BMJ Open

Classification of kinesiophobia in patients after cardiac surgery under extracorporeal circulation in China: latent profile and influencing factors analysis from a cross-sectional study

Wenhui Xing ,[1,2] Jing Jing Piao ,[3] Tong Ren,[1] Yujing Liang,[1] Qi Li ,[2] Yanmei Gu,[2,4] Rong Wang[1]

To cite: Xing W, Piao JJ, Ren T, *et al*. Classification of kinesiophobia in patients after cardiac surgery under extracorporeal circulation in China: latent profile and influencing factors analysis from a cross-sectional study. *BMJ Open* 2025;**15**:e083909. doi:10.1136/bmjopen-2024-083909

► Prepublication history and additional supplemental material for this paper are available online. To view these files, please visit the journal online (https://doi.org/10.1136/bmjopen-2024-083909).

Received 02 January 2024
Accepted 20 December 2024

For numbered affiliations see end of article.

Correspondence to
Dr Rong Wang;
wangrongd@126.com

ABSTRACT

Objective To investigate the potential classification of kinesiophobia in patients after cardiac surgery under extracorporeal circulation from a psychosocial perspective, and analyse the characteristic differences among different latent levels of patients.

Study design This is a cross-sectional study of Chinese adults after cardiac surgery under extracorporeal circulation, aged 18 years and older, recruited from a tertiary hospital in North China.

Methods This study uses latent profile analysis to identify potential classifications of kinesiophobia in questionnaires from 348 patients undergoing cardiac surgery under extracorporeal circulation. Multiple logistic regression analysis was used to evaluate the influencing factors at different latent classifications.

Results The average performance of each indicator in Model 3 is best suited for analysis, Entropy=0.873 and bootstrap likelihood ratio test (p) < 0.0001. The result of regression equation shows postoperative time (p<0.001), age, self-efficacy, pain and social support level (p<0.05) were the factors influencing the potential profile classification of patients after cardiac surgery under extracorporeal circulation.

Conclusion The study identified three distinct classifications of patients: the low kinesiophobia group, the moderate kinesiophobia—high-risk perceived symptoms group and the high kinesiophobia—high exercise avoidance group (HK-HEAG). Addressing kinesiophobia, especially in older male patients during the early postoperative period, is crucial. Enhancing self-efficacy seems effective in reducing kinesiophobia, while increasing social support may not be as beneficial for the HK-HEAG. These findings provide a basis for implementing preventive interventions in cardiac rehabilitation.

Trial registration number The research is registered with the Chinese Clinical Trial Registry (ChiCTR2200057895).

STRENGTHS AND LIMITATIONS OF THIS STUDY

⇒ It is a comprehensive investigation conducted in China, specifically examining the factors that potentially influence the level of kinesiophobia in patients who have undergone cardiac surgery with extracorporeal circulation.
⇒ This study indicatively uses latent profile analysis to classify kinesiophobia of patients after cardiac surgery under extracorporeal circulation.
⇒ Self-report questionnaires in data collection may influence the assessment of kinesiophobia in an objective approach.
⇒ The adaptability of this model is limited to the Chinese background.

INTRODUCTION

Kinesiophobia is defined as an irrational and excessive fear of carrying out a physical movement.[1] Previous studies have reported that psychological factors, such as kinesiophobia, are a significant barrier to patient participation in cardiac rehabilitation (CR).[2–6] In the context of cardiac disease, it is mostly described as a fear of physical activity due to the apprehension of worsening cardiac disease or the possibility of inducing adverse outcomes. Kinesiophobia was detected in 65% of individuals with chronic heart failure and in 86.26% of patients with a first-time acute myocardial infarction.[7 8] According to a previous study, high levels of kinesiophobia can negatively impact not only the performance of daily activities but also CR engagement.[9]

Research has shown that kinesiophobia has an influence and plays an intermediate role in attendance at CR.[1] As a mediator, kinesiophobia is influenced by predictive factors and has indirect effects. General health and muscle endurance increased the probability of attendance at CR, while self-rated anxiety had the opposite effect. There have been studies exploring whether there are positive changes in kinesiophobia based on CR,

with higher levels of aerobic capacity and lower levels of physical activity compared with patients with low levels of kinesiophobia. Results showed a significant reduction in kinesiophobia after an exercise-based CR programme.[10] CR is an important step in the recovery process after cardiac surgery. It is a comprehensive strategy that is aimed at improving a person's physical, psychological and social functioning.[11–13] Studies have shown that exercise-based CR can not only reduce mortality and hospital admissions for cardiovascular disease but also improve quality of life and mental well-being.[12 14 15] CR's effectiveness and importance are recommended as level IA by most international cardiovascular societies.[16–18]

Kinesiophobia is a psychological disorder, and we should pay more attention to those subjective factors that are self-influenced and in constant change. In a potential profile analysis of kinesiophobia in patients with coronary heart disease (CHD),[19] objective demographic information was included in the analysis, and the results showed that patients could be divided into three potential types: 'low fear type', 'intermediate fear type' and 'high fear type'. However, among the influencing factors of kinesiophobia, objective factors cannot be interfered with by medical staff. In addition, research supports that kinesiophobia is positively correlated with age,[19] but the explanation for these potential differences in age has not been studied. From the perspective of social psychology, the research results of Zhang[20] *et al* showed that it was important to alleviate kinesiophobia for patients with low subjective social status, but the mechanism of how social support produced positive effects in different kinesiophobia classifications has not been clarified. Clinical professionals should collect objective influence factors as predictive factors, focusing on targeted interventions based on the patient's own subjective factors.

