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Prognostic nomogram for early-stage cervical cancer in the elderly: A SEER database analysis

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ABSTRACT

Background: To identify key clinical factors affecting the survival of elderly patients with early-stage cervical cancer and to construct a nomogram for predicting their prognosis.

Methods: Patients (aged $\geq$ 65 years old) diagnosed with cervical cancer between 2004 and 2015 at clinical stages IA to IIA were included in this study. Diagnosis was confirmed via pathological examination, and the cases were randomly divided into a training or a validation group in a 7:3 ratio. Univariate and multivariable Cox regression analyses were performed to identify independent factors affecting the prognosis of elderly early-stage cervical cancer patients, based on which a nomogram was constructed to predict their 12-, 24- and 36-month overall survival (OS). The nomogram's performance was evaluated using receiver operating characteristic (ROC) curves, calibration curves and decision curve analysis (DCA) curves.

Results: A total of 686 patients were identified as eligible and assessed. Multivariable Cox proportional hazard regression analysis revealed that age, tumor diameter, marital status and surgical intervention were independent prognostic factors for elderly individuals with early-stage cervical cancer, which were then used to construct the nomogram. The calibration curves showed a strong correlation between predicted and observed survival rates, and Kaplan-Meier survival curves for different risk subgroups demonstrated significant survival differences ($P < 0.001$). DCA confirmed the nomogram's clinical utility in predicting the prognosis of elderly patients with early-stage cervical cancer.

Conclusion: The prognostic model developed in this study can accurately predict the OS of elderly patients with early-stage cervical cancer, showing high concordance with actual clinical outcomes.

1. Introduction

Cervical cancer is one of the most prevalent and fatal malignancies among females in China, ranking as the fourth most common gynecological malignancy worldwide (Bray et al., 2018). With the ongoing aging of the population, the incidence of cervical cancer in the elderly population has been steadily rising, as supported by the research findings of Feldman et al. (Feldman et al., 2018), who found a continuous increase in the incidence of cervical cancer in individuals aged 65 and older during the years 2013 to 2015. Similarly, literature reports indicate that in 2015, approximately 111,000 new cases of cervical cancer were diagnosed in China, with individuals aged $\geq$ 60 years old constituting 23.5 % of these cases (Chen et al., 2016).

Advancements in medical technology and an increased awareness of health have led to a gradual improvement in the early detection rate of cervical cancer, which has significantly enhanced the quality of life and survival rates of cervical cancer patients (LI et al., 2019). The primary treatment modality for early-stage cervical cancer remains surgical intervention. However, elderly patients typically have weaker physical constitutions compared to younger patients and often present with various comorbid chronic conditions, resulting in a higher surgical risk. Consequently, treatment choices tend to be more conservative among elderly cervical cancer patients, which may lead to poorer prognoses. However, there is a lack of literature concerning prognostic evaluations specific to elderly cervical cancer patients.

The Surveillance, Epidemiology, and End Results (SEER) database

Abbreviations: OS, overall survival; ROC, receiver operating characteristic; DCA, decision curve analysis; SEER, Surveillance, Epidemiology, and End Results; AJCC, American Joint Committee on Cancer; SPSS, Statistical Package for the Social Sciences; AUC, area under the curve.

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contains clinical data from millions of malignant tumor patients, providing extensive support for clinical research (Gudauskiene et al., 2019). Nomograms are known for their intuitiveness and convenience and have already found wide application in medical research on various malignancies, including prostate cancer and breast cancer (Farrokhi et al., 2020). In this study, we conducted a retrospective analysis using the clinical data of early-stage cervical cancer patients aged 65 or older diagnosed from 2004 to 2015 with the SEER*Stat software to establish and validate a prognostic prediction model for these patients. Overall, this research aims to enhance clinical awareness on the prognosis of cervical cancer in elderly patients, which could be used as a reference for designing optimal treatment strategies for elderly early-stage cervical cancer patients.

2. Methods

2.1. Patients and data collection

This study utilized data obtained from the SEER*Stat software version 8.3.6, which consists of de-identified patient information. Accordingly, the research is classified as exempt from the need for ethical approval by the institutional review board of our institution, as it involves the use of publicly available, anonymized databases. Our study is also in compliance with the guidelines for the protection of human subjects, ensuring the safety and privacy of individuals, does not require patient informed consent and adheres to the principles outlined in the Declaration of Helsinki for medical research involving human subjects.

