emotional reactions observed by leaders of the Gross Anatomy Laboratory course, our research team listed 25 main emotions to measure students' emotional reactions after they saw a cadaver (Table 1). Items of the ERTCS were rated from 1 (strongly disagree) to 7 (strongly agree) by Likert scale. The English version of ERTCS is provided in a supplementary file.

In order to categorize major emotional changes of students, we conducted a pilot study that consisted of other 158 medical students (96 males and 62 females) at a medical university in northern Taiwan in 2016. Their average age was 20.97 (SD, 1.53) years. We conducted an exploratory factor analysis, with the method of maximum likelihood factoring. The analysis yielded a satisfactory three-factor structure (Table 1). The rotation method of PROMAX was further adopted, as these emotions should be theoretically inter-correlated, and 49.47% of the total variance was accounted for by the three factors, namely negative emotions (e.g., fearful, terrified, and spooky), high-level emotions (e.g., respected, cherished, and grateful), and excited emotions (e.g., fully expected, happy, and curious). Cronbach's α values of the three factors were 0.88, 0.90, and 0.84, respectively.

Table 1
Factor structures of the Emotional Reactions Towards Cadaver Scale

	Factors		
	Negative emotions	High-level emotions	Excited emotions
Fearful	0.794	-0.113	-0.082
Terrified	0.760	-0.135	0.089
Spooky	0.741	-0.227	-0.010
Shocked	0.683	0.032	0.069
Painful	0.668	-0.177	-0.023
Low	0.626	-0.208	-0.141
Unlucky	0.593	-0.374	-0.041
Avoided as a taboo	0.592	-0.188	0.039
Felt like escaping	0.585	-0.237	-0.340
Grief	0.500	0.198	0.177
Nervous	0.461	0.270	0.259
Too sympathetic to bear	0.391	0.255	0.243
Doubtful (to the future processes on a cadaver)	0.354	0.152	0.316
Disappointed (unable to achieve other's expectations)	0.352	0.057	0.068
Respected	-0.123	0.888	0.427
Cherished	-0.082	0.884	0.502
Grateful	-0.181	0.849	0.566
Admirable	-0.095	0.816	0.480
Humble	-0.037	0.768	0.338
Peaceful	-0.395	0.477	0.362
Fully expected	-0.029	0.505	0.804
Happy	-0.005	0.509	0.772
Curious	0.059	0.359	0.715
Familiar (with the silent mentor)	-0.021	0.556	0.667
Excited	0.096	0.191	0.620

Self-Perceived Physical and Mental Condition and Relationship with their Families.

We asked participants to report their self-perceived physical and mental conditions, ranging from 1 (very good) to 5 (very tired). We also asked participants to report their relationships with their families, ranging from 1 (very good) to 5 (very

bad).

Experience of the Death of a Family Member or Friend.

We employed a yes/no questions to ask participants whether they had had any experience of the death of a family member or friend.

Demographic Variables.

We collected participants' basic demographic variables including gender and religious beliefs.

Procedures

Research Procedures

In their third year in the medical school, participants filled out a measure of emotions and self-perceived physical and mental conditions 3 days before the silent mentor initiation ceremony (T1, 21 September 2016). They again filled out the emotional measurement form after the ceremony (T2, 3 October 2016). To evaluate changes at the end of the semester, they also filled out the emotional measurement form at end of the semester (T3, 13 January 2017). The instructions of the questionnaires stated that the results would not influence their scores, to avoid students' concerns about filling out the questionnaires, and they only needed to provide their student ID rather than their names to decrease their uncertainty. The study received ethics approval from the TMU-Joint Institutional Review Board (no. N201602066), and all methods were performed in accordance with the relevant guidelines and regulations. Students volunteered to participate in the study, and informed consent was obtained from all participants.

Ceremony Procedures

Participants in the initiation ceremony included family members of the silent mentors, all of the third-year medical students, and faculty members of the Department of Anatomy and Cell Biology. In the ceremony, each group of students was introduced to the silent mentors' past conduct and deeds to commemorate and appreciate them, and then laid wreaths.

