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Analysis of risk factors faced by Chinese international students based on fuzzy comprehensive evaluation model

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Introduction: China has contributed the most international students to the global higher-education sector for over a decade. Existing research has indicated various risk factors faced by international students. However, few studies have examined the risks experienced by Chinese international students. Two research questions were investigated in this study: (1) Which risk factor has the greatest impact on Chinese international students when studying abroad? and (2) Which risk factor is most frequently experienced by Chinese international students when studying abroad?

Method: To address these questions, this study proposes a fuzzy comprehensive evaluation model for evaluating the risk factors faced by Chinese international students. The model comprises six second-level factors and 22 third-level indicators, which was empirically examined by data collected through 556 questionnaires. The analytical hierarchy process and factor analysis were employed to calculate the index weight of second-level factors and third-level indicators.

Results: The results reveal that the risk factor, psychological discrepancy, has the greatest impact and is most likely to be experienced by Chinese international students. The paper provides an integrated research perspective to study the risk of international students.

Discussion: The paper discussed the factors that impact the risk faced by Chinese international students. The risk faced by Chinese international students was found to be high. Psychological discrepancy, academic choice, and cross-cultural adaptation were the three risk factors that were most likely to be experienced by Chinese international students. Psychological discrepancy, barriers to study, and unforeseen incidents had the highest impact on total risk. Therefore, attention should be paid to these risk factors to avoid the occurrence of risk and its negative impacts.

KEYWORDS

risks faced by Chinese international students, influence factor, evaluation model, impact grade, analytic hierarchy process, fuzzy comprehensive evaluation

1 Introduction

When studying abroad, students experience a range of difficulties, such as large cultural differences (Lacko et al., 2020), adapting to new social and living environments (Iskhakova et al., 2022), and feelings of uncertainty about whether they will complete their degree program (Williams et al., 2018). Thus, international students often face more challenges than those studying domestically. Since the year 2000, the number of Chinese

students moving abroad for university-level education has increased steadily. In 2019, China was the world's largest source of international students for the 12th consecutive year, with over 7 million students overseas (Ministry of Education of the People's Republic of China, 2020). In 2022, after the COVID-19 pandemic, that number is now approximately 6.6 million (Golden Arrow, 2023). As an important section of China's population, the Chinese government is concerned about the safety and well-being of Chinese international students (Bound et al., 2021). Such risks have therefore become a topic of academic interest. Conducting research on assessing the risk of Chinese students studying abroad has become increasingly critical.

Previous research has analyzed risk types and their impacts—for individual risks as well as multiple risks—on international students from several perspectives (Titrek et al., 2016). However, few studies have considered the risk of Chinese international students as a whole, nor have discovered which factor impacts more than others to the risk of Chinese international students, nor to detect which risk factor is more likely to trigger the risk to Chinese international students. To address this research gap, this paper examines the risks Chinese international students face when studying abroad using a fuzzy comprehensive evaluation (FCE) model combined with the analytic hierarchy process (AHP), principal component analysis (PCA), and factor analysis (FA). Furthermore, there is a lack of reliable model to analyze and evaluate the risks of studying abroad. Consequently, it is essential to identify and evaluate the risk factors inherent in studying abroad and to form up a dependable evaluation index system so as to build up an assessment model for such risks.

The study was based on 556 questionnaire responses from Chinese citizens who studied abroad. The responses included experiences from 22 different host countries. This study adds to the existing body of knowledge by investigating which individual risk factor is the most likely to affect Chinese international students and which has the greatest impact on them when studying abroad. Differ from previous studies, this paper provides an integrated perspective to study various risks faced by Chinese international students and attempts to build up an evaluation model as well as a set of risk factor index system to assess the risks of studying abroad. The proposed model and index system can be used to evaluate the risks to international students when living in other countries. International students face an unfamiliar educational and socio-cultural system which are changes compared to which they previously experienced at home, though the degree of change may differ due to individual differences. Risk is unknown, thus may cause resistance to change due to the fear of unknown. This paper offers an insight of risks of studying abroad for international students to reduce the unknown fear and eliminate the resistance to post changes.

The COVID-19 pandemic epidemic negatively impacted the global economy, but increasing the number of international students, especially Chinese international students, can increase host countries' income. However, because Chinese students are now looking at a wider range of possible study destinations, the historically common countries chosen for higher education have been forced to pay more attention to Chinese students. Such countries must consider how to better attract Chinese students to their institutions for higher education. Therefore, the study of Chinese international students is currently not only an international, cross-disciplinary field of study, it also incorporates cross-cultural, economic, and social sustainability factors.

2 Literature review

The term risk denotes uncertainty regarding a specific activity or plan. It also refers to the probability of an undesirable occurrence happening to a person or group of people during a certain event (Aven, 2023a, 2023b; Ylönen and Aven, 2023). In this study, risks to Chinese international students refers to the level of uncertainty experienced throughout the duration of international study, as well as the probability that a negative event will be experienced when studying abroad.

The large and sustained trend of Chinese students studying around the world has attracted a wide range of studies that incorporate various points of view. Scholars have investigated the types of risk therein, and analyzed the risk factors and their influence on international students. Such studies provide an overview of risks international students are exposed to, which are incorporated into the current study to establish theoretical models and analyze how they impact Chinese international students.

From the perspective of perceived risk, Ge (2021) described several risk factors that Chinese international students face, including academic barriers, mental issues, health threats, and racial prejudices. Lam et al. (2017) proposed seven types of risk for international students, namely, financial risk, opportunity costs, family or socio-cultural risk, legal administrative risk, academic or course risk, psychological risk, and physical risk. However, Lam et al. (2017) believed that the influence of risk perception is not equal among international students. Specifically with regards to Chinese international students, their friends and family have a large influence on their decision to study abroad. Besides, students and their parents expect improved employment prospects from international education and the experience of studying abroad (Wang and Singer, 2021).