2.2. Inclusion and exclusion criteria

The study inclusion criteria were: (1) patients diagnosed with cervical cancer following pathological examination between 2004 and 2015; (2) staged as IA-IIA according to the 8th edition of the American Joint Committee on Cancer (AJCC); (3) aged over 65 years; and (4) had complete records of clinicopathological factors assessed for this study. Cervical cancer cases were excluded for the following reasons: (1) diagnosed post-mortem or through death certificates, and (2) had unclear records of study required clinicopathological factors.

Eligible patients were randomly divided into a training group (70 % of cases) and a validation group (30 % of cases) using the R software. Data from the training group were used for nomogram construction, and those from the validation group were used for model validation.

2.3. Study variables

The variables selected for the construction of the nomogram included: (1) demographic variables such as age, race, marital status, and insurance status; (2) tumor clinicopathological characteristics including SEER tumor location type, histological type, grade of differentiation, T stage, and tumor size; and (3) treatment modalities comprising surgery, chemotherapy, and radiotherapy. The primary outcome measured in this study was overall survival (OS), defined as the duration from the diagnosis date to the date of death from any cause.

2.4. Statistical analysis

All statistical analyses in this study were conducted using Statistical Package for the Social Sciences (SPSS) version 25.0 and R software version 3.6.1. Patients were randomly divided into training and validation groups at a 7:3 ratio using R software. The optimal cutoff values for age and tumor size were determined using X-tile software (Tian, 2021), and for ease of data handling, age was categorized into three groups: <74 years, 74–83 years, and > 83 years; the optimal tumor diameter categorization was: <27 mm, 27–59 mm, and > 59 mm. Moreover, T stage was categorized as T1a1, T1a2, T1b1, T1b2, and T2a, and the tumor histological type was categorized as squamous cell carcinoma and non-squamous cell carcinoma. The chi-square test was employed to compare variables between the training and validation groups. Overall, $P < 0.05$ (two-tailed) was considered statistically significant.

To identify independent prognostic factors in elderly early-stage cervical cancer patients, we initially conducted univariate Cox regression analysis and incorporated variables with $P < 0.05$ into multivariable Cox regression analysis. Then, variables with $P < 0.05$ in the multivariable analysis were determined as independent prognostic factors, which were then used to build the nomogram utilizing the “rms” package in R software (Jr, 2020). We projected the impact of each variable’s distinct categories onto a point scale, based on which their sum corresponds to the patient’s total score, from which their 12-month, 24-month, and 36-month OS rates could be determined. Additionally, receiver operating characteristic (ROC) curves were generated for the nomogram to assess its specificity and sensitivity, with the area under the curve (AUC) calculated.

Furthermore, ROC curves for all independent variables or time-dependent ROC curves were generated and compared with the corresponding nomogram AUC values. Calibration curves and decision curve analysis (DCA) curves were also established to evaluate the nomogram. Lastly, based on the optimal cutoff value for risk scores, patients in the training and validation cohorts were stratified into high-risk, intermediate-risk, and low-risk groups, and log-rank tests of Kaplan-Meier survival curves were performed to validate the prognostic value of the nomogram.

3. Results

3.1. Baseline patient characteristics

Based on our predefined inclusion and exclusion criteria, a total of 686 elderly early-stage cervical cancer patients were found eligible for this study. Among them, 482 patients were assigned to the training group and the remaining 204 patients were assigned to the validation group. Data analysis showed that the optimal cutoff values for age were 74 years and 83 years. The pathological characteristics of elderly cervical cancer patients revealed that 69.1 % (474/686) had squamous cell carcinoma, while 30.9 % (212/686) had non-squamous cell carcinoma. Regarding tumor differentiation grade, our present study observed that the majority of patients had moderately differentiated (42.57 %) and poorly differentiated (41.98 %) tumors, followed by highly differentiated (11.95 %) and undifferentiated (3.5 %) tumors. Chi-square tests indicated that the distribution of variables showed no statistically significant difference between the training and validation groups ($P > 0.05$). The detailed information is provided in Table 1.