Few studies have investigated the effects of kinesiophobia in patients after cardiac surgery under extracorporeal circulation. The number of cardiac surgeries has increased tremendously in recent years. In China, cardiac surgery volume increased by 8% in 2020 compared with 2012.[21] Extracorporeal circulation replaces cardiopulmonary function in a non-physiological way during cardiac surgery, and the lung function of patients is significantly decreased after the operation,[22 23] while the blood is in a hypercoagulable state after the operation, and there is a risk of thrombosis.[24] Exercise is the main form of CR, and early postoperative activity is beneficial to patients to reduce postoperative pulmonary complications and thrombotic events.[25 26] However, due to various reasons, patients with kinesiophobia caused a decline in exercise compliance.[1] The factors of kinesiophobia are complex and highly heterogeneous. From the social psychology perspective, the classification of kinesiophobia in patients after cardiac surgery under extracorporeal circulation has not been well characterised. Previous studies[27 28] mainly evaluated patients' kinesiophobia classification from the total score of the scale, which may have the same total score but the score of each item varies greatly. This study fills that gap. Latent profile analysis (LPA) is an 'individual-centric' statistical analysis method that can homogenise sequential data, explore the characteristics of groups without categories and ethnic differences in groups, and then analyse their respective influencing factors in different subgroups.[29] We hypothesised that patients with kinesiophobia after cardiac surgery could be accurately divided into three subgroups using the LPA method, and the features between the groups were well distinguished. Based on the classification results of this study, it provides a reliable reference for clinical medical staff to intervene in cases of kinesiophobia.

MATERIALS AND METHODS

Study design

In this cross-sectional study, subgroups of kinesiophobia characteristics and associated factors in patients after heart surgery were investigated. All participants were recruited from a tertiary hospital in North China and completed the questionnaire from April 2022 to April 2023.

Participants

Participants who met the inclusion criteria were provided with information about the study prior to inclusion, as well as consent and willingness to engage in this study after being fully informed of its objectives.

The participants met the following inclusion and exclusion criteria.

Inclusion criteria

1. Advised by the doctor to participate in CR.
2. Patients who underwent cardiac surgery under extracorporeal circulation (eg, coronary artery bypass grafting and cardiac valve replacement) 3 months prior to the survey.
3. Adults aged 18–75 years.
4. Conscious, mentally and psychologically competent and able to complete the questionnaire.

Exclusion criteria

1. Contraindication to CR (eg, uncontrollable or unstable angina, severe arrhythmias, etc).

2. Refusal to provide personal information for participation in the questionnaire.

3. Recent severe family events (eg, malignancy), psychological instability, individuals actively expressing depressive and anxious tendencies or are suspected of having mild cognitive impairment.

Study tools

Sociodemographic questionnaire

Sociodemographic data were collected, including gender, age, education level, marital status, vocational type, average monthly household income, current residence, smoking status, alcohol consumption, surgical operation approach and postoperative time.

Tampa Scale for Kinesiophobia Heart

The Chinese version of the Tampa Scale for Kinesiophobia Heart (TSK-SV Heart) was used to assess the kinesiophobia levels of patients.[30] This scale consists of 17 items that assess danger, fear, avoidance and dysfunction. The questions were evaluated using the 4-point Likert scale (1=strongly disagree, 2=disagree, 3=agree and 4=strongly agree). A score of 37 or higher indicates a high level of kinesiophobia.[9 31]

Cardiac Exercise Self-Efficacy Instrument

The Cardiac Exercise Self-Efficacy Instrument (CESEI) was developed by Hickey *et al* to measure exercise self-efficacy in CR patients.[32] In 2021, a Chinese version of CESEI was developed through translation, back translation and cultural adjustment.[33] The Chinese version of the CESEI includes 16 items corresponding to one dimension, which are scored on a scale of 1–5. The total score is determined by the sum of the items scored. The higher the score, the higher the patient's self-efficacy in CR. The Cronbach's alpha for the Chinese version of the CESEI is 0.941.

Social Support Rating Scale

The Social Support Rating Scale (SSRS) was used to examine the levels of social support among the participants.[34] The SSRS comprises 10 items divided into 3 categories: objective support, subjective support and social support use. Low, medium and high levels of social support are represented by total scores of 0–22, 23–44 and 45–66, respectively. The Cronbach's alpha of the scale is 0.81.

Multi-dimensional Fatigue Inventory

The Multi-dimensional Fatigue Inventory (MFI-20) was used to determine participants' fatigue levels.[35] General weariness, physical fatigue, reduced activity, diminished motivation and mental fatigue are the five categories of the MFI-20. Responses were given using the 5-point Likert scale ranging from 1 (yes, this is true) to 5 (no, this is not true). This scale has a Cronbach's alpha of 0.882, and it is regularly used to assess patient weariness with good reliability.

Hospital Anxiety and Depression Scale

The Hospital Anxiety and Depression Scale (HADS) was used to determine the level of anxiety and depression in participants.[36] The HADS comprises 14 items with 4 possible answers ranging from 0 to 4, as well as 2 subscales: anxiety and depression. The HADS score indicates the severity of anxiety or depression. The higher the HADS score, the more severe the anxiety or sadness. This scale has been tested in a variety of countries.

Numerical Rating Scale

The Numerical Rating Scale (NRS) is accurate, concise and more feasible. It was once considered the gold standard for pain assessment by the American Pain Society.[37] Patients are asked to select a single number representing the intensity of their pain on a scale of 1–11 (0=no pain and 10=worst pain). A score of 7–8 is classified as severe pain, indicating that the pain is intense.