From the perspective of motivation, Roga et al. (2015) found that highly ranked factors that influence foreign students' choice of country and educational institution included academic quality and reputation, international students and staff, and living cost. Mehar Singh (2016) believed that socio-economic, environmental, and personal factors impact international student's choice of host country and higher education institution. Singh (2016) stated that Chinese students value "environmental cues and educational facilities" and "opportunities after the (abroad) study." Because high-quality environments and facilities are connected with higher tuition fees (Nguyen et al., 2021), education from such institutions requires high economic contributions, which increases a student's expenditure during their time studying abroad (Dezhina and Nafikova, 2019). Although Chinese students expect increased career opportunities as a result of studying abroad, there is always an element of uncertainty, in which there is a risk of undesired or unexpected outcomes.

From a behavioral perspective, Heng and San Juan (2023) built on previous studies and examined three dimensions that affect Chinese international students; communication problems due to language and cultural differences (Campos et al., 2021; Sung, 2020), self-care ability, and psychological internal adjustment, which is related to culture adaptation and re-adaptation (Sezer et al., 2021; English and Chi, 2020; Park, 2019). In another study, Fass-Holmes (2018) reported academic integrity violations as one form of risk that Chinese students face due to differences in culture, language, academic standards, and teaching methods. In addition, Fass-Holmes (2018) also described risk due to stress from migration regulations. Dorado and Fass-Holmes (2016) found low proficiency of English (Campos et al., 2021), heavy

workload, passive and dependent learning style, unclear information about support services beyond teaching courses, and teacher-centric academic culture (Park and Choi, 2022; Choi, 2021) to be the key risk factors that international students face.

From the adaptation perspective, Koo et al. (2021) found that cross-cultural adaptation negatively impacts international students. Rathakrishnan et al. (2021) found that international students' daily lives, as well as the processes of social and cultural adaptation, are considerable sources of stress. Alasmari (2023) listed several items that affect international students, including adaptation, language barriers, culture shock, and psychological episodes (e.g., depression, nostalgia, stress, loneliness, and homesickness). Gebru and Yuksel-Kaptanoglu (2020) found socio-cultural, language, and academic barriers challenge international students' adaptation of social norms, impacting their personal life. Failure to overcome such challenges results in students abandoning their studies and returning to their home country (Bulic, 2015; Titrek et al., 2016). Huang and Mussap (2018) found that prolonged acculturative stress has negative psychological consequences on international students from Asia, including perceived discrimination; language difficulties; homesickness and lack of support networks, which can cause feelings of loneliness (Sezer et al., 2021) and anxiety (Hari et al., 2023); financial/work difficulties; and fear, guilt, and stress due to difficult social experiences (Wang and Singer, 2021). Studying abroad means a change of educational and socio-cultural environment. Adapting to this change is a necessary process that international students have to experience at the beginning of their life abroad. However, both the process and the factors related to it are not certain. Therefore, the adaptation process itself is a risk factor contributing to uncertainty. Even after adaptation, international students face additional risks such as academic pressure, and health and safety issues.

Previous studies have analyzed the types of risk factors international students face from different perspectives; they provide a solid foundation from which this study builds upon to construct a comprehensive model that can analyze the risk factors faced by Chinese international students. However, few studies have considered the risk of international students as a whole, or have stated which specific risk factor is the most pertinent to international studies. Therefore, the following research questions are addressed in this study: (1) Which risk factor has the greatest impact on Chinese international students when studying abroad? and (2) Which risk factor is most frequently experienced by Chinese international students when studying abroad? To answer these questions, this study constructs an evaluation matrix using the FCE method combined with AHP and FA.

3 Methodology

Nguyen et al. (2023) and Wu et al. (2022) suggested using AHP for reliable weights in FCE, which is commonly used in environment and enterprise management research (Li et al., 2021; Yu et al., 2023; Wang et al., 2021; Zhang et al., 2020; Wu et al., 2015). Although, the method of PCA and FCE combination is applied in ecological assessment (Xu et al., 2021; Han et al., 2024; Wu et al., 2018; Yu et al., 2020) and engineering risk evaluation research (Cai et al., 2016), few studies have used this approach to examine the risks posed to Chinese international students. AHP has shown its advantage in determining the weights of complex evaluation indicators and can be used to address the challenge of the multi-variable

risk factors that are examined in this study. PCA helps with identification of key variables and reduction of redundant data, this statistical approach can be used to reduce intercorrelated variables in this study into a few dimensions that gather a big amount of the variability of the original variables (Burt, 1948). FCE is an analytical method based on fuzzy mathematics, which can provide a simple and effective approach for studying and solving complex problems that are difficult to describe with precise mathematical relationships (Jin et al., 2004). In this study, the post methods are combined with FCE to evaluate the various items, and to produce more clear and systematic results. Therefore, AHP and FCE, along with PCA and FA, were employed to establish a comprehensive risk evaluation model for Chinese international students.

3.1 Data acquisition

A semi-structured interview was conducted with 22 individuals separately to collect opinions and risk indicators regarding Chinese international students during July and August, 2023. The interviewees background and the reason of selection are presented below.

Two experts in the field of international higher education, who will give a comprehensive and authoritative overview, in detailed analysis and expertized opinion regarding to studying abroad. Five staff members from Chinese universities who are responsible for organizing Chinese university students to study abroad. They also work as managers and/or tutors when those students are abroad. Two government officials who are responsible for regulating studying abroad were invited as interviewees, as they are stands for related policy making and administration. Three scholars who have studied abroad shared their personal experience and evaluation of the risk regarding studying abroad. Five senior executives who work in different study-abroad agencies, and five people from foreign universities who are in charge of recruiting or managing Chinese students provide their opinions regarding Chinese international students and the risks they have encountered from a practical perspective. From a variety of perspectives, these interviewees offered their opinions and insights, which facilitated a holistic and multifaceted knowledge of Chinese students studying abroad. The interviews were conducted online by members of the research team due to the international context of this study.

During the interview, the interviewees were asked to list the risk factors that influence Chinese international students. In total, 173 items were mentioned, with an average of 7.86 items per person. Three members of the research team worked separately to sort and summarize these items, remove repeated items, and group items according to the risk factors and categories described in the literature. Based on the results of three group discussion sessions, 29 items were selected to be used in the subsequent questionnaire. Each item was represented by a statement regarding studying abroad. Respondents were asked to evaluate each statement based on a five-point Likert scale.