3.2. Independent prognostic factors in elderly early-stage cervical cancer patients

Univariate and multivariable Cox proportional hazard regression analyses were then conducted to identify prognostic factors that significantly influenced the OS of the elderly patients (Table 2). Univariate Cox regression analysis revealed that age, SEER tumor localization, T stage, marital status, tumor diameter and surgical intervention were significant factors for elderly early-stage cervical cancer patients ($P < 0.05$). Furthermore, after performing multivariable Cox regression analysis, age, tumor diameter, marital status and surgical intervention were found to be independent factors affecting the OS of the elderly early-stage cervical cancer patients (all $P < 0.05$). Kaplan-Meier survival analysis also demonstrated a significant difference in the survival of the patients based on age, tumor diameter, marital status and surgical intervention (all $P < 0.05$) (Fig. 1 **A-D**).

Table 1
Descriptive statistics and comparison of elderly early-stage cervical cancer patients baseline characteristics between the training and validation cohorts of SEER database during 2004–2015.

Characteristics		Cohort			P-value
		Total, N = 686 (n, %)	Training, N = 482 (n, %)	Validation, N = 204 (n, %)	
Age	<74	396 (57.73)	288 (59.75)	108 (52.94)	0.0597
	74–83	214 (31.20)	149 (30.91)	65 (31.86)	
	>83	76 (11.08)	45 (9.34)	31 (15.20)	
Race	Black	87 (12.68)	62 (12.86)	25 (12.25)	0.4511
	Other	83 (12.10)	63 (13.07)	20 (9.80)	
	White	516 (75.22)	357 (74.07)	159 (77.94)	
Histological grade	Grade I	82 (11.95)	60 (12.45)	22 (10.78)	0.4851
	Grade II	292 (42.57)	196 (40.66)	96 (47.06)	
	Grade III	288 (41.98)	209 (43.36)	79 (38.73)	
	Grade IV	24 (3.50)	17 (3.53)	7 (3.43)	
Pathological type	SCC	474 (69.10)	338 (70.12)	136 (66.67)	0.4205
	Non-SCC	212 (30.90)	144 (29.88)	68 (33.33)	
Tumor size (mm)	<27	327 (47.67)	219 (45.44)	108 (52.94)	0.1981
	27–59	281 (40.96)	206 (42.74)	75 (36.76)	
	>59	78 (11.37)	57 (11.83)	21 (10.29)	
T stage*	T1a1	56 (8.16)	39 (8.09)	17 (8.33)	0.6427
	T1a2	36 (5.25)	26 (5.39)	10 (4.90)	
	T1b1	356 (51.90)	244 (50.62)	112 (54.90)	
	T1b2	117 (17.06)	89 (18.46)	28 (13.73)	
	T2a	121 (17.64)	84 (17.43)	37 (18.14)	
Surgery	No	175 (25.51)	117 (24.27)	58 (28.43)	0.2955
	Yes	511 (74.49)	365 (75.73)	146 (71.57)	
Radiotherapy	No	316 (46.06)	224 (46.47)	92 (45.10)	0.8053
	Yes	370 (53.94)	258 (53.53)	112 (54.90)	
Chemotherapy	No	444 (64.72)	304 (63.07)	140 (68.63)	0.1919
	Yes	242 (35.28)	178 (36.93)	64 (31.37)	
Insurance status	Insured	669 (97.52)	469 (97.30)	200 (98.04)	0.7654
	Uninsured	17 (2.48)	13 (2.70)	4 (1.96)	
Marital status	Married	242 (35.28)	168 (34.85)	74 (36.27)	0.7885
	Unmarried	444 (64.72)	314 (65.15)	130 (63.73)	
SEER tumor localization	Localized	535 (77.99)	377 (78.22)	158(77.45)	0.6753
	Regional	151 (22.01)	105 (21.78)	46(22.55)	

* , according to the 8th edition of the American Joint Committee on Cancer (AJCC) staging.

Table 2
Univariate and multivariate analysis for determining the associations between clinicodemographic factors and survival outcomes in elderly early-stage cervical cancer patients from the SEER database during 2004–2015.

