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ORIGINAL RESEARCH

A Study on the Current Status and Influencing Factors of "Hollow Syndrome" Among Medical University Students

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Background: The "hollow heart disease" phenomenon is on the rise today. We introduce a new concept, "hollow syndrome", and explore its multiple influencing factors as well as its relationship with mental resilience. This study aims to provide support to mental health for university population and to provide a reference for the intervention of hollow syndrome.

Methods: We used Hollow Syndrome Scale and Mental Resilience Scale to conduct cross-sectional study and data collection from 3,173 Chinese university students. After thorough reliability and validity test on the two scales, independent samples *t*-tests and one-way ANOVA were used to explore differences in hollow syndrome across demographic characteristics, and least significant difference was performed after stratification for grade level. Pearson correlation analyses were used to find correlations between mental resilience and hollow syndrome. Finally, we used multiple linear regression to explore its risk and protective factors..

Results: Medical major (P=0.011, *Cohen's d*=0194), grade, overweight, major satisfaction, experience of being left-behind before 18, participant's disease status, paternal disease status (*Cohen's d*=0.207), maternal disease status differed significantly on total Hollow Syndrome Scale score (all P<0.001). Grade (β=0.042, P=0.019), major satisfaction (β=0.122, P<0.001,*Cohen's d*=−0.582) were positively correlated with total score; overweight (β=−0.064, P<0.001,*Cohen's d*=0.179), experience of being left-behind before 18 (β=−0.065, P<0.001,*Cohen's d*=0.249), participant's disease status (β=−0.068, P<0.001,*Cohen's d*=0.282), maternal disease status (β=−0.053, P=0.007,*Cohen's d*=0.151) were negatively correlated with total score. There was a significant difference in total scores in second and graduated year compared to the first-year students (P<0.001). Overall, the first and the third year had lower Hollow Syndrome Scale score. This suggests that students in both grades are more likely to develop hollow syndrome.

Conclusion: The psychological problems of medical students need to be taken seriously. Attention should be focused on the first and third year medical university students.

Keywords: hollow syndrome, mental resilience, values deficiency, prevalence survey, least significant difference

Introduction

The term "hollow" is not the first time appeared in public. As early as 2016, Professor Kaiwen Xu of Peking University Psychological Centre proposed the concept of "Hollow heart disease (HHD)" in a forum speech entitled *Hollow heart disease of the times and the economics of anxiety —a kind of psychological disorder* caused by values deficiency, which is manifested in a strong sense of loneliness, a low sense of well-being and acquisition.[1] He believes that the core issue of HHD can be simply described as the absence of a value system that supports a sense of meaning and existence, in other words, not knowing who one is, why one lives, and not understanding what one's existence, value, and meaning are.[2] The

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more exactly clinical manifestations of HHD are low mood and reduced interest, feeling no life meaning and motivation, poor socialisation and loneliness,[3] from a symptomatic perspective, these characteristics are similar to those of depression, which manifested as low mood, loss of interest, and lack of pleasure. Even though these performances are similar to the main clinical features of quarter-life crisis, the age distribution they are aimed at is different. The latter is common in people aged 20–29, who have moved from a comfortable life to real life, leading to confused career directionanger, stress, incompetence and other emotions.[4]

However, the main difference is that traditional antipsychotic medications are ineffective in treating hollow syndrome.[5] In recent years, many scholars have conducted empirical studies on HHD among university students, and some studies have classified the pathological characteristics of it in detail and verified its rationality.[6] In addition, from the perspective of education, some scholars believe that HHD is caused by factors such as traditional test-based education and lack of educational philosophy.[7] However, according to the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5) and the International Classification of Diseases, 11th Revision (ICD-11), mental health is no longer limited to the description of a single disease, but more inclined to the concept of the spectrum of disease, and the significance and advantages of the concept of "syndromes" are thus further demonstrated.[8,9] Although there is no lack of research on HHD in China, most of the research only focuses on the concept of HHD as a single disease, the explanation of the "hollow heart phenomenon" and the evidence of the factors affecting it is still insufficient, and at the same time, there are still limitations in the coverage of research subjects and the amount of data collected, and this is incompatible with the concept of multidimensional and comprehensive mental health education. Therefore, explaining the "hollow heart phenomenon" as a "syndrome" and exploring it more comprehensively is a good supplement to the current situation of contemporary university students' mental health.