STATISTICAL ANALYSIS

The statistical analysis was conducted using SPSS 22.0 software. For normally distributed quantitative data, descriptive statistics were presented as mean±SD, and group comparisons were performed using differential analysis. Qualitative data were described using frequencies and percentages, and group comparisons were performed using the χ^2 test. To establish the LPA model, the Mplus 8.3 software was used. The TSK-SV Heart score of patients after heart surgery was used as the model's observed variable. The initial model category was set to 1, and the number of model levels was gradually increased. Model fit was assessed using various criteria, including the Akaike information criteria (AIC), Bayesian information criteria (BIC), sample-size-adjusted BIC (aBIC), entropy index, Lo–Mendell–Rubin likelihood ratio test (LMRT) and bootstrap likelihood ratio test (BLRT). Smaller values of AIC, BIC and aBIC indicate better model fit. A higher entropy value closer to 1 suggests a higher probability of accurate individual classification. LMRT and BLRT were used to compare the fit of k-individual models to k–1 models. Based on the results of the LPA of kinesiophobia, a multiple logistic analysis was performed to explore the factors influencing the latent profile classification of patients' kinesiophobia after heart surgery. The statistical tests were two-tailed, and a difference of $p<0.05$ was considered statistically significant.

RESULTS

Convenience sampling was employed with 412 participants who underwent cardiac surgery under extracorporeal circulation. 42 participants were excluded according to the inclusion and exclusion criteria, leaving 370 eligible participants in the study. 18 questionnaires had more than five blanks or missed important information, while another four questionnaires had the same answer choice for more than five consecutive questions. All the above 22 questionnaires had been excluded. Finally, 348 questionnaires were left for analysis (figure 1).

Demographic characteristics of the participants

In the current study, 248 male participants (71.26%) and 100 female participants (28.74%) aged 18–45 years (18.97%), 46–65 years (40.80%) and 66–75 years (40.23%) were included. 252 participants (72.41%) underwent a conventional approach, while 101 participants (27.58%) used sternum-sparing approach. 95 participants (27.29%) were 3–6 months postoperative, 132 participants (37.93%) were 7–12 months postoperative, 90 patients (25.86%) were 13–18 months postoperative and 31 patients (8.90%) were 19–24 months

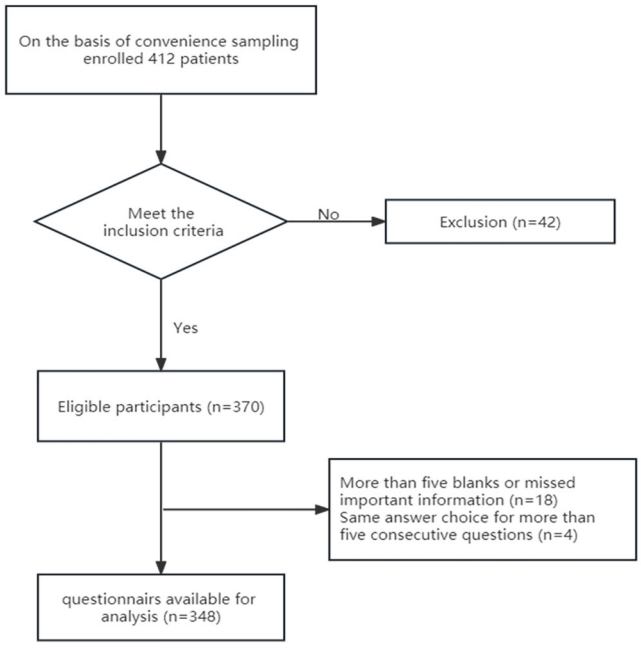

Figure 1 Flow diagram of participants.

postoperative. Detailed characteristics of the participants are displayed in online supplemental table 1.

LPA of the participants' kinesiophobia scores

LPA was conducted to identify the heterogeneity of kinesiophobia in patients after cardiac surgery under extracorporeal circulation. Four models were initially constructed based on model fit indicators AIC, BIC, aBIC, entropy, LMRT and BLRT. As the classification number increases (online supplemental table 2), the AIC, BIC and aBIC values gradually decrease and reach a minimum in Model 4 with LMRT value 0.131 (>0.05), while the matching indicators in Model 3 all fit well (<0.05). Furthermore, there was no cross in the three levels, as shown in figure 2. Therefore, Model 3 of kinesiophobia after heart surgery was accepted in the current study.

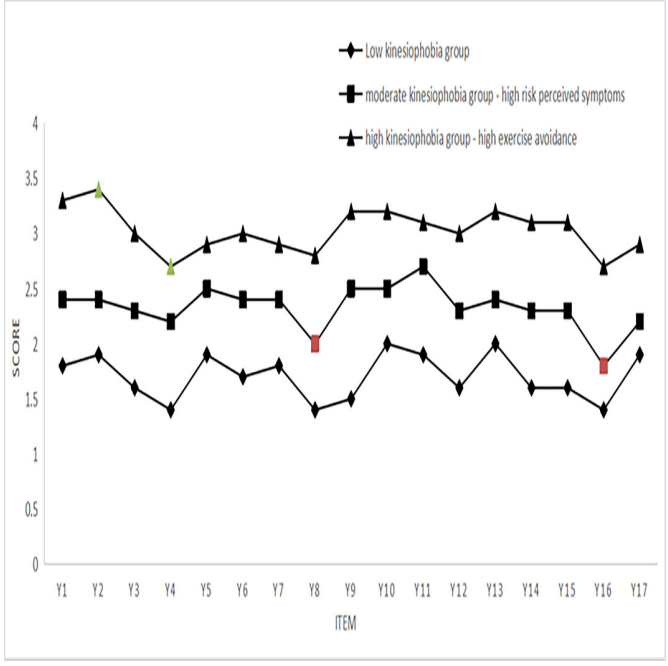

Figure 2 Latent profile analysis classification.