Variables	Univariate analysis		Multivariate analysis	
	HR (95 %CI)	p-value	HR (95 %CI)	p-value
Age				
<74	Reference		Reference	
74–83	1.87 (1.27–2.78)	0.002	1.8 (1.21–2.68)	0.0039
>83	4.03 (2.51–6.46)	0	2.77 (1.69–4.55)	<0.001
Race				
Black	Reference			
Other	0.49 (0.24–1.01)	0.053		
White	0.68 (0.43–1.07)	0.095		
Insurance status				
Insured	Reference			
Uninsured	1.99 (0.73–5.41)	0.176		
Marital status				
Married	Reference			
Unmarried	1.54 (1.03–2.29)	0.034	1.42 (0.95–2.14)	0.0476
Tumor size				
<27	Reference			
27–59	1.97 (1.31–2.96)	0.001	1.49 (0.92–2.42)	0.1037
>59	3.72 (2.26–6.1)	0	3.1 (1.55–6.17)	0.0013
SEER tumor localization				
Localized	Reference			
Regional	1.78 (1.22–2.61)	0.003	0.83 (0.3–2.29)	0.7164
Histological grade				
Grade I	Reference			
Grade II	1.23 (0.63–2.39)	0.548		
Grade III	1.87 (0.99–3.53)	0.055		
Grade IV	1.4 (0.49–4.02)	0.536		
Pathological type				
SCC	Reference			
Non SCC	1.03 (0.7–1.5)	0.89		
T stage*				
T1a1	Reference			
T1a2	1.33 (0.3–5.94)	0.711		
T1b1	2.39 (0.87–6.58)	0.093		
T1b2	3.65 (1.28–10.41)	0.016		
T2a	5.18 (1.84–14.61)	0.002		
Radiation				
No	Reference			
Yes	1.2 (0.85–1.71)	0.305		
Surgery				
No	Reference			
Yes	0.42 (0.3–0.61)	0	0.63 (0.43–0.94)	0.0234
Chemotherapy				
No	Reference			
Yes	1.14 (0.79–1.63)	0.484		

* , according to the 8th edition of the American Joint Committee on Cancer (AJCC) staging.

3.3. Construction and validation of a prognostic nomogram for elderly early-stage cervical cancer patients

Using the four identified independent prognostic factors, we constructed and validated the prognostic nomogram tailored to elderly