The questionnaire was drafted up in Chinese. The inclusion requirements for respondents were Chinese citizens who completed a period of international study. The questionnaire was distributed using the snowball sampling method. Initially, the research team distributed the questionnaire to individuals they knew to form the layer-A respondent group, inviting those who met the criteria to respond and asking them to forward the questionnaire to anyone they knew who were suitable, thus forming the layer-B respondent group. The layer-B respondents were then asked to complete the questionnaire and

forward it to anyone they knew who were suitable, thus forming the layer-C respondent group, and so on.

3.2 Data analysis

3.2.1 Demographic data

A total of 556 valid questionnaires were collected. The respondents' study destinations covered 22 countries, including those in North America, Europe, Asia, and Oceania. The respondents' majors encompassed various fields, including science, engineering, humanities, social sciences, art, and various other disciplines. The demographic data are listed in Table 1.

3.2.2 Reliability and validity analysis

Corrected item-total correlation (CITC) was used to test the correlation between each item and the individual risk factors. Any item with a CITC value lower than 0.3 was removed. A further reliability test was then conducted, and the CITC of each item was rechecked. This procedure was repeated until the CITC of each item reached the required minimum of 0.3 (Hair et al., 1998). At the end of this process, 26 out of the original 29 items were retained. Cronbach's α was 0.893, showing that the items were highly correlated with each other.

SPSS 25 was used to calculate the Kaiser–Meyer–Olkin (KMO) measurement value, which was 0.867. Bartlett's spherical test showed

a significant correlation at the 0.000 level, as shown in Table 2. According to Kaiser (1974), a KMO of >0.8 signifies that data are suitable for factor analysis. The calculated p -value of <0.05 showed that there was a strong correlation among the questions in this questionnaire and the risk factors. The questionnaire was therefore deemed to be reliable and feasible, and did not require further modification.

3.2.3 Refinement of second-level factors and third-level indicators

PCA was used to determine the potential common factor with a characteristic root of ≥ 1 , and to perform maximum variance orthogonal rotation. To prevent redundant information arising from inter-item correlation, dimensionality reduction via PCA was applied to the items derived from original data analysis (Royce, 1963). Any confounding factor or those with loads of <0.6 were removed. Finally, 22 items were retained as third-level indicators, and six common factors were used as second-level factors to construct the model, as shown in Table 3. The PCA results are shown in Table 4. The factor rotation results are shown in Table 5.

Factor A is defined as barriers to study, with a variance contribution rate of 28.68%; it consists of five indicators: delaying graduation, failure to obtain a degree, no interest in major, giving up studying abroad, and language difficulties. Factor A reflects the risk directly related to study that Chinese international students may encounter during their time abroad.

Factor B is defined as unforeseen incidents, with a variance contribution rate of 12.12%; it consists of five indicators: epidemic outbreaks, lack of contact with domestic family and friends, criminal or public security incidents, serious diseases, and migration regulation. Factor B reflects unexpected events that Chinese international students may encounter in a foreign country.

Factor C is defined as cross-cultural adaptation, with a variance contribution rate of 8.89%; it consists of three indicators: communication with the destination university, daily life adjustment, and interactions with local people. Factor C reflects the adaptation process of Chinese international students when they are studying abroad.

Factor D is defined as psychological discrepancy, with a variance contribution rate of 8.31%; it consists of three indicators: severe loneliness, the gap between expectations and reality, and re-adjustment failure after returning to China. Factor D reflects the possible psychological risks Chinese international students face due to the gap between expectations and reality.

Factor E is defined as economic ability, with a variance contribution rate of 5.68%; it consists of three indicators: studying expenses, career prospects, and financial difficulties. Factor E reflects the financial risks related to studying abroad that Chinese international students may face.

Factor F is defined as academic choice, with a variance contribution rate of 4.99%; it consists of three indicators: academic certification authentication, admission intention, and visa application. Factor F reflects the risks associated with choice of major, courses, and education institution.

3.3 Weight determination

The 1–9 scale method is used to mark the multiple comparison results of the absolute importance of the second-level factors and

TABLE 1 Results of descriptive statistical analysis.

| Gender | Male | 303 | 54.50% | Female | 253 | 45.50% |
|---------------------|------------------------|-----|--------|------------------------------|-----|---------|
| Major studied | Natural science | 81 | 14.50% | Social sciences and business | 129 | 23.20% |
| | Agricultural science | 12 | 2.20% | Art | 25 | 4.50% |
| | Humanities | 90 | 16.10% | Others | 6 | 1.10% |
| | Engineering technology | 156 | 28.10% | Total | 556 | 100% |
| | Medicine and health | 57 | 10.30% | | | |
| Destination country | United States | 56 | 10.10% | Poland | 8 | 1.40% |
| | Canada | 56 | 10.10% | Spain | 17 | 3.10% |
| | Britain | 52 | 9.40% | Italy | 12 | 2.20% |
| | France | 15 | 2.70% | Japan | 33 | 5.90% |
| | Germany | 31 | 5.60% | Korea | 33 | 5.90% |
| | Denmark | 16 | 2.90% | Australia | 46 | 8.30% |
| | Norse | 12 | 2.20% | New Zealand | 10 | 1.80% |
| | Sweden | 35 | 6.30% | Singapore | 7 | 1.30% |
| | Finland | 33 | 5.90% | Malaysia | 6 | 1.10% |
| | Estonia | 36 | 6.50% | Thailand | 6 | 1.10% |
| | Latvia | 12 | 2.20% | Not listed | 8 | 1.40% |
| | Lithuania | 16 | 2.90% | Total | | 100.00% |

TABLE 2 KMO and Bartlett's test results.

| | | |
|-------------------------------|--------------------|----------|
| KMO value | 0.867 | |
| Bartlett's test of sphericity | Approx. Chi-Square | 5451.821 |
| | df | 231 |
| | P-value | 0.000 |

TABLE 3 Determined factors and indicators of risk of Chinese international students.