In Model 3, the different groups were named as the low kinesiophobia group (LKG), moderate kinesiophobia—high-risk perceived symptoms group (MK-HRPSG) and high kinesiophobia—high exercise avoidance group (HK-HEAG). The LKG (72/348, 20.6%) had low scores in all items with a TSK-SV Heart score of (34.08±4.12). The MK-HRPSG (148/348, 42.6%) had moderate scores on all items with a TSK-SV Heart score of (48.91±7.07). The HK-HEAG (128/348, 36.8%) had high scores in all items with a TSK-SV Heart score of (51.81±6.07).

One-way analysis of variance of different potential classification impact factors

There were differences in different potential classifications of kinesiophobia in participants, and there were statistically significant differences in the degree distribution of age, postoperative time, pain, social support and self-efficacy (p<0.05), as shown in online supplemental table 3.

Multiple logistic regression analysis of potential classification factors

Taking LKG as a reference to conduct disordered multi-classification logistic regression analysis, the classifications of kinesiophobia were taken as dependent variables, with significant variables in the above analysis as independent variables and covariables. The results showed that age, postoperative time, self-efficacy, pain and social support were factors influencing the potential classification of kinesiophobia (p<0.05), as shown in online supplemental table 4.

DISCUSSION

Characteristics of participants

The data for this study were collected from a tertiary hospital in the country with an ample volume of cardiac surgeries. In this study, there was a higher proportion of male participants compared with female participants (male:female=2.48:1), which aligns with findings from previous studies.[38–41] It is noteworthy that female participants constitute no more than 30% of the study population in research trials.[40–42]

There are several factors contributing to this gender disparity. First, mortality rates and risk for the most prevalent cardiovascular diseases consistently tend to be higher among men than women.[43] Moreover, women face disparities in wealth, income and access to resources, which can hinder their timely access to medical care. A study revealed that women with low incomes, low levels of education and residing in deprived areas are more likely to delay seeking medical attention.[44] Lastly, a lack of awareness among women about the importance of CHD and emergency care contributes to delays in

seeking medical attention.[45] A report from the European Heart Survey found that women aged 60 years and above were less likely to undergo coronary artery bypass grafting(CABG) compared with men, whereas they were more likely to receive percutaneous coronary intervention (PCI), adding to the gender differences in surgical treatment.[46]

Analysis of a 3-classification model of kinesiophobia score

Among the models tested, Model 3 exhibited significant characteristics. As our results indicate, Model 4 had the best-fitting AIC, BIC and entropy values. Model 4 allows variances and covariances to be freely estimated and varied across profiles. However, this improvement in fit came at the expense of differences when compared with other models. Model 4 had a lower LMRT value (0.131) in particular. Ultimately, we selected Model 3 due to its relatively low AIC and BIC values, along with a high entropy value of 0.873, suggesting accurate classification of participants into the appropriate profile. Furthermore, the LMRT and BLRT values in Model 3 were low (0.05 and 0.01, respectively), indicating good model fit.

The researchers established a score of 37 as the threshold for determining the presence of kinesiophobia.[47] A score of 37 or higher indicates a high level of kinesiophobia.[27] Notably, participants in the LKG in Model 3, obtained a mean score of (34.08±4.12), indicating a lower degree of kinesiophobia. This finding aligns with previous studies.[27 48] The MK-HRPSG in Model 3 scored lower on items 8 (2.00±0.73) and 16 (1.90±0.75) compared with an average item score of 2.33. These items belong to the risk perception dimension. The results suggest that participants in the MK-HRPSG exhibit a heightened perception of risk, which may result in decreased adherence to recommended treatments.[49] In contrast, participants in the HK-HEAG in Model 3 obtained higher scores on item 2 (3.43±0.55) and lower scores on item 4 (2.86±0.84) compared with the average item score of 3.03. These particular items are indicative of exercise avoidance tendencies. Consequently, participants in the HK-HEAG in Model 3 may demonstrate greater resistance to and avoidance of physical activity when advised by their doctors regarding exercise prescriptions.[50]

Based on the presented results, Model 3 effectively minimises individual heterogeneity by considering latent traits, resulting in the identification of distinct subgroups. The results of this study showed potential classifications of kinesiophobia, which were mainly affected by age, postoperative time, self-efficacy, pain and social support.

Factors affecting classification

We observed that age under 45 years did not play a role in influencing the classification of kinesiophobia. In this study, age was analysed categorically as a rank variable, which differed from previous studies that treated age as a continuous variable.[19] Remarkably, our findings emphasised the significance of age above 45 years, specifically indicating that patients aged over 45 years were more likely to exhibit tendencies towards HK-HEAG. These results align with existing research showing higher levels of kinesiophobia among older adults,[51] which is consistent with our research. The increased kinesiophobia with ageing can be attributed to factors such as physical frailty, which not only leads to a decrease in energy but also heightens the fear of injury and falling. In addition, it is difficult for the elderly to acquire scientific knowledge about kinesiophobia,[52] which further aggravates exercise avoidance. However, Gunn *et al*[53] reported an adverse association between age and kinesiophobia among adults, suggesting that older individuals may have more available time and exercise experience, which reduces their anxiety towards potentially harmful activities. It is important to note that generalising findings based on age is not appropriate, as age under 45 years did not prove to be a significant factor in our study. Future studies should focus on exploring the kinesiophobia classification in older adults.

