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Effects of Different Surgery Time Windows on Clinical Efficacy of Hip Arthroplasty in Elderly Patients with Femoral Neck Fractures in Western Guangxi Region

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ABSTRACT

Objective: To investigate whether the time from injury to surgery (≤48 h) affects perioperative indicators, postoperative pain, hip function recovery, and complication rates in elderly patients with femoral neck fractures undergoing total hip arthroplasty in western Guangxi region. Methods: A retrospective cohort study design was employed. A total of 120 elderly (≥65 years old) patients with femoral neck fractures who underwent total hip arthroplasty at the Department of Joint Surgery, Baise People's Hospital from September 2020 to June 2026 were enrolled. Patients were divided into early surgery group (≤48 h, n = 60) and delayed surgery group (>48 h, n = 60) based on the time from injury to surgery. General information, intraoperative blood loss, hospital stay, preoperative and postoperative hemoglobin and albumin levels, preoperative D-dimer, visual analogue scale (VAS) scores at various postoperative time points, Harris hip scores at 1 week and 1 month postoperatively, and postoperative complication rates were compared between the two groups. Results: No statistically significant differences were found in gender or age between the two groups (P > 0.05). The early surgery group had a shorter hospital stay than the delayed surgery group [(8.62 ± 4.83) d vs (12.07 ± 5.70) d, P < 0.001]. No statistically significant differences were found in intraoperative blood loss or preoperative and postoperative hemoglobin levels between the two groups (P > 0.05). The early surgery group had higher preoperative albumin levels than the delayed surgery group [(40.65

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± 3.65) g/L vs (38.93 ± 2.92) g/L, P = 0.005], with no statistically significant difference in postoperative albumin levels (P > 0.05). The early surgery group had higher preoperative D-dimer levels [M = 5672.5 vs 1372.0 ng/ml, P = 0.001]. Harris scores at 1 week and 1 month postoperatively were higher in the early surgery group than in the delayed surgery group [(60.42 ± 3.71) vs (56.83 ± 3.20) points; (66.57 ± 4.04) vs (62.38 ± 2.31) points, both P < 0.001]. VAS scores at postoperative days 1, 2, 3, and 1 week were lower in the early surgery group than in the delayed surgery group (P < 0.05), with no statistically significant difference at 1 month postoperatively (P > 0.05). No statistically significant differences were found in prosthesis-related complications, postoperative hematoma/deep vein thrombosis/pneumonia rates between the two groups (P > 0.05). Conclusion: For elderly patients with femoral neck fractures in western Guangxi region, performing hip arthroplasty within 48 h after injury, provided that the general condition permits, can shorten hospital stay, alleviate early postoperative pain, and promote hip function recovery. However, the effects on intraoperative blood loss, postoperative laboratory indicators, and complication rates require validation through larger sample studies.

1. INTRODUCTION

Femoral neck fracture is one of the most common severe lower extremity traumas in the elderly population. Due to osteoporosis, decreased balance ability, and increased fall risk, its incidence rises markedly with age [1]. After such fractures, patients require prolonged bed rest, and complications related to bed rest such as hypostatic pneumonia, deep vein thrombosis, pressure ulcers, and delirium follow sequentially, with a 1-year mortality rate reaching 20% - 30%, earning it the nickname "the last fracture of life" [2]. With the popularization of joint surgery and enhanced recovery after surgery (ERAS) concepts, domestic and international guidelines advocate early surgery after medical conditions stabilize, aiming to enable early ambulation, shorten hospital stay, and reduce mortality risk [3]. The American guideline for hip fractures in the elderly recommends completing surgery within 48 h of admission, while a multi-center survey in China showed that less than 20% of patients actually undergo surgery within 48 h, with over 80% experiencing wait times exceeding 48 h [4].

Western Guangxi region is located at the junction of Yunnan, Guizhou, and Guangxi provinces, with large mountainous areas, relatively lagging economic development, concentrated ethnic minority populations, and uneven distribution of primary medical resources. Local elderly patients often experience prolonged time from injury to surgery due to multiple referral steps, need for medical comorbidity management, and payment system constraints. Current research on surgery time windows mainly comes from tier-3 hospitals in eastern major cities, and clinical evidence specific to western Guangxi as a distinct geographic and economic region remains limited. This study retrospectively analyzed data from 120 elderly patients with femoral neck fractures undergoing hip arthroplasty at Baise People's Hospital, comparing early versus delayed surgery at the 48-h threshold for periprocedural indicators, postoperative pain, hip function, and complications, aiming to provide data reference for developing region-appropriate diagnostic and treatment pathways for elderly hip fractures in western Guangxi.