Mental resilience (MR), a personal characteristic that enables positive adaptation in the face of adversity, is closely related to self-resilience and attitude towards coping with problems,[10] and plays an important role in individual's happiness experience.[11,12] Positive mental health factors (eg, emotional state) and better physiological behaviours can increase psychological resilience.[13,14] Individuals who lack psychological resilience are more susceptible to negative perceptions and the external environment and are more likely to be internalised by negative emotions and reinforced by negative perceptions. It can be manifested as diminished personal needs, loss of interest and motivation, boredom, excessive self-blame for failures, over-underestimation of one's own abilities, and decreased social support and quality of life.[15–18]

The late adolescence and early adulthood stage in which college students live is a critical period for the formation and development of values in their life histories. The components of psychological resilience include personality and adaptability,[19] but for freshmen, the first thing they have to face is the role change, this period of time university students are in the transition of psychological maturity, the perfection of the value system, and the whole college period is affected by the academic requirements, self-time management, financial pressures, career choices, and other factors, therefore, the university students are more likely to suffer from mental and physical ill-health due to multiple stresses and negative influences,[20,21] especially for medical students, because they have a long learning period and strict professional skills, they are more likely to develop serious mental illness[22.] Student burnout is more common during the academic period, and medical students during this period often experience emotional exhaustion, reduced learning effectiveness, and psychological alienation caused by long-term academic pressure.[23] Similarly, in view of the manifestations of the HHD, some studies have summarised the reasons for the formation of the HHD in the university student population as follows: physical and mental stress imbalance after the university entrance examination; the gap between ideals and reality is too big after entering the university; the family expects too much of the children; social pressure; and the wrong value guidance of "judge a person's success or failure on the basis of his achievements".[24]

For medical students, they are experiencing more and more psychological problems due to strict study schedules, high expectations, and heavy academic pressure, they exhibit more negative psychological symptoms than other average university students.[25] Because HHD is a pathology, but "hollow syndrome" is not. People with hollow syndrome can still participate in social activities. Therefore, we introduced the new concept of "hollow syndrome (HS)" to conduct a questionnaire survey and analyze the current situation to gain an in-depth understanding of the current situation of HS among medical students. In order to comprehensively and accurately grasp the current situation of HS and MR

among medical students, this study used the Hollow Syndrome Scale and Mental Resilience Questionnaire to carry out research to deeply analyse the impact of HS on the overall status of the mental health among medical college students and its influencing factors, and on the basis of which, we proposed the path of improvement and interventions for college students, so as to provide references for the prevention of the psychological status of HS among medical university students.

Materials and Methods

Participants

This study used the convenience sampling method to select undergraduate students from an medical university in Shandong Province. The survey was conducted from September 2024 to January 2025, including 3173 participants totally: freshmen (1,788), second-year university student (516), third-year university student (718), and graduating year (including the fourth year of four-year university and the fifth year of five-year university) (21) students. Among them, there were 2972 students from Jining Medical University and 201 students from outside schools. All participants were ensured to complete the questionnaire independently. After collecting the questionnaires, 130 invalid questionnaires were excluded, and finally 3043 valid questionnaires were obtained, the effective rate is 95.9%. The order of questions, option settings of the paper and electronic questionnaires were kept consistent to minimize bias. All participants signed an informed consent form and were informed of the purpose of the study, data confidentiality and the principle of voluntary participation. The study was approved by the Ethics Committee of Jining Medical University (approval number: JNMC-YX-2025-052).

Data Collection

In the early stage of this study, we used a combination of online and offline questionnaires. All participants in our school were distributed paper questionnaires offline and collected them on the spot, while the external schools used Questionnaire Star to answer the questions online. And we have ensured the consistency of the online and offline questionnaires. In the later stage, we used Epidata 3.1 software and double-checked to enter all the data from the paper version of the questionnaire into the system and then exported it to an Excel spreadsheet. Logical checks were carried out to ensure the data accuracy.