There is a time effect of kinesiophobia in the postoperative period. Our study discovered that the period between 3 and 6 months after surgery is a critical time frame for kinesiophobia concerns. The level of kinesiophobia decreased with the increase in postoperative time,[54 55] and postoperative time was not a factor affecting the classification of kinesiophobia after 6 months. The longer the postoperative period, the less likely they were to be classified as HK-HEAG. This finding aligns with previous studies conducted on patients following an acute coronary artery disease event, which reported that kinesiophobia scores were highest (32.5) at baseline, decreasing to 30.9 after 2 weeks and 30.1 after 4 months, suggesting a decline in kinesiophobia over time.[56] This trend may be due to the gradual recovery of exercise capacity and cardiac function over time, as patients can gradually tolerate increased exercise and feel the benefits of participating in it. Early postoperative activity has been shown to improve functional recovery time,[57] especially through early postoperative activities on the floor. Clinical staff should help patients overcome their kinesiophobia as early as possible to promote their engagement in CR as soon as possible, improve their cardiopulmonary function, reduce the incidence of postoperative venous thrombosis[58] and minimise the length of hospital stay.[59]

Self-efficacy plays an important role in kinesiophobia classifications.[60] In our study, we observed a negative association between self-efficacy and kinesiophobia, which aligns with previous research findings.[53 61] Patients with high self-efficacy scores were more likely to be classified as MK-HRPSG. According to Schwarzer *et al*'s theory, individuals with low self-efficacy face difficulties accepting their health status and have lower confidence and expectations regarding exercise.[62] They exhibit extreme reluctance to seek help when faced with unexpected traumatic events during exercise and are more prone to kinesiophobia.[63] However, patients with high self-efficacy demonstrate favourable psychological adaptation and coping skills when faced with heart surgery, enabling them to approach challenges more proactively.[64] Consequently, enhancing

self-efficacy is an effective measure for preventing and alleviating kinesiophobia, and various interventions focused on increasing self-efficacy are currently available in postoperative settings.[65–67] Further studies are needed to determine whether their use in patients undergoing cardiac surgery results in positive outcomes. Additionally, the inclusion of pain measurements in kinesiophobia assessments is essential.[68] The fear-avoidance model theory suggests that if patients perceive pain as a frightening stimulus and experience an exacerbation of pain, they adopt negative coping mechanisms to avoid activities that trigger pain, thus exhibiting kinesiophobia.[69] Therefore, it is necessary to provide patients with education on pain perception, help them understand the benefits of exercise, relieve their fear of pain and enhance their confidence in engaging in physical activity.[70]

Social support emerges as the primary factor influencing kinesiophobia in MK-HRPSG patients. Social support was negatively correlated with the classification level of kinesiophobia.[71] It is consistent with the results of a qualitative study on 16 female patients by Keessen *et al*.[72] In accordance with social support theory,[73 74] individuals with ample social support are more inclined to confide their negative emotions to family, friends and social networks. This, in turn, boosts their confidence in facing discomfort and diminishes kinesiophobia. Notably, our observations revealed no significant correlation between social support and kinesiophobia in the HK-HEAG. As a result, we postulate that alternative interventions should be explored to alleviate kinesiophobia in HK-HEAG patients, other than the domain of social support.

Limitations of this study

This study has taken a step in the direction of defining and understanding kinesiophobia in patients in North China. It is possible that other patients with different cultural backgrounds may produce different results. In addition, it is important to emphasise that methodological problems in the research design limit our interpretations. Self-report questionnaires in data collection may also influence the assessment of kinesiophobia in an objective approach. Finally, the LPA method has advantages in group classification, in which the selection process is decided by researchers according to the comprehensive judgement of indicators. Thus, it is likely that the results involve some subjectivity.

CONCLUSIONS

This study uses LPA to identify potential classifications of kinesiophobia in patients after cardiac surgery under extracorporeal circulation. The findings indicate that patients fall into three distinct classifications: LMG, MK-HRPSG and HK-HEAG. It is crucial for clinical staff to prioritise addressing kinesiophobia, particularly in older male patients during the early postoperative period. Furthermore, enhancing self-efficacy shows promise as an effective method for reducing kinesiophobia, while increasing social support may not yield desirable outcomes in the HK-HEAG. These findings offer a valuable evidence-based foundation for implementing preventative interventions to address kinesiophobia during CR for patients undergoing cardiac surgery. It is important to note that this study is cross-sectional, and future research should consider expanding the sample size and conducting longitudinal studies to validate the obtained results.

Author affiliations
[1]Department of Cardiovascular Surgery, The Sixth Medical Centre of PLA General Hospital, Beijing, China
[2]Hebei University of Chinese Medicine, Shijiazhuang, Hebei, China
[3]Kobe University Graduate School of Health Sciences, Kobe, Hyogo, Japan
[4]Hebei Key Laboratory of Health Care with Traditional Chinese Medicine, Shijiazhuang, Hebei, China

Acknowledgements The study was undertaken during the COVID-19 pandemic. We sincerely thank the clinicians and nurses who supported the research by assisting with data collection. We also thank the study participants.

Contributors WX and JJP are joint first authors. RW obtained funding. WX designed the study. JJP, TR and YL collected the data. WX and QL were involved in data cleaning and analysed the data. YG contributed to the interpretation of the results and critical revision of the manuscript for important intellectual content and approved the final version of the manuscript. All authors have read and approved the final manuscript. RW is the guarantor of this study.

Funding This work was supported by the National Key Research and Development Program of China (grant number 2022YFB4700805).

Competing interests None declared.

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

Patient consent for publication Not applicable.

Ethics approval This study involves human participants and was approved by the ethical review committee of the Sixth Medical Centre of PLA General Hospital (Beijing, China, HZKY-PJ-2022-2). The research was registered with the Chinese Clinical Trial Registry (ChiCTR2200057895). Participants gave informed consent to participate in the study before taking part.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement No data are available.