| Second-level factor | Third-level indicator |
|-------------------------------|---|
| Barriers to study (A) | Delaying graduation (A ₁); failure to obtain a degree (A ₂); no interest in majors (A ₃); giving up studying abroad (A ₄); language difficulties (A ₅) |
| Unforeseen incidents (B) | Epidemic outbreaks (B ₁); lack of contact with domestic family and friends (B ₂); criminal or public security incidents (B ₃); serious diseases (B ₄); migration regulation (B ₅) |
| Cross-cultural adaptation (C) | Communicating with the studying universities (C ₁); daily life adjustment (C ₂); dealing with local people (C ₃) |
| Psychological discrepancy (D) | Severe loneliness (D ₁); the gap between expectations and reality (D ₂); re-adjustment failure after returning to China (D ₃) |
| Economic ability (E) | Studying expenses (E ₁); career prospects (E ₂); financial difficulties (E ₃) |
| Academic choice (F) | Academic certification authentication (F ₁); admission intention (F ₂); visa application (F ₃) |

TABLE 4 Total variance calculated by principal component analysis.

| Factor | Eigenvalues | | | Rotated variance |
|--------|-------------|---------------|--------------|------------------|
| | Total | % of Variance | Cumulative % | Cumulative % |
| A | 6.310 | 28.681 | 28.681 | 3.379 |
| B | 2.666 | 12.119 | 40.800 | 3.061 |
| C | 1.955 | 8.885 | 49.685 | 2.307 |
| D | 1.828 | 8.310 | 57.995 | 2.239 |
| E | 1.249 | 5.680 | 63.674 | 2.073 |
| F | 1.098 | 4.993 | 68.667 | 2.048 |

the third-level indicators, so as to build up judgment matrixes and weight vectors by AHP. Seventeen experts were invited to evaluate these factors and indicators. The final score of each item was taken as an approximate value of the average score. The consistency test result (CR), judgment matrix, and weight vector of each second-level factor ($W_s, s = A, B, C, \dots, F$) and of each third-level indicator ($W_t, t = A_1, A_2, \dots, F_3$) are shown in Tables 6, 7 respectively. As the CR value for each judgement matrix is <0.1, all matrices satisfy the consistency test because the calculated

weights are consistent. Therefore, the proposed model is acceptable.

Each second-level weight vector (W_s) is multiplied by the weight vector of its third-level indicator (W_t) to obtain the weight of each risk factor ($W_{AHP-t}, t = A_1, A_2, \dots, F_3$). The weight of each third-level indicator is calculated by FA ($W_{FA-t}, t = A_1, A_2, \dots, F_3$).

The weight vector of each second-level factor ($M_s, s = A, B, C, \dots, F$) is the mean of the weight of the corresponding third-level indicator obtained using AHP and FA (e.g., $M_A [0.061 0.057 0.072 0.046 0.062]$). The calculation results of FA and the determined weights of the third-level indicators are shown in Table 8.

3.4 FCE model construction

The procedure of defining the membership vectors for the second-level factors includes 5 steps.

Step1: construct the factor set.

According to the evaluation factors and indicator system of risk of Chinese international students mentioned in Table 3, the factor set A, B, C, D, E, and F are six second-level factors, and the 22 third-level indicators are present in the corresponding set. Set T represents the total risk experienced by Chinese international students:

$$A = \{A_1, A_2, A_3, A_4, A_5\}; B = \{B_1, B_2, B_3, B_4, B_5\}; C = \{C_1, C_2, C_3\}; D = \{D_1, D_2, D_3\}; E = \{E_1, E_2, E_3\}; F = \{F_1, F_2, F_3\}; T = \{A, B, C, D, E, F\}.$$

Step2: provide an evaluation set.

The evaluation set is a collection consisting of five grades used to evaluate the risk of Chinese international students facing. The fuzzy evaluation grade of risk factors that Chinese international students face contains five layers: very high risk (4,5), high risk (3,4), moderate risk (2,3), low risk (1,2), and very low risk (0,1).

Step3: construct the weight set.

Based on the weight vector which is determined by AHP and FA methods, the weight set $M_s (s = A, B, C, \dots, F)$ is constructed: $M_s = [m_1, m_2, m_3, \dots, m_i]$, where i is the number of indicators.

Step4: single-factor fuzzy evaluation.

The formula $Rate = \frac{Frequency}{556}$ was used to calculate the rate of

each score point (5, 4, 3, 2, 1) in the scale for the third-level indicators in the questionnaire, where 5 means completely agree and 1 means completely disagree. Frequency is defined as the number of times each score point was selected by the respondents in the 556 valid questionnaires. Subsequently, the fuzzy evaluation matrix $R_s (s = A, B, C, \dots, F)$ of the six second-level factors was obtained, as shown in Table 9.

Step5: defining the membership vectors for the second-level factors.

The membership vectors of the second-level factors were defined as $N_s = M_s * R_s (s = A, B, C, \dots, F)$, where M_s is the weight set and R_s is

TABLE 5 Rotated Factor loading of remaining items after principal component analysis.

| Indicator | Factor A | Factor B | Factor C | Factor D | Factor E | Factor F |
|-----------|----------|----------|----------|----------|----------|----------|
| 01 | 0.811 | | | | | |
| 02 | 0.801 | | | | | |
| 03 | 0.739 | | | | | |
| 04 | 0.735 | | | | | |
| 05 | 0.670 | | | | | |
| 06 | | 0.833 | | | | |
| 07 | | 0.754 | | | | |
| 08 | | 0.746 | | | | |
| 09 | | 0.723 | | | | |
| 10 | | 0.624 | | | | |
| 11 | | | 0.865 | | | |
| 12 | | | 0.847 | | | |
| 13 | | | 0.799 | | | |
| 14 | | | | 0.871 | | |
| 15 | | | | 0.863 | | |
| 16 | | | | 0.821 | | |
| 17 | | | | | 0.826 | |
| 18 | | | | | 0.784 | |
| 19 | | | | | 0.639 | |
| 20 | | | | | | 0.835 |
| 21 | | | | | | 0.767 |
| 22 | | | | | | 0.731 |

TABLE 6 Second-level factors judgment matrix.