Measures

Basic Demographic Information Questionnaire

Social demographic information including gender, age, height, weight, major satisfaction, whether the participant is from one-child family, annual family's annual income, experience of being left-behind before the age of 18 (if yes, the participant was required to answer the question about the earliest age of being left-behind, the primary caretaker during the period of being left-behind, the duration of time that the family member was out of the house, and the means and frequency to contact with the family member during the period of being left-behind), and the structure of the family (eg, nuclear, restructured, or single-parent family, etc.), participant's disease status, paternal disease status and maternal disease status [disease status was determined based on self-reported presence of one or more conditions across 14 predefined organ/system categories (eg, cardiovascular, respiratory, neurological, etc). If a participant selects any disease option, this question will be marked as "affected"; otherwise, it will be marked as "unaffected" [0=unaffected, 1=affected], whether he/she has any goals during his/her university studies (to graduate without failing a class, to run for class committee or school organization, to obtain a scholarship, etc.), and whether he/she has any direction after graduation (eg, to get a job, to take a public examination, to go to a graduate school), and so on.

Hollow Syndrome Scale

The Questionnaire on the Phenomenon of Hollow Disease in College Students compiled by Yuxi Jin[26] was used. This questionnaire covers the opinions of Prof. Kevin Xu and other scholars on the phenomenon and manifestation of HHD. The second part of the original scale has a total of 33 questions, including 6 dimensions: sense of meaning in life (5 questions), loneliness (4 questions), depression (7 questions), interpersonal communication (4 questions), self-evaluation

(10 questions), and suicide (3 questions). Among them, 5, 6, 7, 10, 1, 13, 14, 17, and 22 are reverse scoring questions. A rigorous exploratory factor analysis was conducted on the original scale to verify its reliability and validity, and the items that did not meet the statistical criteria were deleted, and finally a total of 9 items were deleted (each item deleted needed to be re-conducted with exploratory factor analysis), of which 7 items (4, 7, 11, 13, 15, 23, 27) were deleted in the second part to obtain the formal questionnaire. We selected the second part of the formal questionnaire (26 questions) as our "hollow syndrome scale" for questionnaires. Using SPSS26.0 system, reverse scoring questions (5, 6, 10, 12, 14, 17, 22 questions) were set up in the software system, respectively, for reverse scoring and then calculated the total score of the scale. The questionnaire was scored on a five-point scale (1=not at all, 5=fully). The lower the total score of the questionnaire, the more manifestations of the HS and the more serious the "hollow heart phenomenon" of the subjects, the one is more likely to have HS. We also provided the original questionnaire and the formal questionnaire of the scale used, see Supplementary Material Table S1 and Table S2, respectively.

Mental Resilience Scale

We used the short version of the Psychological Resilience Scale (10-item Connor-Davidson resilience scale, CD-RISC -10), which was simplified by Campbell-Shills et al[27] for the CD-RISC (25-item scale), and the Chinese version was revised by Zhang-Danmei et al.[28] This scale consists of 10 items and is scored on a 4-point Likert scale (1=not at all, 4=fully). The total score of the scale is the direct sum of the scores of each question. The higher the total score, the stronger the mental resilience.

Statistical Analysis

Data analysis were done by SPSS 26.0. Qualitative data in demographics is described by frequency counts and percentages, while quantitative information is described by "mean ± standard deviation". The scales used in this study were assessed for internal consistency by Cronbach's alpha coefficient and exploratory factor analysis (EFA) was used to verify structural validity (KMO values, Bachlit's test of sphericity). We further used SPSS Amos 28.0 to calculate the confirmatory factor analysis (CFA) model fit indices [two indicators: Comparative Fit Index (CFI) and Root Mean Square Error of Approximation (RMSEA)] of the Hollow Syndrome Scale.[29] We used independent samples t-tests and one-way analysis of variance (ANOVA) to explore differences in HS across demographic characteristics. Post hoc multiple comparisons were performed after stratification of grades. We used Pearson's correlation analysis to analyse the correlation between MR and HS. After identifying confounders, the influences of HS were further analyzed by multivariate linear regression. $P<0.05$ indicates statistical significance.