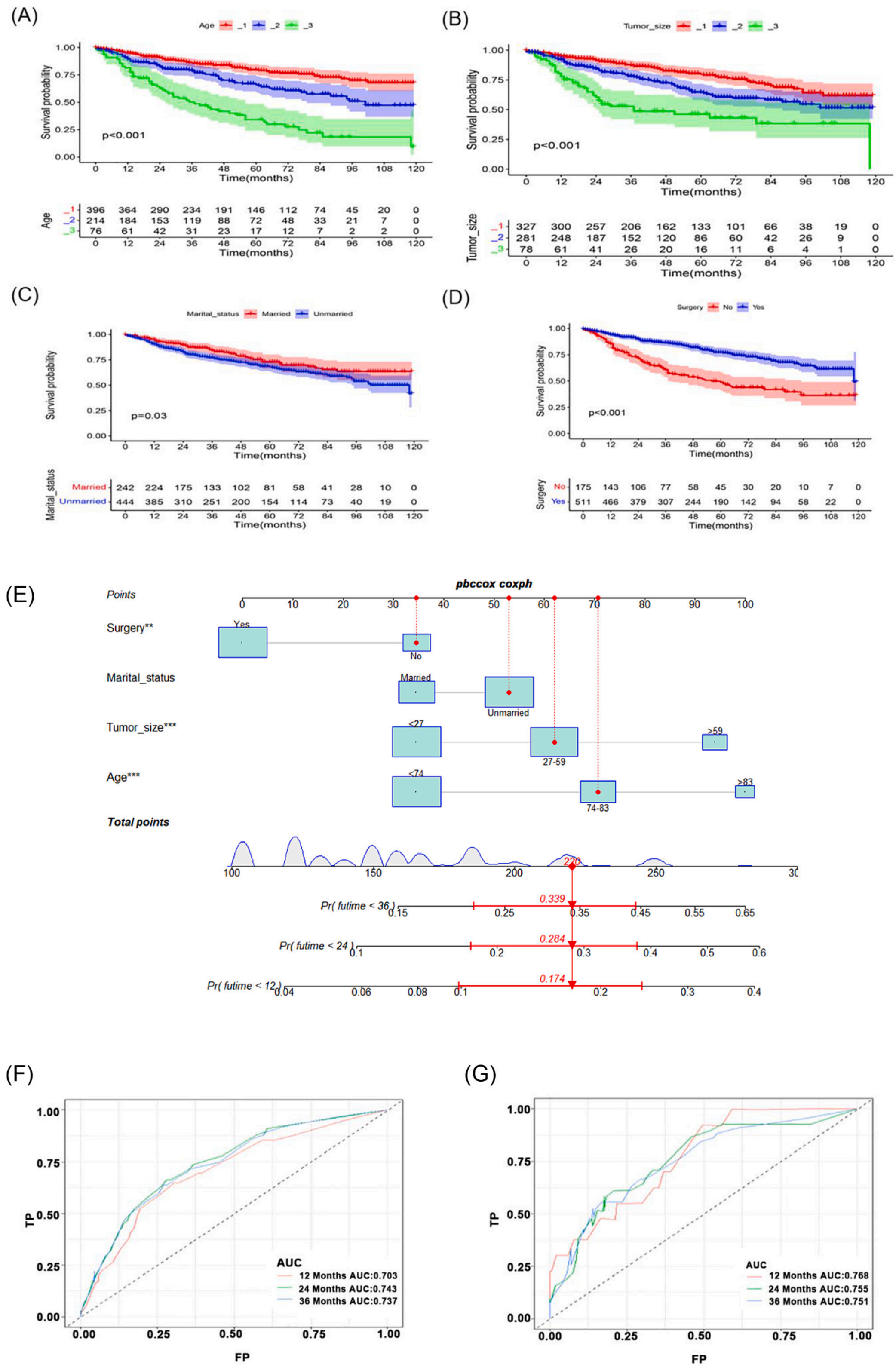

Fig. 1. Kaplan-Meier analysis and prognostic nomogram for elderly early-stage cervical cancer patients in the SEER database from 2004 to 2015. Survival curves for elderly early-stage cervical cancer patients according to (A) age, (B) tumor diameter, (C) marital status, and (D) surgery intervention. (E) Prognostic nomogram for predicting the 12-, 24- and 36-month overall survival of elderly early-stage cervical cancer patients in the SEER database during 2004–2015. (F-G) ROC analysis for validating our proposed nomogram of elderly early-stage cervical cancer from the SEER during 2004–2015. ROC curves for predicting the 12-, 24- and 36-month overall survival rates in the (F) training and (G) validation cohorts. Abbreviation: ROC, receiver operating characteristic; AUC, area under the curve; TP, true positive; FP, false positive;

early-stage cervical cancer patients (Fig. 1**E**). The AUC values for the 12-month, 24-month, and 36-month predictions in the nomogram model were found to be 0.703, 0.743, and 0.737 for the training group and 0.768, 0.755, and 0.751 for the validation group, respectively (Fig. 1**F, G**), suggesting satisfactorily robust predictive performance of our model.

Next, we conducted a thorough comparison of the model's discriminative ability with that of individual prognostic factors. Our analysis revealed that, across both the training and validation groups, the AUC values for the nomogram outperformed those of all individual factors at the 12-month, 24-month, and 36-month time points (Fig. 2 **A-F**), indicating the superior predictive capabilities of the nomogram. Additionally, examination of the calibration curves for the nomogram demonstrated a high degree of alignment between the predicted and actual outcomes within both the training and validation groups (**Figure S1**).

Moreover, our DCA results demonstrated the promising clinical applicability of the nomogram in predicting the prognosis of elderly early-stage cervical cancer patients (Fig. 2 **G-L**). To further stratify the risk among elderly early-stage cervical cancer patients, we used the X-tile software, which categorized them into low, intermediate, and high-risk subgroups based on their total scores. Specifically, patients with scores below 140 were classified as low-risk, those with scores between 140 and 186 as intermediate-risk, and those with scores exceeding 186 as high-risk. Kaplan-Meier survival analysis revealed significant disparities in the OS between the low-risk and high-risk groups ($P < 0.001$) (Fig. 3). Patients assigned to the low-risk subgroup exhibited more favorable prognoses, underscoring the satisfactory risk-stratification potential of the constructed nomogram.

4. Discussion

In this study, most of the elderly cervical cancer patients were diagnosed with squamous cell carcinoma, which is consistent with findings reported in most literature (Li et al., 2017), while no significant statistical difference in OS between these two histological types was observed ($P > 0.05$). The relationship between histological type and the prognosis of early-stage cervical cancer patients has been a subject of debate. Xie et al. (Xie et al., 2018), in their analysis of 810 patients with stage IB-IIA cervical cancer, found no significant difference in the five-year survival rates between squamous cell carcinoma and adenocarcinoma patients. However, Jae et al. (Noh et al., 2014) discovered that in patients with stage IA-IIA cervical cancer, disease-free survival and OS were associated with the histological type, with squamous cell carcinoma exhibiting a better prognosis than adenocarcinoma. To resolve these discrepancies, future research should focus on larger, more detailed studies that incorporate subgroup analyses, explore molecular and genetic underpinnings, and utilize longitudinal and international collaborative approaches to elucidate the role of histological types in prognosis more definitively, potentially guiding more tailored treatment strategies for early-stage cervical cancer patients.