ORCID iDs
Wenhui Xing http://orcid.org/0009-0009-4898-8277
Jing Jing Piao http://orcid.org/0000-0003-2022-5947
Qi Li http://orcid.org/0000-0002-5940-8428

REFERENCES

1 Bäck M, Cider Å, Herlitz J, *et al*. Kinesiophobia mediates the influences on attendance at exercise-based cardiac rehabilitation

in patients with coronary artery disease. *Physiother Theory Pract* 2016;32:571–80.
2 Kinesiophobia as a Problem in Adherence to Physical Activity Recommendations in Elderly Polish Patients with Coronary Artery Disease. *PPA* 2019.
3 Rubin R. Although Cardiac Rehab Saves Lives, Few Eligible Patients Take Part. *JAMA* 2019;322:386.
4 Bäck M, Öberg B, Krevers B. Important aspects in relation to patients' attendance at exercise-based cardiac rehabilitation - facilitators, barriers and physiotherapist's role: a qualitative study. *BMC Cardiovasc Disord* 2017;17:77:77:.
5 Rogerson MC, Murphy BM, Bird S, *et al*. "I don't have the heart": a qualitative study of barriers to and facilitators of physical activity for people with coronary heart disease and depressive symptoms. *Int J Behav Nutr Phys Act* 2012;9:140.
6 Brunetti ND, Guerra A, Ieva R, *et al*. Scared for the scar: fearsome impact of acute cardiovascular disease on perceived kinesiophobia (fear of movement). *Clin Cardiol* 2017;40:480–4.
7 WANG Yaxin SW, Guanhua JIA, Nana QIN, *et al*. The status quo and influencing factors of kinesiophobia among first-onset Acute Myocardial Infarction. *Chin Nurs Manag* 2022;22:63–9.
8 JingwenQ, XIONG JuanjuanPAN Xin GK. The status and influencing factors of kinesiophobia in elderly patients with chronic heart failure. *Chin J Nurs* 2022;57:408–14.
9 Bäck M, Cider Å, Herlitz J, *et al*. The impact on kinesiophobia (fear of movement) by clinical variables for patients with coronary artery disease. *Int J Cardiol* 2013;167:391–7.
10 Baykal Şahin H, Kalaycıoğlu E, Şahin M. The effect of cardiac rehabilitation on kinesiophobia in patients with coronary artery disease. *Turk J Phys Med Rehabil* 2021;67:203–10.
11 Winnige P, Vysoky R, Dosbaba F, *et al*. Cardiac rehabilitation and its essential role in the secondary prevention of cardiovascular diseases. *World J Clin Cases* 2021;9:1761–84.
12 Taylor RS, Dalal HM, McDonagh STJ. The role of cardiac rehabilitation in improving cardiovascular outcomes. *Nat Rev Cardiol* 2022;19:180–94.
13 Epstein E, Maisel S, Maysent K, *et al*. Cardiac rehabilitation for coronary artery disease: latest updates. *Curr Opin Cardiol* 2021;36:556–64.
14 Abraham LN, Sibilitz KL, Berg SK, *et al*. Exercise-based cardiac rehabilitation for adults after heart valve surgery. *Cochrane Database Syst Rev* 2021;5:CD010876.
15 Patel DK, Duncan MS, Shah AS, *et al*. Association of Cardiac Rehabilitation With Decreased Hospitalization and Mortality Risk After Cardiac Valve Surgery. *JAMA Cardiol* 2019;4:1250–9.
16 Ambrosetti M, Abreu A, Corra U, *et al*. Secondary prevention through comprehensive cardiovascular rehabilitation: From knowledge to implementation. 2020 update. *Eur J Prev Cardiol* 2021;28:460–95.
17 Abreu A, Frederix I, Dendale P, *et al*. Standardization and quality improvement of secondary prevention through cardiovascular rehabilitation programmes in Europe: The avenue towards EAPC accreditation programme: A position statement of the Secondary Prevention and Rehabilitation Section of the European Association of Preventive Cardiology (EAPC). *Eur J Prev Cardiol* 2021;28:496–509.
18 Budts W, Pieles GE, Roos-Hesselink JW, *et al*. Recommendations for participation in competitive sport in adolescent and adult athletes with Congenital Heart Disease (CHD): position statement of the Sports Cardiology & Exercise Section of the European Association of Preventive Cardiology (EAPC), the European Society of Cardiology (ESC) Working Group on Adult Congenital Heart Disease and the Sports Cardiology, Physical Activity and Prevention Working Group of the Association for European Paediatric and Congenital Cardiology (AEPC). *Eur Heart J* 2020;41:4191–9.
19 Wang Z, Zhang Y, Wang Y, *et al*. Kinesiophobia and its associated factors in patients with coronary heart disease: a cross-sectional study based on latent feature analysis. *BMJ Open* 2023;13:e072170.
20 Zhang X, Zhao Q, Wang M, *et al*. Fear of movement and its associated psychosocial factors in heart failure patients: a cross-sectional study. *Eur J Cardiovasc Nurs* 2023;22:273–81.
21 xiaotong H. White book of Chinese cardiovascular surgery and extracorporeal circulation in 2020. *Chin J Extracorp Circ* 2021;19:257–60.
22 Li X-F, Jiang R-J, Mao W-J, *et al*. The effect of driving pressure-guided versus conventional mechanical ventilation strategy on pulmonary complications following on-pump cardiac surgery: A randomized clinical trial. *J Clin Anesth* 2023;89:111150.