Results

Reliability Test and Validity Test

Table 1 demonstrates the results of the reliability test of the two scales. We further conducted a reliability test on the Hollow Syndrome Scale, and the results indicated that the overall scale's Cronbach's α was 0.710, which is acceptable after the deletion of certain items (such as items 5, 6, 9, 11, 12, and 13), the α coefficient slightly increased to between 0.71 and 0.73; however, these items hold significant theoretical importance and have thus been retained. We provide detailed data on the reliability test of the Hollow Syndrome Scale, see Supplementary Material Table S3. The Cronbach's alpha coefficient of the Mental Resilience Scale was 0.90, indicating that the internal consistency of the two meets the

Table 1 Reliability Test and Validity Test of Scale

Scale	Cronbach 's α Ratio	KMO	Bartlett Spherical Inspection	
			Df	P value
Hollow Syndrome Scale	0.70	0.92	325	<0.001
Mental Resilience Scale	0.90	0.94	45	<0.001

Abbreviations: KMO value, Kaiser-Meyer-Olkin value; Df, Degrees of Freedom.

statistical requirements ($P<0.05$). In terms of validity, the KMO value of the Hollow Syndrome Scale was 0.92 ($P<0.05$); the results of confirmatory factor analysis model fit indices: $\chi^2/df=11.5$, CFI=0.900, RMSEA=0.059, indicating excellent fit. The KMO value of the Mental Resilience Scale was 0.94 ($P<0.05$), and the factor loadings of each scale were all >0.6, indicating that the two had good structural validity, and they were able to effectively reflect the characteristics of the participants' HS and MR of the present study. The reliability and validity test results of the hollow syndrome scale and the fit indices of the confirmatory factor analysis model are shown in Supplementary Material Table S4.

Participants' Demographic Information

Data were analyzed from 3043 respondents. Of these, 1385 (45.5%) were male and 1648 (54.2%) were female; 2861 (94.0%) were majored in medicine and 182 (6.0%) in non-medicine. 498 (16.4%) had left-behind experience before the age of 18 and 2545 (83.6%) had no left-behind experience. We used independent sample t-tests and one-way ANOVA to assess differences in Hollow Syndrome Scale scores among individuals with different demographic characteristics. The analysis revealed that the following variables were statistically significant associated with the total Hollow Syndrome Score: medical major ($P= 0.011$), grade level, overweight, major satisfaction, left-behind experience before the age of 18, participant illness, illness of participant's father, and illness of participant's mother (*all* $P< 0.001$). Table 2 demonstrates the detailed demographic characteristics of the study participants and the results of the analysis of variance.

Table 2 Descriptive Statistics and Comparative Analysis of Participants' Demographic Characters

Variables		N(%)	[Hollow Syndrome Scale Score,($\bar{x} \pm s$)]	t/F	Cohen's d/P [95% CI]
Sex				2.684	0.014/0.702[−0.45, 0.66]
	Male	1385(45.5%)	84.56±7.98		
	Female	1648(54.2%)	84.45±7.61		
Whether you are majored in Medical major?				0.316	0.194/0.011[0.35, 2.68]
	Yes	2861(94.0%)	84.40±7.74		
	No	182(6.0%)	85.91±8.21		
Grade level				11.763	—/ <0.001[84.21, 84.76]
	First-year	1788(58.8%)	84.00±7.65		
	Second-year	516(17.0%)	86.18±8.09		
	Third-year	718(23.6%)	84.39±7.65		
	Graduating-year (Forth-year+Fifth-year)	21(0.7%)	87.62±8.35		
Reah adulthood				1.078	−0.138/0.146[0.67, 2.11]
	Yes	2926(96.2%)	84.53±7.76		
	No	117(3.8%)	83.46±8.15		
Are you overweight?				0.136	0.179/<0.001[0.15, 0.83]
	Yes	550 (18.1%)	83.35±7.75		
	No	2493 (81.9%)	84.74±7.76		
Major satisfaction				0.864	−0.582/<0.001[−5.65, −3.32]
	Yes	2864(94.1%)	84.75±7.67		
	No	179(5.9%)	80.27±8.26		−0.045/0.260[−0.97, 0.26]
One-child family				1.599	
	Yes	843(27.7%)	84.74±7.96		
	No	2200(72.3%)	84.39±7.70		0.249/<0.001[1.19, 2.68]
Experience of being left-behind before the age of 18.				1.885	
	Yes	498(16.4%)	82.87±7.52		
	No	2545(83.6%)	84.80±7.79		0.282/<0.001[1.45, 2.90]
Participant's disease status				3.035	
	Yes	536(17.6%)	82.69±8.25		
	No	2507(82.4%)	84.87±7.62		0.207/<0.001[0.58, 1.75]
Paternal disease status				0.284	
	Yes	1001(32.9%)	83.70±7.71		
	No	2042(67.1%)	84.87±7.78		0.151/<0.001[0.96, 2.25]

(*Continued*)

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Table 2 (Continued).