| Factor | A | B | C | D | E | F | W_s | CR |
|--------|-----|-----|-----|-----|-----|---|-------|-------|
| A | 1 | 1 | 2 | 2 | 2 | 3 | 0.251 | 0.036 |
| B | 1 | 1 | 3 | 1/2 | 2 | 3 | 0.213 | |
| C | 1/2 | 1/3 | 1 | 1/3 | 1 | 2 | 0.103 | |
| D | 1/2 | 2 | 3 | 1 | 3 | 3 | 0.256 | |
| E | 1/2 | 1/2 | 1 | 1/3 | 1 | 2 | 0.110 | |
| F | 1/3 | 1/3 | 1/2 | 1/3 | 1/2 | 1 | 0.068 | |

the fuzzy evaluation matrix. The normalized membership vectors are listed below:

Barriers to study vector: $\bar{N}_A = [0.105 \ 0.290 \ 0.339 \ 0.147 \ 0.119]$

Unforeseen incidents vector: $\bar{N}_B = [0.086 \ 0.152 \ 0.188 \ 0.302 \ 0.272]$

Cross-cultural adaptation vector: $\bar{N}_C = [0.226 \ 0.447 \ 0.216 \ 0.077 \ 0.033]$

Psychological discrepancy vector: $\bar{N}_D = [0.378 \ 0.441 \ 0.106 \ 0.047 \ 0.029]$

Economic ability vector: $\bar{N}_E = [0.211 \ 0.267 \ 0.227 \ 0.190 \ 0.105]$

Academic choice vector: $\bar{N}_F = [0.315 \ 0.432 \ 0.161 \ 0.061 \ 0.032]$

4 Results

4.1 Evaluation of the risk factors

The risk evaluation formula of the second-level factor (risk factor) is $G_s = \bar{N}_s * V^T$, where \bar{N}_s is the normalized membership vector, and V^T is the transpose of the fuzzy evaluation matrix $[5, 4, 3, 2, 1]^T$. Thus, the risk grade was calculated as follows:

- $G_A = 3.115$, the evaluation grade is high risk.
- $G_B = 2.478$, the evaluation grade is moderate risk.
- $G_C = 3.753$, the evaluation grade is high risk.
- $G_D = 4.095$, the evaluation grade is very high risk.
- $G_E = 3.289$, the evaluation grade is high risk.
- $G_F = 3.940$, the evaluation grade is high risk.

4.2 Evaluation of the risk of Chinese international students

The formula $G = Z * V^T$ was used to evaluate the overall risk faced by Chinese international students, where Z is the overall membership vector and V^T is the transpose of the fuzzy evaluation matrix. The overall membership vector is $Z = W * \bar{N}$, where W is the weight matrix, which consists of the weight of each second-level indicator shown in Table 6, and \bar{N} is a matrix composed of the normalized membership vectors of the second-level factors. Hence, the following formula is used to calculate the overall risk: $G = W * \bar{N} * V^T$. The matrices W , \bar{N} and Z are listed below, respectively. The calculated result of the risk of Chinese international students is 3.372, and the evaluation grade is high risk.

$W = [0.251 \ 0.213 \ 0.103 \ 0.256 \ 0.110 \ 0.068]$

$$\bar{N} = \begin{bmatrix} 0.105 & 0.290 & 0.339 & 0.147 & 0.119 \\ 0.086 & 0.152 & 0.188 & 0.302 & 0.272 \\ 0.226 & 0.447 & 0.216 & 0.077 & 0.033 \\ 0.378 & 0.441 & 0.106 & 0.047 & 0.029 \\ 0.211 & 0.267 & 0.227 & 0.190 & 0.105 \\ 0.315 & 0.432 & 0.161 & 0.061 & 0.032 \end{bmatrix}$$

$Z = [0.209 \ 0.323 \ 0.210 \ 0.146 \ 0.112]$

5 Discussion

The risk-factors are evaluated by the FCE model. In general, the results show that the risk faced by Chinese international students ($G = 3.372$) is high. The overall membership vector (Z) of the risk factors shows that 20.9% of the respondents felt that the total risk was very high, 32.3% felt that it was high, and 21.0% felt that it was a moderate risk, 14.6 and 11.2% of respondents believed that the risk was low or very low, respectively. More than 50% of participants reported difficulties in adapting to studying abroad. Among the risks confronted by Chinese international students, the risk of psychological discrepancy ranked top, which has the greatest impact and is most likely to be experienced by Chinese international students. Each factor will be discussed in this part.

TABLE 7 Third-level indicators judgment matrix.

| Indicator | A ₁ | A ₂ | A ₃ | A ₄ | A ₅ | W _t | CR | Indicator | B ₁ | B ₂ | B ₃ | B ₄ | B ₅ | W _t | CR |
|----------------|----------------|----------------|----------------|----------------|----------------|----------------|-------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|-------|
| A ₁ | 1 | 1 | 1/2 | 2 | 1 | 0.186 | 0.016 | B ₁ | 1 | 1/3 | 1/3 | 1/4 | 1 | 0.087 | 0.008 |
| A ₂ | 1 | 1 | 1/2 | 2 | 1/2 | 0.162 | | B ₂ | 3 | 1 | 1 | 1 | 2 | 0.255 | |
| A ₃ | 2 | 2 | 1 | 3 | 1 | 0.307 | | B ₃ | 3 | 1 | 1 | 1 | 2 | 0.255 | |
| A ₄ | 1/2 | 1/2 | 1/3 | 1 | 1/2 | 0.099 | | B ₄ | 4 | 1 | 1 | 1 | 3 | 0.293 | |
| A ₅ | 1 | 2 | 1 | 2 | 1 | 0.246 | | B ₅ | 1 | 1/2 | 1/2 | 1/3 | 1 | 0.109 | |

| Indicator | C ₁ | C ₂ | C ₃ | W _t | CR | Indicator | D ₁ | D ₂ | D ₃ | W _t | CR |
|----------------|----------------|----------------|----------------|----------------|-------|----------------|----------------|----------------|----------------|----------------|----|
| C ₁ | 1 | 1/2 | 2 | 0.297 | 0.009 | D ₁ | 1 | 2 | 1 | 0.400 | 0 |
| C ₂ | 2 | 1 | 3 | 0.540 | | D ₂ | 1/2 | 1 | 1/2 | 0.200 | |
| C ₃ | 1/2 | 1/3 | 1 | 0.163 | | D ₃ | 1 | 2 | 1 | 0.400 | |

| Indicator | E ₁ | E ₂ | E ₃ | W _t | CR | Indicator | F ₁ | F ₂ | F ₃ | W _t | CR |
|----------------|----------------|----------------|----------------|----------------|-------|----------------|----------------|----------------|----------------|----------------|-------|
| E ₁ | 1 | 1/2 | 1/3 | 0.163 | 0.009 | F ₁ | 1 | 1/3 | 1/2 | 0.159 | 0.051 |
| E ₂ | 2 | 1 | 1/2 | 0.297 | | F ₂ | 3 | 1 | 3 | 0.589 | |
| E ₃ | 3 | 2 | 1 | 0.540 | | F ₃ | 2 | 1/3 | 1 | 0.252 | |