Data Processing

We first conducted descriptive statistics to show the distribution of the three emotions at different time points. Then we conducted paired-sample *t*-tests to examine whether the levels of the three emotions changed with time. Finally, we conducted two hierarchical regression analyses to examine whether participants' high-level emotions at T2 and T3 could respectively predict their negative emotions at T2 and T3 when the participants' gender, religious beliefs, experience of death of another, high-level emotions, and negative emotions at T1 were controlled for.

Table 2
Descriptive statistics of the three emotions at three time points and self-perceived conditions

	Time 1		Time 2		Time 3		Paired-sample <i>t</i> -test					
	Mean	SD	Mean	SD	Mean	SD	T1 vs. T2		T2 vs. T3		T1 vs. T3	
							<i>t(df)</i>	<i>p</i>	<i>t(df)</i>	<i>p</i>	<i>t(df)</i>	<i>p</i>
Negative emotions	3.00	0.89	2.54	0.91	2.36	0.90	4.473 (80)	< 0.001	2.371 (83)	0.020	6.994 (100)	< 0.001
High-level emotions	5.68	0.83	5.95	0.81	5.99	0.95	-2.243 (80)	0.028	-1.216 (83)	0.228	-4.062 (100)	< 0.001
Excited emotions	4.39	1.04	5.02	1.02	4.77	1.20	-5.770 (80)	< 0.001	1.951 (83)	0.054	-4.002 (100)	< 0.001
Self-perceived condition	1.67	0.709										
* Emotions were rated by the Emotional Reactions Towards Cadavers Scale with a Likert-type scale from 1 (strongly disagree) to 7 (strongly agree). SD, standard deviation.												

Table 3
Hierarchical regression analyses of high-level emotions to negative emotions at T2 and T3

Model 1: Regression of T2 on negative emotions		<i>b</i>	β	<i>p</i>	Model 2: Regression of T3 on negative emotions		<i>b</i>	β	<i>p</i>
Level 1	Constant	2.719		< 0.001	Level 1	Constant	2.556		< 0.001
$\Delta R^2 = 0.016$	Have religious beliefs	-0.168	-0.095	0.354	$\Delta R^2 = 0.007$	Have religious beliefs	-0.043	-0.025	0.816
$\Delta F = 0.398$	Experience the death of another	-0.067	-0.036	0.721	$\Delta F = 0.163$	Experience the death of another	-0.051	-0.028	0.793
$p = 0.810$	Self-perceived condition	0.038	0.028	0.785	$p = 0.957$	Self-perceived condition	-0.068	-0.058	0.595
	Gender	-0.120	-0.068	0.504		Gender	-0.060	-0.035	0.748
Level 2	Constant	1.878		0.007	Level 2	Constant	1.902		0.008
$\Delta R^2 = 0.287$	Have religious beliefs	-0.214	-0.122	0.167	$\Delta R^2 = 0.137$	Have religious beliefs	-0.062	-0.037	0.718
$\Delta F = 19.542$	Experience the death of another	0.012	0.007	0.940	$\Delta F = 6.889$	Experience the death of another	-0.021	-0.012	0.906
$p < 0.001$	Self-perceived condition	-0.136	-0.100	0.267	$p = 0.002$	Self-perceived condition	-0.157	-0.134	0.203
	Gender	-0.125	-0.071	0.417		Gender	-0.040	-0.023	0.821
	Negative emotions (T1)	0.547	0.534	< 0.001		Negative emotions (T1)	0.365	0.369	0.001
	High-level emotions (T1)	-0.096	-0.095	0.280		High-level emotions (T1)	-0.058	-0.062	0.539
Level 3	Constant	2.870		< 0.001	Level 3	Constant	3.487		< 0.001
$\Delta R^2 = 0.054$	Have religious beliefs	-0.164	-0.093	0.283	$\Delta R^2 = 0.113$	Have religious beliefs	0.030	0.018	0.856
$\Delta F = 5.412$	Experience the death of another	0.011	0.006	0.942	$\Delta F = 12.963$	Experience the death of another	0.013	0.007	0.938
$p < 0.001$	Self-perceived condition	-0.132	-0.097	0.273	$p = 0.001$	Self-perceived condition	-0.269	-0.229	0.026
	Gender	-0.144	-0.082	0.341		Gender	-0.045	-0.026	0.787
	Negative emotions (T1)	0.519	0.508	0.000		Negative emotions (T1)	0.347	0.351	< 0.001
	High-level emotions (T1)	0.025	0.024	0.806		High-level emotions (T1)	0.098	0.104	0.323
	High-level emotions (T2)	-0.271	-0.234	0.022		High-level emotions (T3)	-0.382	-0.390	0.001

Results

Descriptive statistics are shown in Table 2. In general, participants reported high values for high-level emotions, a middle level for excited emotions, and low values for negative emotions.