Variables		N(%)	[Hollow Syndrome Scale Score,($\bar{x} \pm s$)]	t/F	Cohen's d/P [95% CI]
Maternal disease status				0.026	
	Yes	734(24.1%)	83.27±7.79		
	No	2309(75.9%)	84.87±7.73		
Have goals during university				−0.642	−0.089/0.522[−2.81, 1.44]
	Yes	2948(96.9%)	84.51±7.68		
	No	95(3.1%)	83.82±10.33		
Have a direction after graduation				3.348	−0.112/0.414[−2.97,1.22]
	Yes	2989(98.2%)	84.50±7.75		
	No	54(1.8%)	83.63±9.21		

Note: All reverse scoring questions have been re-scored.

Results of Least Significant Difference for Grade Levels

For the variables that were statistically significant in the analysis of variance, we further conducted post hoc multiple comparisons of one-way ANOVA using the Least Significant Difference (LSD) method on the grade-level stratification to explore whether different grades affect the HS. The results found that there was a significant difference (P<0.001) between grades on the total Hollow Syndrome Scale score, as evidenced by the fact that the second and the graduating grades both scored higher than the first grade, and that the second grade scored higher than the third grade. In the overall trend, the total scores of the Hollow Syndrome Scale in the first year and the third year were low, reflecting that the phenomenon of hollow syndrome was more serious among college students in these two grades. Attention needs to be paid to the mental health status of college students in these two grades. Table 3 shows the LSD post hoc multiple comparison results of the grades.

Results of Correlation Analysis of Dimension Variable

Table 4 shows the results of the Pearson correlation analysis between the Hollow Syndrome Scale and the Mental Resilience Scale: HS and MR were significantly, moderately, positively correlated (r=0.504, P<0.001).

Analysis of Influencing Factors

After controlling for the three confounding factors (the variables represented by meaningless P-values in the basic demographic information were removed, including sex, reah adulthood, one-child family, have goals during university, have a direction after graduation), the remaining factors were incorporated using multivariate linear regression to analyse

Table 3 Results of LSD Post Hoc Multiple Comparisons for Grade Levels

(I) Compared Grade	(J) Comparison Grade	Mean Difference (I-J)	$\bar{x} \pm s$	P(95% CI)
First-year	Second-year	−2.177*	84.00±7.65	<0.001[−2.93,-1.42]
	Third-year	−0.393		0.25[−1.06,0.28]
	Final-year	−3.620*		0.033[−6.95,-0.29]
Second-year	First-year	2.177*	86.18±8.09	<0.001[1.42,2.93]
	Third-year	1.784*		<0.001[0.91,2.66]
	Final-year	−1.443		0.402[−4.82,1.93]
Third-year	First-year	0.393	84.39±7.65	0.25[−0.28,1.06]
	Second-year	−1.784*		<0.001[−2.66,-0.91]
	Final-year	−3.226		0.06[−6.58,0.13]
Final-year	First-year	3.620*	87.62±8.35	0.033[0.29,6.95]
	Second-year	1.443		0.402[−1.93,4.82]
	Third-year	3.226		0.06[−0.13,6.58]

Note: *P<0.05.

Table 4 Correlation Analysis of Scale

	Mental Resilience Scale	
	Pearson	P
Hollow Syndrome Scale	0.504**	<0.001

Note: **P<0.001.

Table 5 Correlation Analysis Between Demographic Variables and the Hollow Syndrome Scale

Implicit Variable	Standardized Coefficient	P	VIF	Adjusted R^2
	β			
Whether you are majored in Medical major?	−0.033	0.061	1.007	0.041
Grade level	0.042	0.019	1.008	
Are you overweight?	−0.064	<0.001	1.005	
Major satisfaction	0.122	<0.001	1.015	
Are you be left-behind before 18?	−0.065	<0.001	1.032	
Participant's disease status	−0.068	<0.001	1.091	
Paternal disease status	−0.024	0.211	1.207	
Maternal disease status	−0.053	0.007	1.206	

Note: Independent variable: Hollow Syndrome Scale.
Abbreviation: VIF, Variance Inflation Factor.