TABLE 8 Determined weights of third-level indicators.

| Indicator | W _{AHP-t} | W _{FA-t} | Mean of weight |
|----------------|--------------------|-------------------|----------------|
| A ₁ | 0.047 | 0.074 | 0.061 |
| A ₂ | 0.041 | 0.074 | 0.057 |
| A ₃ | 0.077 | 0.068 | 0.072 |
| A ₄ | 0.025 | 0.067 | 0.046 |
| A ₅ | 0.062 | 0.061 | 0.062 |
| B ₁ | 0.019 | 0.050 | 0.034 |
| B ₂ | 0.054 | 0.045 | 0.050 |
| B ₃ | 0.054 | 0.045 | 0.049 |
| B ₄ | 0.063 | 0.043 | 0.053 |
| B ₅ | 0.023 | 0.037 | 0.030 |
| C ₁ | 0.030 | 0.044 | 0.037 |
| C ₂ | 0.055 | 0.043 | 0.049 |
| C ₃ | 0.017 | 0.041 | 0.029 |
| D ₁ | 0.102 | 0.043 | 0.073 |
| D ₂ | 0.051 | 0.043 | 0.047 |
| D ₃ | 0.102 | 0.041 | 0.071 |
| E ₁ | 0.018 | 0.034 | 0.026 |
| E ₂ | 0.033 | 0.032 | 0.032 |
| E ₃ | 0.059 | 0.026 | 0.043 |
| F ₁ | 0.011 | 0.032 | 0.021 |
| F ₂ | 0.040 | 0.029 | 0.035 |
| F ₃ | 0.017 | 0.028 | 0.023 |

Factor A, barriers to study (weight = 0.251, G_A = 3.115), was found to be a high risk. Factor A covers five indicators, namely, delaying graduation (A₁, weight = 0.061), failure to obtain a degree (A₂, weight = 0.057), no interest in major (A₃, weight = 0.072), giving up studying abroad (A₄, weight = 0.046), and language difficulties (A₅,

weight = 0.062). The indicators belonging to Factor A have relatively higher weights in their contribution to the total risk faced by Chinese international students because they may lead substantial failure of studying abroad. In Chinese culture, the pursuit of academic achievement is the primary of young (Yan and Berliner, 2011; Aldwin and Greenberger, 1987). However, as studying abroad does not guarantee graduation and receiving a degree, indicators A₁ (delaying graduation) and A₂ (failure to obtain a degree) can happen when a student does not demonstrate acceptable academic performance. Indicators A₃ (no interest in major) and A₄ (giving up studying abroad) may happen if a student does not have sufficient interest in their chosen major and cannot transfer to another major. Indicator A₅ (language difficulties) may be encountered by most Chinese international students, especially at the beginning of their time studying abroad, when attending lectures, reading literature, and communicating and discussing in class.

Factor B, unforeseen incidents (weight = 0.213, G_B = 2.478), was found to be a moderate risk. This factor contributed the least to the total risk faced by Chinese international students. However, three indicators within this factor had a higher impact to the risk of Chinese international students. In total, 73.8% of respondents disagree or strongly disagree with indicator B₂, lack of contact with domestic family and friends (weight = 0.050). This finding shows that most Chinese international students understand the importance of maintaining contact with their family when studying abroad. Notably, most students did not encounter criminal or public security incidents (B₃, weight = 0.049), or serious diseases (B₄, weight = 0.053) when they were abroad. Therefore, indicators B₃ and B₄ did not significantly impact the total risk. Indeed, although the possibility of unforeseen incidents is always low, they can be highly damaging to the individual. Nevertheless, five interviewees mentioned indicators B₃ and B₄ as serious threats to Chinese international students, as shown by the following quotes: “Racial discrimination towards Chinese nationals has been recognized as a fatal threat for Chinese international students living abroad” (Interviewee 2). “Criminal activities such as theft and robbery targeting to Chinese international students have never decreased”

TABLE 9 Risk evaluation matrix for Chinese international students.

| Second-level factor | Third-level indicator | Frequency | | | | | Risk evaluation matrix |
|---------------------|-----------------------|-----------|-------|-------|-------|-------|------------------------|
| | | 5 | 4 | 3 | 2 | 1 | |
| A | A ₁ | 0.104 | 0.306 | 0.333 | 0.164 | 0.094 | R _A |
| | A ₂ | 0.146 | 0.392 | 0.245 | 0.115 | 0.103 | |
| | A ₃ | 0.049 | 0.129 | 0.500 | 0.149 | 0.173 | |
| | A ₄ | 0.122 | 0.397 | 0.270 | 0.110 | 0.101 | |
| | A ₅ | 0.119 | 0.291 | 0.295 | 0.187 | 0.108 | |
| B | B ₁ | 0.146 | 0.304 | 0.255 | 0.156 | 0.138 | R _B |
| | B ₂ | 0.063 | 0.086 | 0.113 | 0.362 | 0.376 | |
| | B ₃ | 0.061 | 0.076 | 0.162 | 0.365 | 0.336 | |
| | B ₄ | 0.067 | 0.129 | 0.203 | 0.327 | 0.273 | |
| | B ₅ | 0.133 | 0.255 | 0.255 | 0.216 | 0.140 | |
| C | C ₁ | 0.237 | 0.486 | 0.167 | 0.077 | 0.032 | R _C |
| | C ₂ | 0.207 | 0.412 | 0.263 | 0.079 | 0.040 | |
| | C ₃ | 0.245 | 0.457 | 0.201 | 0.074 | 0.023 | |
| D | D ₁ | 0.284 | 0.487 | 0.147 | 0.058 | 0.029 | R _D |
| | D ₂ | 0.306 | 0.484 | 0.128 | 0.054 | 0.029 | |
| | D ₃ | 0.525 | 0.367 | 0.049 | 0.031 | 0.029 | |
| E | E ₁ | 0.221 | 0.433 | 0.230 | 0.079 | 0.036 | R _E |
| | E ₂ | 0.376 | 0.362 | 0.113 | 0.086 | 0.063 | |
| | E ₃ | 0.083 | 0.095 | 0.309 | 0.335 | 0.178 | |
| F | F ₁ | 0.387 | 0.441 | 0.115 | 0.034 | 0.023 | R _F |
| | F ₂ | 0.221 | 0.433 | 0.230 | 0.079 | 0.036 | |
| | F ₃ | 0.397 | 0.412 | 0.099 | 0.058 | 0.034 | |