We conducted paired-sample *t*-tests to examine whether the three types of emotions changed with time, and results are shown in Table 2. Results showed that participants had fewer negative emotions after they participated in the ceremony (T1 vs. T2), and even fewer negative emotions at the end of the semester (T2 vs. T3). Participants had significantly more high-level emotions after they participated in the ceremony (T1 vs. T2), but no significant change at the end of the semester (T2 vs. T3). Participants had significantly more excited emotions after they participated in the ceremony (T1 vs. T2), and a marginally significant drop of their excited emotions at the end of the semester (T2 vs. T3). In short, after the ceremony, participants had fewer negative emotions, more high-level emotions, and more excited emotions. At the end of the semester, their negative emotions continued to drop, their high-level emotions remained high, and their excited emotions had rebounded and were back to the level before the ceremony.

Last, we conducted two hierarchy regression analyses to examine whether participants' high-level emotions at T2 and T3 would respectively predict their negative emotions at T2 and T3 when participants' high-level emotions and negative emotions at T1 were controlled for. Results are shown in Table 3.

In both analyses, at level 1, we controlled for confounding variables, including gender, having religious beliefs, self-perceived physical and mental conditions, and having had experienced the death of a family member or friend. At level 2, we controlled for participants' negative emotions and high-level emotions at T1. At level 3, we regressed participants' high-level emotions at T2 and T3 on their negative emotions at T2 and T3, respectively. Results showed that participants' high-level emotions at both T2 and T3 significantly and negatively predicted their negative emotions at T2 and T3. We provide some discussion of these results as follows.

Discussion

Although the literature on coping strategies, whether coming from educational interventions or from students' adoption during the course of a gross anatomy laboratory, crucial emotional reactions still remained under-elaborated, and related factors undifferentiated [8, 16, 17, 20, 22, 34]. We elaborated this problem with the ERTCS by distinguishing three different emotions—negative, high-level, and excited emotions—and then established a relationship between high-level emotions and negative emotions. High-level emotions represent an achievement of our educational intervention, and were the main effect of the initiation ceremony and family-member interviews, while negative emotions were a crucial and refined indicator of medical students' emotional reactions toward cadavers during the course. With the help of differentiation, we not only viewed high-level emotions as a predictive variable and negative emotions as a dependent variable by separating them from excited emotions, which could be a confounding factor, but also analytically considered both the diachronic relationship within high-level emotions or negative emotions and the synchronic relationship between the two types of emotion. Only when the relationship among different emotional reactions were elaborated could we researchers scrutinize the 'coping strategies' designed by educators. In other words, we found that the educational intervention, both the initiation ceremony and the family-member interview, could raise students' high-level emotions and decrease students' negative emotions.

Based on this primary finding, we demonstrated in advance the question of how students' high-level emotions can decrease their negative emotions after controlling demographic factors. Within the trends of high-level emotions continuing to rise and negative emotions continuing to drop from T1 to T2 and T3, the three-step hierarchical or sequential regression analysis showed three crucial points worthy of discussion.

First, external factors, represented by controlled variables such as gender, religion, experience of a death of another, and self-perceived conditions, had no significant effects on students' negative emotions at T2 and T3. Although our findings

did not exclusively reject previous research about different emotional reactions in terms of gender or religious factors, those external factors actually had no influences when the diachronic and synchronic relationships between different emotional reactions were considered. This basic finding enabled us to shift our focus from external factors to internal factors in advance.