the relationship between the meaningful variables and the total score of the Hollow Syndrome Scale. The results showed that grade levels (β=0.042, P=0.019) and major satisfaction (β=0.122, P<0.001,*Cohen's d*=−0.582) were significantly and positively correlated with the total Hollow Syndrome Scale score, while overweight (β=−0.064, P<0.001,*Cohen's d*=0.179), experience of being left-behind before the age of 18 (β=−0.065, P<0.001,*Cohen's d*=0.249), participant's disease status (β=−0.068, P<0.001,*Cohen's d*=0.282), and maternal disease status (β=−0.053, P=0.007,*Cohen's d*=0.151) were significantly, negatively correlated with the total Hollow Syndrome Scale score. Table 5 expresses the results of the correlation analysis between demographic variables and Hollow Syndrome Scale after controlling for confounders. In terms of the strength of the effect with the total score of the Hollow Syndrome Scale, we concluded that the three factors of major satisfaction, experience of being left-behind before the age of 18, and maternal disease status showed a moderate effect on the total score of the Hollow Syndrome Scale, and the effect size of major satisfaction was the highest. The two factors of medical major and overweight had a low effect on the total score of the Hollow Syndrome Scale.

Discussion

The study introduces the new concept of "hollow syndrome", and through a survey and analysis of 3,173 university students, we discovered the complex manifestations of HS and its influencing factors in the university student population.

Original family happiness acquisition is intricately related to the HS. Factors such as interpersonal relationships and family of origin can work with HS through individual happiness experiences.[30] A social research study found that the silent family culture, inactive or lack of parental listening, and insecure parent–child relationships can positively predict the prevalence of adverse events in adolescents' lives.[31] At the same time, the absence of parenting roles in childhood can have a negative impact on the subsequent growth of individuals,[32] especially for the special group: the left-behind children. They may suffer from physical and psychological "double hollow syndrome" due to the lack of security and parent–child communication.[33] In addition, education is an expression of the sense of original family happiness acquisition, and some university students may form a bad psychological state of selfishness, indifference, and jealousy due to the difference in educational background,[33,34] then leading to HS.

The psychological problems of medical students need to be paid extra attention. Factors such as weight, major, major satisfaction, and interpersonal relationships are associated with individual perceptions and can significantly influence the manifestation of the HS in college students. Positive self-perceptions are necessary for the prevention of the HS, and they can prevent the occurrence of the individual's HS by establishing effective self-awareness.[35] Among these factors, weight, major and professional satisfaction, and interpersonal relationships can lead to HS through negativity such as anxiety and depression. Students are susceptible to appearance anxiety, and the more excessive the focus on external appearance such as weight, the higher risk of negative emotions such as anxiety and depression, and the more likely it is to affect interpersonal interactions.[36] Medical students with high professional satisfaction can improve their personal satisfaction and sense of accomplishment by improving their enthusiasm in the classroom and communicating with teachers, reducing learning slackness, and avoiding the occurrence of anxiety and depression.[37,38] At the same time, poor interpersonal relationships can further lead to negative emotions such as anger, anxiety, and depression in the medical college population, and can significantly and positively predict the incidence of depression in college students.[39–41] Several studies have shown that discordant teacher–student relationships may also cause students to develop negative emotions such as learning anxiety and social anxiety,[42] leading to individual mood disorders and triggering the HS.[43]

The grade levels, this factor was likewise significantly related to the HS. In our study, we found that the total Hollow Syndrome Scale score was significantly lower in first-year and third-year medical students compared with second-year students, suggesting that the manifestation of "hollow phenomenon" was more noticeable in these two grades. A questionnaire survey on the mental health of freshman showed that school adjustment and psychological resilience of freshmen were significantly, positively correlated, and they were mediated by parental emotion in the original family; some of the freshmen were unable to adjust their new study, life and social lifestyles in a timely manner after entering the university, leading to the emergence of the hollow syndrome through the generation of negative emotions such as loneliness, depression, low self-esteem, anxiety, and social intimidation.[44] Second-year students experience significantly more positive life events than students in other grades,[45] and college students in this grade have higher mental resilience and post-stress growth than first-year students.[46] Second-year students improved their mental resilience and environmental adaptability based on their first-year experiences. Third-year university students, on the other hand, have psychosomatic problems such as paranoia, compulsion, depression, anxiety, and other psychosomatic problems due to the increase in multiple pressures such as uncertainty about the direction of further education and finances.[47] Therefore, they need to be focused on.[48] In addition, our study found that the total score of the Hollow Syndrome Scale in the graduation year was significantly higher than that of the first year, and also showed an increasing trend compared with other grades, indicating that the manifestation and severity of the HS in the graduation year was lower than that in other grades. This may be related to the increased self-control and emotion management ability of college students. A random sample study found that senior students have more learning and practical experience than junior students, may have higher concentration and better solutions when dealing with problems, are able to focus on their feelings more comprehensively, and are better able to deal with stress,[49] such students may be slightly less at risk of facing quarter-life crisis after graduation. Although in our findings, there was no statistically significant difference between the graduating grade and the second and third grades in the total Hollow Syndrome Scale score, we speculate that this is associate with the small number of visitors in the graduating grades and the lower statistical efficiency.