2. MATERIALS AND METHODS

2.1. General Information

A retrospective cohort study design was used. Elderly patients with femoral neck fractures admitted to the Department of Joint Surgery, Baise People's Hospital from September 2020 to June 2026 were enrolled. Inclusion criteria were: (1) age ≥ 65 years; (2) imaging-confirmed fresh unilateral femoral neck fracture; (3) underwent total hip arthroplasty; (4) complete clinical and follow-up data. Exclusion criteria were: (1) old

fractures more than 3 weeks post-injury; (2) concurrent fractures in other parts of the ipsilateral or contralateral limb; (3) pathologic fractures or tumor-related fractures; (4) severe psychiatric illness or cognitive impairment precluding follow-up cooperation; (5) missing key data. A total of 120 cases were enrolled and divided into early surgery group (≤48 h, n = 60) and delayed surgery group (>48 h, n = 60) based on time from injury to surgery. The study protocol was approved by the Medical Ethics Committee of Baise People's Hospital, and all patients' families signed informed consent for surgery.

2.2. Surgical Procedures

Both groups were operated by the same senior joint surgery team. Patients were placed in lateral decubitus position under general anesthesia with endotracheal intubation, and routine disinfection and draping were performed. A posterior-lateral approach to the hip was used. The skin, subcutaneous tissue, and deep fascia were incised layer by layer. The gluteus maximus was bluntly dissected, the short external rotator tendons were severed and retracted proximally, and the joint capsule was incised in a "T" shape. The femoral neck was osteotomized vertically approximately 1.5 cm above the femoral calcar, and the femoral head was removed and its diameter measured. The acetabulum was reamed stepwise to subchondral bone bleeding. The non-cemented acetabular component was implanted at 40˚ abduction and 15˚ anteversion, and after confirming stable fixation, the polyethylene liner was inserted. The femoral canal was sequentially reamed. After trial reduction, limb length and hip stability were assessed. With no dislocation observed at 45˚ internal rotation, 90˚ abduction/adduction, and 90˚ flexion, the trial component was removed. The femoral canal was irrigated with 0.9% sodium chloride injection, and the non-cemented femoral stem and femoral head prosthesis were implanted. After reducing the joint, range of motion and stability in all directions were rechecked. The wound was repeatedly irrigated, the short external rotators were repaired, the incision was closed layer by layer, and one blood drain was left in place. Both groups received the same ERAS protocol postoperatively, including multimodal analgesia, low-molecular-weight heparin anticoagulation, active ankle pump exercises and muscle contraction training on postoperative day 1, and assisted standing and ambulation with a walker on postoperative day 2.

2.3. Outcome Measures

(1) Periprocedural indicators, including surgical side, intraoperative blood loss, and hospital stay; (2) Laboratory indicators, including preoperative and postoperative day 1 hemoglobin and albumin, and preoperative D-dimer; (3) Pain assessment, recorded using the visual analogue scale (VAS) for resting pain at postoperative days 1, 2, 3, 1 week, and 1 month; (4) Hip function, assessed using the Harris Hip Score (HHS) at 1 week and 1 month postoperatively. This scale includes four dimensions: pain, function, deformity, and range of motion, with a total score of 100 points; higher scores indicate better hip function; (5) Postoperative complications, including prosthetic dislocation, loosening, periprosthetic fracture, surgical site hematoma, deep vein thrombosis, pulmonary infection, and pressure ulcers, as well as incision primary healing rate.

2.4. Statistical Methods

Statistical analysis was performed using SPSS 26.0 software. Normally distributed continuous variables are expressed as mean ± standard deviation ($\bar{x}$ ± s) and compared between groups using the independent samples t-test. Skewed distributed continuous variables are expressed as median (M) and interquartile range [P25, P75] and compared using the Mann-Whitney U test. Categorical variables are expressed as number and percentage [n (%)] and compared between groups using the chi-square test or Fisher's exact test. $P < 0.05$ was considered statistically significant.

3. RESULTS

3.1. Comparison of General Information Between Two Groups

The early surgery group included 60 cases (18 males, 42 females), aged 61 - 99 years (mean 77.98 ± 8.97

years); the delayed surgery group included 60 cases (17 males, 43 females), aged 56 - 95 years (mean 77.13 ± 8.50 years). No statistically significant differences were found in gender or age between the two groups (P > 0.05), indicating comparability. See Table 1.