Second, both models 1 and 2 in the hierarchical regression analysis showed that high-level emotions might have a synchronic impact on negative emotions. Results indicated an elaborate relationship between consistently rising high-level emotions and consistently dropping negative emotions. More important to us was the fact that the impact of high-level emotions on negative emotions became stronger ($b = -0.271$ in model 1; $b = -0.382$ in model 2), while the impact of previous negative emotions on negative emotions became weaker ($b = 0.591$ in model 1; $b = 0.347$ in model 2). This advanced finding supports our research argument: although there is much research on mitigating negative emotions and coping strategies, medical students' negative emotions will gradually decrease, which might be a foreseeable consequence of students' adaptation [5, 6, 12, 13, 21]; on the contrary, the often-neglected factor, actively and positively reducing students' negative emotions, should come from another rising factor which was the result of the educational intervention combined with students' perceptions. In our research finding, the consistently rising high-level emotions played a role as an active, positive factor, and filled the vacuum in research on students' negative emotions.

Third, educational interventions such as the initiation ceremony and family-member interviews might have two different mechanisms mitigating students' negative emotions. In a direct-influencing mechanism, we found that students' negative emotions were mitigated and decreased after the initiation ceremony and family-member interview. However, there might be another way, an indirect-influencing mechanism, of mitigation. In this study we elaborated that on the one hand, high-level emotions increased after the initiation ceremony and family-member interview, and high-level emotions also caused a mitigating impact on negative emotions. Only after we established relationships among the educational intervention, high-level emotions, and negative emotions was the indirect-influencing mechanism obviously revealed.

In summary, the present study demonstrated that (1) educational interventions, such as the initiation ceremony and family-member interview, can significantly increase high-level emotions and decrease negative emotions; (2) high-level emotions can significantly decrease negative emotions under a condition in which external factors are controlled. These two related findings indicate an interesting fact that after differentiating emotions into high-level, excited, and negative emotions, we found an internal way of mitigating medical students' negative emotions during a gross anatomy course. Trying to elaborate the internal causality between high-level emotions and negative emotions becomes a new issue worthy of noting, while past research usually focused on coping strategies, whether personal or institutional ones.

Furthermore, high-level emotions based on the ERTCS (see Table 1) echo the concept of gratitude, which had a buffering effect of decreasing negative emotions. We could extend this confirmative finding in advance. Our research finding that high-level emotions significantly mitigated negative emotions indicates a practical implication in medical education which has been trying to combine body dissection with medical humanities: directly deploying biographical information or the life story of a silent mentor rather than indirectly developing students' coping strategies. We believe that the implications of our study will both facilitate instructors' practice and improve students' learning effectiveness in gross anatomy courses. From comparisons between Taiwan and other countries, medical students in our research sample reflected a lower scope of negative emotions, which implies that there was seemingly no dramatic mitigation of all kinds of negative emotions as occurs in other researches' contexts.

Limitations of our research might come from methodological issues that we did not have a control group. All of our students participated in either the initiation ceremony or family-member interview. From viewpoint of experimental design, we should have experimental and control groups to examine the difference between groups theoretically. In our processes, however, students were encouraged to join in these activities, and they were actually pleased to participate in because of value and meaning. Statistics methods were used to compensate the shortcoming of no control group. We

suggest that researchers could take the opportunity to do the comparisons between Taiwan and other countries or do the randomized control studies in the future.

Conclusions

In general, we found that our intervention can increase students' high-level emotions and decrease students' negative emotions, and the former could predict the latter. It is helpful to combine dissection course with medical humanities for students to cope with their negative emotion during gross anatomy course.

Declarations

Ethics approval and consent to participate

The study received ethics approval from the Joint Institutional Review Board of Taipei Medical University (April 26, 2016, no. N201602066). The instructions of the questionnaires stated that the results would not influence participants' scores to avoid students' concerns about filling out the questionnaire, and the responses of participants remained confidential. Students volunteered to participate in the study, and informed consent was obtained from all participants.

Consent for publication

Not applicable

Availability of data and materials

The datasets generated and analyzed during the current study are not publicly available due to protection of the privacy of subjects, but are available from the corresponding author on reasonable request.

Competing interests

The authors declare they have no conflicts of interest.

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Authors' contributions

RJC and DYH conceived of the present idea. RJC acquired the data. PFT and DYH developed the theory, performed the computations, and verified the analytical methods. HYN analyzed the data. All authors discussed the results. All authors read and approved the final manuscript.

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