23 Martinsson A, Houltz E, Wallinder A, *et al*. Lung recruitment in the prone position after cardiac surgery: a randomised controlled study. *Br J Anaesth* 2021;126:1067–74.
24 Chu MWA, Ruel M, Graeve A, *et al*. Low-Dose vs Standard Warfarin After Mechanical Mitral Valve Replacement: A Randomized Trial. *Ann Thorac Surg* 2023;115:929–38.
25 Ramos Dos Santos PM, Aquaroni Ricci N, Aparecida Bordignon Suster É, *et al*. Effects of early mobilisation in patients after cardiac surgery: a systematic review. *Physiotherapy* 2017;103:1–12.
26 Dibben GO, Faulkner J, Oldridge N, *et al*. Exercise-based cardiac rehabilitation for coronary heart disease: a meta-analysis. *Eur Heart J* 2023;44:452–69.
27 Ding Y, Pan Y, Wang M, *et al*. Factors influencing kinesiophobia during the "blanking period" after radiofrequency catheter ablation in patients with atrial fibrillation by the fear-avoidance model. *Int J Cardiol* 2022;363:49–55.
28 Wang H, Hu F, Lyu X, *et al*. Kinesiophobia could affect shoulder function after repair of rotator cuff tears. *BMC Musculoskelet Disord* 2022;23:714.
29 Zhou M, Thayer WM, Bridges JFP. Using Latent Class Analysis to Model Preference Heterogeneity in Health: A Systematic Review. *Pharmacoeconomics* 2018;36:175–87.
30 Damar HT, Bilik Ö, Baksi A, *et al*. Examining the relationship between elderly patients' fear of falling after spinal surgery and pain, kinesiophobia, anxiety, depression and the associated factors. *Geriatr Nurs* 2021;42:1006–11.
31 LEI MengjieLT, XIONGS, SANG M. Reliability and validity test of Chinese version of the Tampa Scale for Kinesiophobia Heart. *Chin Nurs Manag* 2019;19:1637–42.
32 Hickey ML, Owen SV, Froman RD. Instrument development: cardiac diet and exercise self-efficacy. *Nurs Res* 1992;41:347–51.
33 Sun Yuxiao ZC, Zhu Y. The Chinesization and reliability and validity test of the Cardiac Exercise Self-Efficacy Instrument. *Chin J Mod Nurs* 2021;27:6.
34 Shuiyuan X. Theoretical basis and research application of social support rating Scale. *J Clin Psychiatry* 1994;39:315–25.
35 Smets EMA, Garssen B, Bonke B, *et al*. The multidimensional Fatigue Inventory (MFI) psychometric qualities of an instrument to assess fatigue. *J Psychosom Res* 1995;39:315–25.
36 Herrmann C. International experiences with the Hospital Anxiety and Depression Scale--a review of validation data and clinical results. *J Psychosom Res* 1997;42:17–41.
37 Kasaeyan Naeini E, Subramanian A, Calderon M-D, *et al*. Pain Recognition With Electrocardiographic Features in Postoperative Patients: Method Validation Study. *J Med Internet Res* 2021;23:e25079.
38 Alwekhyan SA, Alshraideh JA, Yousef KM, *et al*. Nurse-guided incentive spirometry use and postoperative pulmonary complications among cardiac surgery patients: A randomized controlled trial. *Int J Nurs Pract* 2022;28:e13023.
39 Shruti Prabhakaran NairRH, Vijayendra R. Evaluation of Fear Avoidance Belief and Kinesiophobia in Patients after Undergoing InPatient Cardiac Rehabilitation Post Cardiac Surgery. *Int J Health Sci Res* 2018.
40 Turan A, Duncan A, Leung S, *et al*. Dexmedetomidine for reduction of atrial fibrillation and delirium after cardiac surgery (DECADE): a randomised placebo-controlled trial. *Lancet* 2020;396:177–85.
41 Shi J, Zhou C, Pan W, *et al*. Effect of High- vs Low-Dose Tranexamic Acid Infusion on Need for Red Blood Cell Transfusion and Adverse Events in Patients Undergoing Cardiac Surgery: The OPTIMAL Randomized Clinical Trial. *JAMA* 2022;328:336–47.
42 Khamis RY, Ammari T, Mikhail GW. Gender differences in coronary heart disease. *Heart* 2016;102:1142–9.
43 Townsend N, Kazakiewicz D, Lucy Wright F, *et al*. Epidemiology of cardiovascular disease in Europe. *Nat Rev Cardiol* 2022;19:133–43.
44 Cífková R. Gender differences in secondary prevention of coronary heart disease: Far from closing the gap. *Int J Cardiol* 2022;355:52–3.
45 Grant SW, Ouzounian M. Closing the gender gap in cardiac surgery outcomes: more work to be done. *Eur J Cardiothorac Surg* 2022;61:703–4.
46 Ferrannini G, De Bacquer D, Vynckier P, *et al*. Gender differences in screening for glucose perturbations, cardiovascular risk factor management and prognosis in patients with dysglycaemia and coronary artery disease: results from the ESC-EORP EUROASPIRE surveys. *Cardiovasc Diabetol* 2021;20:38.
47 Chen J, Guo W, Liu H, *et al*. Translation and psychometric evaluation of a scale to measure the fear of activity in Chinese patients with coronary artery disease. *Nurs Open* 2023;10:4033–43.
48 Bäck M, Caldenius V, Svensson L, *et al*. Perceptions of Kinesiophobia in Relation to Physical Activity and Exercise After Myocardial Infarction: A Qualitative Study. *Phys Ther* 2020;100:2110–9.
49 Craske MG, Niles AN, Burklund LJ, *et al*. Randomized controlled trial of cognitive behavioral therapy and acceptance and commitment