(Interviewee 9). “Compared to foreigners, Chinese students are more likely to be injured or harmed when they encounter criminal cases in foreign countries” (Interviewee 5). Students who get a serious disease have to give up studying, though it is not desired, commented by Interviewee 11 & Interviewee 13.

Factor C, cross-cultural adaptation (weight = 0.103, G_C = 3.753), was found to be a high risk. Indicator C₂, daily life adjustment (weight = 0.049), had the highest weight among the three third-level indicators. Because Chinese students are from a different cultural background compared to other students (Dahal et al., 2018), they have a different understanding of values, lifestyle, religion, and beliefs. Therefore, studying abroad acts as a huge change in the cultural environment for Chinese students. The cognitive rigidity forms a resistance to this change (Oreg, 2003), which takes time and energy to adapt. However, indicator C₂ exhibited the difficulty as the most. The reason was highlighted by Interviewee 3, who stated “many Chinese students are used to meticulous care by their parents; once away from their parents, their daily life becomes a big problem!” Therefore, cross-cultural adaptation is an important risk factor for Chinese international students, with daily life adjustment being the most significant challenge.

Factor D, psychological discrepancy (weight = 0.256), was the most significant risk factor among the six second-level factors; it had an evaluation score of 4.095, indicating a very high risk. Indicator D₁, severe loneliness (weight = 0.073), and indicator D₃,

re-adjustment failure after returning to China (weight = 0.071), proved to be crucial elements of the psychological discrepancy factor. Feelings of loneliness in Chinese international students may be caused by the challenges of adapting to a new environment, as well as homesickness. Loss of contact with family and familiar social networks increases the loneliness experienced by international students (Hari et al., 2023). Pressure from educational requirements, as well as discomfort in daily life and social activities, both impact the mental health of Chinese international students, which was especially true during the COVID-19 pandemic (Ke et al., 2023), as noted by Interviewee 15:

During the COVID-19 pandemic, Chinese international students living in China and abroad experienced a unique pressure compared to other international students because studying destination countries’ governments imposed border restrictions, people were not allowed to cross the Chinese boarder, which meant Chinese international students abroad were unable to return to China or their family as they were not able to go abroad once they went back to China. Meanwhile, some students from China were unable to go abroad. They had only limited connection with their university, some had not even experienced the education abroad yet, but the payment order of tuition fees came without any discount nor delay. During that time, the students and their families both felt pressured.

Chinese international students usually stay abroad for several years, they frequently experience cultural re-adaptation when they move back to China (Fanari et al., 2021). The process involves re-acclimatizing to China's domestic environment, as described by Interviewee 7:

This process includes significant adjustments, such as lifestyle, values, and working culture. It may cause feelings of stress or anxiety, helplessness, academic problems for returnee students, interpersonal difficulties, and feeling like they are an alien or puzzling. As these feelings are not expected nor desired, as a result, psychological discrepancy occurs.

Factor E, economic ability (weight = 0.110, $G_E = 3.289$), was found to be a high risk. Financial difficulties (E_3 , weight = 0.043) was the indicator with the highest weight of those related to Factor E. Studying abroad requires a high economic investment, including tuition fees, living expenses, and transportation expenses. Interviewee 12 stated that, usually:

The study expenses of Chinese international students are wholly provided by their parents. Cases of serious sickness, injury, or loss to the provider or the student's family may influence the student studying abroad, and the worst result is the student has to stop or give up studying.

Although this scenario is a highly unlikely, if it does happen, it can significantly impact the student's ability to progress in their studies, and the possible loss of tuition fees and time costs can be considerable. Moreover, if a family's economic ability is insufficient to fully support a student abroad, the student has to choose between giving up studying abroad or taking on part-time work to support themselves. The latter choice also depends on the host country's working policy on international students.

Factor F, academic choice (weight = 0.068, $G_F = 3.940$), was found to be a high risk. This factor includes three third-level indicators: academic certification authentication (F_1 , weight = 0.021), admission intention (F_2 , weight = 0.035), and visa application (F_3 , weight = 0.023). The weights show that the admission intention and visa application have greater impacts on the total risk of Chinese international students because Chinese students have limited choices of international higher education institutions. Additionally, international students have to comply with the host nation's immigration laws and regulations.

The risk faced by Chinese international students was found to be high. Psychological discrepancy had the largest impact on the risk of Chinese international students, as well as the highest possibility of occurrence. Psychological discrepancy ($G_D = 4.095$), academic choice ($G_F = 3.940$), and cross-cultural adaptation ($G_C = 3.753$) were the three risk factors that were most likely to be experienced by Chinese international students. Psychological discrepancy (weight = 0.256), barriers to study (weight = 0.251), and unforeseen incidents (weight = 0.213) had a combined weight of 0.720, and thus had the highest impact on total risk.

The high total weights of these three factors signify their prominent role in determining the overall risk level of Chinese international students, thus warranting special attention and consideration. This result indicates that Chinese international students in the host country must grapple with not only language and cultural

barriers, but also psychological discrepancy, academic hurdles. Besides adapting to new lifestyles and academic settings in destination countries, among other multifaceted challenges, they need to make right choice and get ready before departure to abroad. Therefore, attention should be paid to these risk factors, and countermeasures should be taken in a timely manner to avoid the occurrence of risk and its negative impacts.