The relationship between MR and HS has received extensive attention from researchers. MR can reflect one's coping skillsis, and these two are the core elements for individuals in the process of adversity and growth.[50] People with low psychological resilience and poor coping ability are more easily to suffer from psychological maladies, which in turn leads to the emergence of the HS. A large amount of domestic and international data survey research shows that the growth of adolescents is closely linked to the sense of belonging to school, and the HS population is related to the lack of a sense of belonging to school and poorer psychological resilience.[51,52] The formalization and utilitarianism of traditional education can make students lacking a sense of belonging and cause HS.[3] At the same time, some studies have claimed that MR can also be mediated by negative interpersonal relationships, and the worse interpersonal relationships, the lower personal mood, the worse MR, and the higher generation of negative mental health indicators,[53] and the vulnerability to HS are thus increased. Meanwhile, MR of college students can directly predict the degree of interpersonal harmony and can indirectly predict interpersonal relationships through positive coping styles.[54] Whereas

intervention trials indicated that attention and interpretive therapy, cognitive interventions, and positive psychological interventions had significant efficacy on HS, and these three interventions were the most effective interventions to increase MR,[55] this further elucidated the strong association between MR and HS. However, during actual work, for the special group of medical students, some of them may experience an improvement in MR due to factors such as the reduced burnout, the long duration of undergraduate studies and their aspiration for the nature of the profession.

Limitations

Compared with the discovered results, this study still has the following deficiencies: 1. As the sample only comes from a single medical college, although this study conducted a large-scale questionnaire in higher education institutions, the generalization of the results should be undertaken with caution, and it is recommended that future studies adopt multicenter probabilistic sampling. 2. Although our questionnaire was double-checked and logically tested for data quality control, its assessment format used in this study may not completely eliminate the slackness of participants in answering the questions. We will further optimize the questionnaire format and evaluation time to obtain more realistic data and to improve respondents' compliance. 3. This study was a cross-sectional study; thus, the supporting evidence of causation is still inadequate. A longitudinal follow-up cohort is needed to further explore the multiple factors contributing to the hollow syndrome.

Conclusion

This study investigated the multiple influences on medical university students' HS and the relationship with MR. We concluded the following findings: medical students' personal growth experience affects the total Hollow Syndrome Scale score; grade levels influences the population distribution and manifestation of HS; and MR is related to the total Hollow Syndrome Scale score. HS is an emerging concept, and its use to describe the "hollow phenomenon", which is mainly manifested by the lack of a sense of value, can better explore and explain the current situation of contemporary mental health problems. The findings of this study provide a new empirical basis for understanding the psychological adjustment dilemma of contemporary medical students and are of great value in guiding the development of targeted intervention strategies. Subsequent studies can further deepen the sample representation and mechanism exploration. The mental health issues of medical students need to be given special attention. At the same time, focus on incorporating mental resilience training into the necessary aspects of mental health protection, establishing a major identity cultivation system, and carrying out a family functioning restoration programme for high-risk groups.

Abbreviations

MR, mental resilience; HS, hollow syndrome; HHD, hollow heart disease; VIF, Variance Inflation Factor; EFA, exploratory factor analysis; CFI, Comparative Fit Index; RMSEA, Root Mean Square Error of Approximation; ANOVA, one-way analysis of variance; KMO value, Kaiser–Meyer–Olkin value; Df, Degrees of Freedom; LSD, the Least Significant Difference; 95% CI, 95% confidence interval.

Ethics Approval and Consent to Participate

Informed consent was obtained from each participant prior to data collection. The Research Ethics Committee of Jining Medical University approved this study. The procedures used in this study adhere to the tenets of the Declaration of Helsinki.

Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

Disclosure

The authors declare no conflicts of interest in this work.

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