therapy for social phobia: outcomes and moderators. *J Consult Clin Psychol* 2014;82:1034–48.
50 Bullock GS, Sell TC, Zarega R, *et al*. Kinesiophobia, Knee Self-Efficacy, and Fear Avoidance Beliefs in People with ACL Injury: A Systematic Review and Meta-Analysis. *Sports Med* 2022;52:3001–19.
51 Larsson C, Ekvall Hansson E, Sundquist K, *et al*. Kinesiophobia and its relation to pain characteristics and cognitive affective variables in older adults with chronic pain. *BMC Geriatr* 2016;16:128.
52 Alpalhão V, Cordeiro N, Pezarat-Correia P. Kinesiophobia and Fear Avoidance in Older Adults: A Scoping Review on the State of Research Activity. *J Aging Phys Act* 2022;30:1075–84.
53 Gunn AH, Schwartz TA, Arbeeva LS, *et al*. Fear of Movement and Associated Factors Among Adults With Symptomatic Knee Osteoarthritis. *Arthritis Care Res (Hoboken)* 2017;69:1826–33.
54 Archer KR, Devin CJ, Vanston SW, *et al*. Cognitive-Behavioral-Based Physical Therapy for Patients With Chronic Pain Undergoing Lumbar Spine Surgery: A Randomized Controlled Trial. *J Pain* 2016;17:76–89.
55 Reinking S, Seehusen CN, Walker GA, *et al*. Transitory kinesiophobia after sport-related concussion and its correlation with reaction time. *J Sci Med Sport* 2022;25:20–4.
56 Bäck M, Lundberg M, Cider Å, *et al*. Relevance of Kinesiophobia in Relation to Changes Over Time Among Patients After an Acute Coronary Artery Disease Event. *J Cardiopulm Rehabil Prev* 2018;38:224–30.
57 Mudumbai SC, Kim TE, Howard SK, *et al*. An ultrasound-guided fascia iliaca catheter technique does not impair ambulatory ability within a clinical pathway for total hip arthroplasty. *Korean J Anesthesiol* 2016;69:368–75.
58 Feng S, Xie B, Li Z, *et al*. Retrospective Study on the Application of Enhanced Recovery After Surgery Measures to Promote Postoperative Rehabilitation in 50 Patients With Brain Tumor Undergoing Craniotomy. *Front Oncol* 2021;11:755378.
59 Daskivich TJ, Houman J, Lopez M, *et al*. Association of Wearable Activity Monitors With Assessment of Daily Ambulation and Length of Stay Among Patients Undergoing Major Surgery. *JAMA Netw Open* 2019;2:e187673.
60 Piao JJ, Gu Y, Ling Y, *et al*. Mediating effect of kinesiophobia between self-efficacy and physical activity levels in post-CABG patients: protocol for a prospective, multicentre, cross-sectional study in China. *BMJ Open* 2022;12:e062013.
61 Du S, Hu L, Bai Y, *et al*. The Influence of Self-Efficacy, Fear-Avoidance Belief, and Coping Styles on Quality of Life for Chinese Patients with Chronic Nonspecific Low Back Pain: A Multisite Cross-Sectional Study. *Pain Pract* 2018;18:736–47.
62 Schwarzer R, Antoniuk A, Gholami M. A brief intervention changing oral self-care, self-efficacy, and self-monitoring. *Br J Health Psychol* 2015;20:56–67.
63 Lin AW, Dollahite JS, Sobal J, *et al*. Health-related knowledge, beliefs and self-efficacy in women with polycystic ovary syndrome. *Hum Reprod* 2018;33:91–100.
64 ZYT SY. Influence Path of Self-efficacy and Coping Methods on Self-care Behaviors of Patients with Chronic Cardiac Failure. *Nursing J Chin Peoples Lib Army* 2017;2023–12.
65 Meng Y, Deng B, Liang X, *et al*. Effectiveness of self-efficacy-enhancing interventions on rehabilitation following total hip replacement: a randomized controlled trial with six-month follow-up. *J Orthop Surg Res* 2022;17:225.
66 Kroemeke A, Sobczyk-Kruszelnicka M. Interaction effect of coping self-efficacy and received support in daily life of hematopoietic cell transplant patient-caregiver dyads. *PLoS ONE* 2021;16:e0260128.
67 Egerton T, Bennell KL, McManus F, *et al*. Comparative effect of two educational videos on self-efficacy and kinesiophobia in people with knee osteoarthritis: an online randomised controlled trial. *Osteoarthr Cartil* 2022;30:1398–410.
68 Asiri F, Reddy RS, Tedla JS, *et al*. Kinesiophobia and its correlations with pain, proprioception, and functional performance among individuals with chronic neck pain. *PLoS ONE* 2021;16:e0254262.
69 Vlaeyen JWS, Linton SJ. Fear-avoidance and its consequences in chronic musculoskeletal pain: a state of the art. *Pain* 2000;85:317–32.
70 Giusti EM, Lacerenza M, Manzoni GM, *et al*. Psychological and psychosocial predictors of chronic postsurgical pain: a systematic review and meta-analysis. *Pain* 2021;162:10–30.
71 Tan M, Liu Y, Zhao R, *et al*. The effect of pain social support on kinesiophobia in older patients with rheumatoid arthritis: The mediating role of self-perceived burden. *Geriatr Nurs* 2023;50:52–7.
72 Keessen P, Latour CHM, van Duijvenbode ICD, *et al*. Factors related to fear of movement after acute cardiac hospitalization. *BMC Cardiovasc Disord* 2020;20:495.
73 SY X. The theoretical basis and application of social support questionnaire. *Clin Psychol Med* 1994;1994:98–100.
74 Langford CPH, Bowsher J, Maloney JP, *et al*. Social support: a conceptual analysis. *J Adv Nurs* 1997;25:95–100.