Table 1. Comparison of general information between two groups.

Item	Early group (n = 60)	Delayed group (n = 60)	Statistic	P value
Gender (male/female, cases)	18/42	17/43	$\chi^2 = 0.000$	1.000
Age (years, $\bar{x} \pm s$)	77.98 ± 8.97	77.13 ± 8.50	t = 0.533	0.595

3.2. Comparison of Periprocedural Indicators between Two Groups

The hospital stay in the early surgery group was (8.62 ± 4.83) d, significantly shorter than (12.07 ± 5.70) d in the delayed surgery group, with high statistical significance (P < 0.001). Intraoperative blood loss was (151.0 ± 129.9) ml in the early surgery group versus (160.8 ± 142.7) ml in the delayed surgery group, with no statistically significant difference (P = 0.695). See Table 2.

Table 2. Comparison of periprocedural indicators between two groups ($\bar{x} \pm s$).

Indicator	Early group	Delayed group	t value	P value
Hospital stay (d)	8.62 ± 4.83	12.07 ± 5.70	−3.579	<0.001
Intraoperative blood loss (ml)	151.0 ± 129.9	160.8 ± 142.7	−0.394	0.695

3.3. Comparison of Preoperative and Postoperative Laboratory Indicators between Two Groups

No statistically significant difference was found in preoperative hemoglobin between the two groups [(121.3 ± 15.1) g/L vs (119.9 ± 21.5) g/L, P = 0.688]. Postoperative hemoglobin decreased significantly compared to preoperative levels in both groups, but no statistically significant difference was found between groups postoperatively (P = 0.720). The early surgery group had higher preoperative albumin levels than the delayed surgery group [(40.65 ± 3.65) g/L vs (38.93 ± 2.92) g/L, P = 0.005]; postoperatively, both groups showed significant decreases in albumin compared to preoperative levels, but no statistically significant difference was found between groups (P = 0.360). Due to missing D-dimer tests on admission for some patients, 52 cases in the early group and 51 cases in the delayed group were included in the analysis. The median preoperative D-dimer was 5672.5 ng/ml in the early group, higher than 1372.0 ng/ml in the delayed group, with statistical significance (P = 0.001). See Table 3.

Table 3. Comparison of preoperative and postoperative laboratory indicators between two groups.

Indicator	Early group	Delayed group	Statistic	P value
Preoperative hemoglobin (g/L)	121.3 ± 15.1	119.9 ± 21.5	t = 0.403	0.688
Postoperative hemoglobin (g/L)	105.5 ± 13.2	104.5 ± 17.1	t = 0.359	0.720
Preoperative albumin (g/L)	40.65 ± 3.65	38.93 ± 2.92	t = 2.855	0.005
Postoperative albumin (g/L)	31.33 ± 4.02	30.69 ± 3.49	t = 0.919	0.360
D-dimer [ng/ml, M (P25, P75)]	5672.5 (2352.0, 9128.3)	1372.0 (845.0, 4885.0)	Z = −3.206	0.001

3.4. Comparison of Postoperative Hip Harris Scores Between Two Groups

At 1 week postoperatively, the Harris score was (60.42 ± 3.71) points in the early surgery group, higher than (56.83 ± 3.20) points in the delayed surgery group, with high statistical significance ($P < 0.001$). At 1 month postoperatively, the early surgery group increased to (66.57 ± 4.04) points and the delayed surgery group to (62.38 ± 2.31) points, with the early surgery group still higher, with high statistical significance ($P < 0.001$). Both groups showed significant improvement at 1 month compared to 1 week postoperatively, with statistically significant within-group differences. See Figure 1.