Based on the calculating results, the above six factors and the secondary indicators reveal the degree of risk impact and the possibility of risk occurrence during the process of Chinese international students studying abroad. The research considers studying abroad as a change and stands on individual perspective, discussed risks caused by this change, which differ from Oreg (2003) studying, from organizational behavior perspective illustrated individual differences in psychological resistance to change.

6 Conclusion and suggestion

The findings of this study serve as a reference for improving the quality of overseas education and enhancing the risk prevention and management of Chinese international students. The findings indicate that psychological discrepancy is the most important risk factor affecting Chinese international students. Therefore, considering psychological discrepancy should be a priority when Chinese students are considering studying abroad. This finding should also be considered by international universities and national policy-makers when Chinese students are studying in their countries. Some countermeasures on risk avoidance are suggested for Chinese students when considering to study abroad. This study provides insight into the lives of Chinese international students and considers their needs beyond those in higher education. Thus, it can be used by international universities as a guide for how they can effectively support Chinese students. National policy-makers can also use the findings to support Chinese international students when developing or amending policies.

6.1 Suggestions to Chinese international students

To have a successful, safe, and healthy experience while studying abroad, the following suggestions are provided to Chinese international students. First, when choosing a major, personal interests and strengths should be considered in addition to future career prospects. Potential students should make a career plan, research their professional prospects, and consult professional advisors. Prospective students should be clear about their aims and try to improve their abilities in the language most commonly used in their desired profession, especially in English. In addition, students studying abroad must adjust their learning methods and living styles proactively when they enter the host country to shorten the adaptation period.

Second, students should increase their awareness of cultural diversity and try to improve their cross-cultural knowledge and skills before going abroad. Studying cultural differences between China and host countries, getting to know their destination's history, customs, traditions, laws, religions, and geography, and understanding the climate of the host country will improve their experience and reduce the likelihood of experiencing risk factors. When studying abroad,

Chinese international students should be confident to ask questions and express personal views and feelings. Chinese international students should avoid self-isolation and try to communicate with other international students and local people, so as to integrate into local life as quickly as possible. Third, participating in a variety of cultural exchange activities and familiarizing themselves with local culture and customs may help Chinese students to reduce loneliness and homesickness. Moreover, these suggestions will help them to integrate with the local people. When feeling overwhelming psychological pressure or thinking that they are unable to adapt to local life in a foreign country, students should ask psychologists for professional help. Finally, when in a foreign country, students should regularly contact family and friends to receive the support and comfort they need.

6.2 Suggestions to international universities

International universities can improve the experience of Chinese students studying abroad by providing high-quality education services. First, they could provide online training courses that explain their teaching and learning styles, common manners, and local transportation guides, among other topics that can help Chinese students adapt to studying and living abroad. This online approach may allow Chinese students to obtain necessary training before they leave China, so they can quickly adapt to life in the host country. Moreover, this is an approach that international universities can use to market themselves to Chinese students. Second, international universities should consider organizing cultural activities for Chinese students. For instance, organizing an International Cultural Festival where international students from various countries are invited to exhibit their traditional cultures, arts, and cuisines; or inviting experts, scholars, or cultural celebrities to conduct cultural lectures or cross-cultural seminars, explaining the culture, history, and arts of the host country, thereby enhancing international students' understanding of the host country's culture, which could help them to adjust and adapt to the host country's culture and lifestyle. Third, tutors could be provided to help Chinese students adjust to their new study and living arrangements to help them to resolve psychological issues and release psychological pressure, thus avoiding psychological discrepancy. International universities can also encourage Chinese international students to engage in research projects, thereby enhancing their research capabilities and cross-cultural research proficiency.

6.3 Suggestions to policy-makers

For host-country governments, it is suggested to provide a stable social environment and friendly policy-orientation sessions. Host-country governments can optimize their student visa and entry policies by streamlining the visa application process and implementing more flexible visa regulations for Chinese international students, such as extending visa validity periods and broadening visa categories. A student advisory center should be established to improve the service system for not only Chinese but all international students, ensuring that any issues encountered by international students in their

academic pursuits and daily lives are promptly addressed. Good relations with China should be maintained to attract more Chinese students. This is especially important in today's world of diversified study-abroad destinations. Sustainable and tolerant migration regulations represent a government's attitude towards international students. Hence, a good relationship with China may create a domestic social environment that is open and happy to receive Chinese students. This will enhance the attractiveness of the country and make it the preferred destination for Chinese students to study abroad.

In summary, Chinese international students have to face risk influenced by different factors throughout the whole period that they are abroad. Chinese students should enhance their risk awareness and also understand measures to prevent risks. The host country and university should also provide more support and assistance to Chinese students to help them avoid risk and improve their experience of studying abroad.

6.4 Limitations and future research

This study used self-reported data, which may be under the influence of common method variance. A commonly used preventative measure was used, and the questions and questionnaire were shortened as much as possible. The snowball sampling method helped to maximize the amount of valid responses. As the study used a cross-sectional design, it was impossible to obtain continuous data on the development trends of Chinese students studying abroad. Therefore, the study selected Chinese citizens who had completed a period of study abroad as respondents. Further studies should develop a method that can assess the development trend. Another limitation is that this study did not examine the different study periods of Chinese students study abroad, nor the time spent in respective host countries. For further studies, larger sample sizes that include respondents who spent a similar amount of time in respective host countries—or that focus on fixed short-term periods of study—can be conducted. The culture of each host country was not taken into account in this study, as the research focused on Chinese students. In the future, studies focused on culture variance between host country and Chinese international students could be considered.

Data availability statement

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

Ethics statement

Ethical review and approval was not required for the study on human participants in accordance with the local legislation and institutional requirements. Written informed consent from the participants was not required to participate in this study in

accordance with the national legislation and the institutional requirements.

Author contributions

JG: Conceptualization, Formal analysis, Funding acquisition, Investigation, Project administration, Supervision, Writing – original draft, Writing – review & editing, Methodology. ZZ: Formal analysis, Methodology, Writing – original draft, Writing – review & editing. HL: Formal analysis, Investigation, Methodology, Software, Writing – review & editing, Data curation.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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