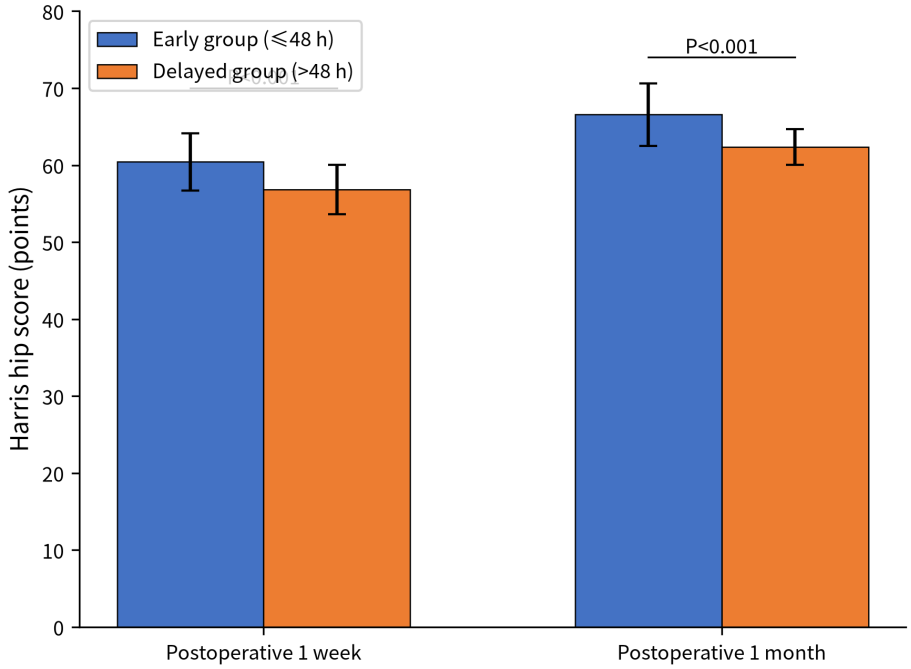


Figure 1. Comparison of postoperative Harris hip scores at various time points between two groups.

3.5. Comparison of Postoperative VAS Pain Scores at Various Time Points between Two Groups

VAS scores at postoperative days 1, 2, 3, and 1 week were lower in the early surgery group than in the delayed surgery group, with statistically significant differences ($P < 0.05$). At 1 month postoperatively, VAS scores in both groups decreased to mild pain levels, with no statistically significant difference between groups ($P = 0.231$). See Table 4 and Figure 2.

Table 4. Comparison of postoperative VAS scores at various time points between two groups (points).

Postoperative time point	Early group M (P25, P75)	Delayed group M (P25, P75)	Z value	P value
Day 1	6.0 (6.0, 7.0)	7.0 (6.0, 7.0)	−2.026	0.042
Day 2	4.0 (3.0, 5.0)	4.0 (3.8, 5.0)	−2.969	0.003
Day 3	3.0 (2.8, 4.0)	3.0 (3.0, 4.0)	−2.281	0.023
1 week	2.0 (2.0, 3.0)	3.0 (2.0, 3.0)	−2.285	0.023
1 month	1.5 (1.0, 2.0)	2.0 (1.0, 2.0)	−1.199	0.231

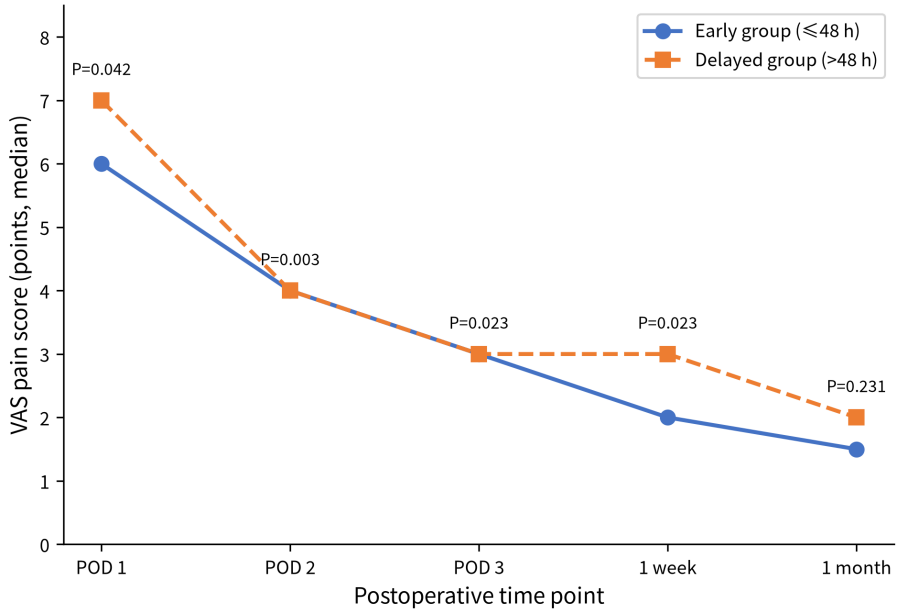


Figure 2. Comparison of postoperative VAS pain scores at various time points between two groups.

3.6. Comparison of Postoperative Complications and Incision Healing between Two Groups

One case (1.67%) of prosthetic dislocation, loosening, or periprosthetic fracture occurred in the early surgery group and 1 case (1.67%) in the delayed surgery group, with no statistically significant difference (P = 1.000). Postoperative surgical site hematoma, deep vein thrombosis, or pneumonia occurred in 32 cases (53.33%) in the early surgery group and 32 cases (53.33%) in the delayed surgery group, with no statistically significant difference (P = 1.000). Pressure ulcers occurred in 1 case (1.67%) in the early surgery group and 3 cases (5.00%) in the delayed surgery group, with no statistically significant difference (P = 0.611). Primary incision healing was achieved in 48 cases (80.00%) in the early surgery group and 60 cases (100.00%) in the delayed surgery group, with a statistically significant difference in primary healing rates between groups (P < 0.001). See Table 5.

Table 5. Comparison of postoperative complications and incision healing between two groups.

Complication type	Early group [n (%)]	Delayed group [n (%)]	χ^2 value	P value
Prosthetic dislocation/loosening/ periprosthetic fracture	1 (1.67)	1 (1.67)	0.000	1.000
Hematoma/DVT/pneumonia any	32 (53.33)	32 (53.33)	0.000	1.000
Pressure ulcer	1 (1.67)	3 (5.00)	0.259	0.611
Primary incision healing	48 (80.00)	60 (100.00)	11.204	<0.001

4. DISCUSSION

The timing of surgery after femoral neck fracture in the elderly has long been a hot topic of discussion at the intersection of joint surgery and geriatric medicine. Proponents of early surgery argue that early restoration of limb function can shorten bed rest time, reduce bed rest-related complications such as hypostatic

pneumonia, deep vein thrombosis, and pressure ulcers, while alleviating patient pain and reducing the incidence of postoperative delirium [5]. Those advocating delayed surgery emphasize that elderly patients often have medical comorbidities such as hypertension, diabetes mellitus, coronary heart disease, and chronic obstructive pulmonary disease, and rushed surgery may increase the risk of anesthesia-related and periprocedural cardiovascular events; therefore, medical conditions should be optimized before surgery [6]. Given that primary healthcare institutions in western Guangxi have limited preoperative evaluation capabilities, multiple referral steps, and some patients face economic constraints, the time from injury to surgery often exceeds 48 h in clinical practice, making the relationship between surgery time window and clinical outcomes in this region worthy of separate investigation.

This study showed that the early surgery group had significantly shorter hospital stays than the delayed surgery group, consistent with most domestic and international studies [7] [8]. This may be because early surgery patients experience faster pain relief and can get out of bed to stand and walk earlier, accelerating postoperative recovery; whereas delayed surgery patients remain on bed rest for longer preoperatively and require extended time postoperatively to regain strength, consequently prolonging the overall hospitalization period. For regions like western Guangxi with relatively limited medical resources and healthcare funds, shortening hospital stay not only accelerates bed turnover but also reduces family caregiving costs and total medical expenditures, demonstrating significant health economic implications.

No statistically significant difference in intraoperative blood loss was found between the two groups in this study, suggesting that the surgery time window did not significantly affect the operative trauma itself. Preoperative hemoglobin baseline was similar between groups, and both showed comparable postoperative decreases, indicating similar hematologic impact of surgery. The early surgery group had higher preoperative albumin levels than the delayed group; this difference may be related to inadequate nutritional intake, chronic consumption, and stress response during the preoperative waiting period in the delayed group; however, postoperatively both groups showed comparable albumin decreases, suggesting similar degrees of protein catabolism from surgical trauma. The early surgery group had markedly higher preoperative D-dimer levels, which may be because early surgery patients underwent surgery shortly after injury when the post-traumatic coagulation cascade activation products had not yet been metabolically cleared, whereas in the delayed group, coagulation activation products had undergone partial metabolism during the preoperative waiting period, resulting in relatively lower measured values. This finding suggests that D-dimer levels are heavily influenced by time since injury and should not be used as an absolute indicator of thrombosis risk alone; clinical interpretation should incorporate the time since injury.

Regarding hip function recovery, this study found that Harris scores at 1 week and 1 month postoperatively were significantly higher in the early surgery group than in the delayed surgery group, consistent with the findings of Chen Jun *et al.* [9] and Jiang Luoyong *et al.* [10]. Early surgery allows restoration of hip stability shortly after fracture, enabling early initiation of range of motion and muscle strength training, avoiding joint stiffness and muscle atrophy from prolonged immobilization. Delayed surgery patients suffer quadriceps atrophy and periarticular soft tissue adhesions from prolonged preoperative bed rest; even with successful surgery, postoperative recovery is relatively slower. Regarding pain, VAS scores at postoperative days 1 - 3 and 1 week were lower in the early surgery group, suggesting an advantage of early surgery in alleviating fracture-related pain; at 1 month postoperatively, both groups' pain decreased to mild levels with no significant intergroup difference, suggesting that the effect of surgery time window on pain is primarily manifested in the early postoperative period.

Regarding complications, no statistically significant differences were found between groups in prosthesis-related complications, combined hematoma/DVT/pneumonia rates, or pressure ulcer rates, which is not entirely consistent with some previous reports. Possible explanations include: first, this was a single-center retrospective study with only 120 cases, limiting statistical power to detect true intergroup differences; second, in recent years, Baise People's Hospital has routinely implemented multidisciplinary consultations for elderly hip fracture patients, with standardized postoperative anticoagulation, respiratory training, and nursing care, resulting in relatively consistent periprocedural management regardless of surgery timing, which

may have narrowed intergroup complication differences. The higher primary healing rate in the delayed group is an unexpected finding that may be related to nutritional issues such as anemia and hypoalbuminemia in some early group patients at admission; larger sample studies are needed for further analysis.

The clinical significance of this study is that for elderly patients with femoral neck fractures in western Guangxi region, surgery should be completed within 48 h after injury whenever conditions permit, to shorten hospital stay, alleviate early postoperative pain, and promote hip function recovery. It is recommended that tier-2 and above hospitals in this region establish rapid pathways coordinating orthopedics, anesthesiology, geriatrics, and pulmonologygeriatric hip fracture standardized treatment guidelines, reducing unnecessary preoperative wait times; meanwhile, improving medical insurance coordination and primary transfer processes for economically disadvantaged and referral-difficult patients, enabling more elderly patients in western Guangxi to benefit from early surgery [11] [12].

5. CONCLUSION

For elderly patients with femoral neck fractures in western Guangxi region, performing total hip arthroplasty within 48 h after injury, provided that the general condition tolerates surgery, can shorten hospital stay, alleviate early postoperative pain, and promote early hip function recovery. The effects of surgery timing on intraoperative blood loss, postoperative hemoglobin and albumin levels, prosthesis-related complications, and combined thromboembolic/pulmonary complication rates require further validation through multicenter, large-sample prospective studies.

6. LIMITATIONS OF THIS STUDY

This study has the following limitations. First, it was a single-center retrospective study with patients recruited from Baise People's Hospital only; results should be extrapolated to other primary hospitals in western Guangxi with caution. Second, the sample size was relatively small, limiting statistical power for some subgroup analyses; future studies should enlarge sample size and pursue multicenter collaboration. Third, the follow-up period was short, extending only to 1 month postoperatively, lacking long-term functional and mortality data at 3 months, 6 months, and 1 year. Fourth, specific reasons for surgery delay (e.g., medical comorbidity management, bed waiting, patient-related factors) were not further analyzed; different causes of delay may have different prognostic implications, and subgroup analysis could be pursued in future studies.

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DECLARATION OF COMPETING INTEREST

All authors of this study declare that no personal or commercial conflicts of interest exist during the conduct of this research and manuscript preparation. No financial support or technical assistance was received from any enterprise or organization. The research data are authentic and objective, with no fabrication

or manipulation. All authors have reviewed and approved the submission of this manuscript.

AUTHOR CONTRIBUTIONS

Huaheng LI: Study design, statistical analysis, manuscript drafting; Zhipeng HUANG: Study design, data collection and curation, manuscript review and editing; Xiannian SHAO: Data collection, data curation; Jialong NONG: Data collection, data curation; Jiabao WU: Data collection, data curation; Guosheng SU: Conceptualization, manuscript review and editing, supervision; Jili LU: Conceptualization, manuscript review and editing, supervision.

CONFLICTS OF INTEREST

The authors declare no conflicts of interest regarding the publication of this paper.

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