Regarding tumor differentiation grade, our findings align with previous research on elderly cervical cancer patients, emphasizing the prevalence of moderately and poorly differentiated tumors (Huang et al., 2017; Xie et al., 2018). Furthermore, earlier studies (Tian, 2021) have established that differentiation grade, tumor diameter, lymph node metastasis, and pathological staging are independent factors influencing the five-year survival of middle-aged and elderly cervical cancer patients (all $P < 0.05$). It is generally acknowledged that tumors with lower differentiation grades tend to exhibit higher malignancy. However, we did not identify differentiation grade as a prognostic factor for cervical cancer. This disparity may be attributed to the similarity in the proportions of tumor cell differentiation levels among the study population and differences in statistical methods. Thus, further research is required to elucidate this variation.

Our findings show that marital status can significantly influence the prognosis of cervical cancer patients ($P < 0.05$), which are in line with those of Guan Xiuting et al. (Guan et al., 2020), who also concluded that marital status serves as a significant psychosocial factor impacting the survival prognosis of cervical cancer patients. Marriage provides women with a sense of security, particularly those with low or no income. Being married can act as a protective factor by ensuring a better quality of life, timely medical check-ups, and the early detection of health issues. Additionally, married patients often receive systematic treatment and regular follow-ups, encouraged by their families. However, it is important to note that the quality of the marriage directly influences the overall quality of life for the patient. In comparison to divorced patients, married patients generally exhibit a more positive outlook. Nevertheless, there is limited research on the impact of marital status on cervical cancer in China, and further investigation is warranted. The age at the time of diagnosis may be associated with cervical cancer prognosis. In studies focusing on prognostic factors for early-stage cervical cancer confined to stages I-II, no consensus was observed in regard to the correlation between age and prognosis (Eo et al., 2018). In addition, it has been suggested that age is not an independent factor influencing the prognosis of early-stage cervical cancer (Xu et al., 2021). Wang Suqin et al. (Wang et al., 2017) also indicate that age is not a prognostic factor for elderly cervical cancer. In this study, age was categorized into < 74 years, 74–83 years, and > 83 years, and the differences in OS rates among these groups were statistically significant ($P < 0.05$). These variations might be attributed to regional and ethnic differences among the study populations or variations in cutoff values. However, age alone should not be the sole criterion for treatment decisions. Instead, treatment plans should consider the patient's actual physical condition to determine the appropriate treatment approach. Early curative treatment should be considered whenever possible, and individuals of advanced age may achieve treatment outcomes similar to those of younger patients when receiving standard therapy. Furthermore, this study demonstrates through both univariate and multivariable Cox analysis that tumor diameter has a statistically significant impact on OS ($P < 0.05$), consistent with previous studies (Ding et al., 2021; Tian, 2021). Larger tumor diameters are associated with more active local growth, increased likelihood of early infiltration, and lymph node metastasis. Furthermore, rapid tumor growth can lead to tumor cell necrosis and the production of hypoxic cells, rendering them less responsive to radiation and chemotherapy, resulting in poorer treatment outcomes. Consequently, patients with larger tumor diameters tend to have worse prognoses.

The current trend in cervical cancer management is leaning towards early surgical intervention combined with comprehensive treatment. The main objective of surgical treatment is to remove cervical lesions and adjacent tissues that are either already affected or at risk, with the goal of improving OS rates and reducing the likelihood of recurrence. In line with this approach, Wang et al. (Wang et al., 2017) reported a significant association between surgical intervention and the 5-year survival rate in elderly cervical cancer patients when compared to treatment with radiation therapy or chemotherapy alone ($P < 0.05$). Furthermore, this study emphasizes that whether elderly early-stage cervical cancer patients undergo surgery independently impacts their prognosis.

Our present study also highlighted that tailored surgical approaches can significantly impact patient outcomes, aligning with the findings from Bogani et al. (Bogani et al., 2022), which showed that the shift from minimally invasive to open radical hysterectomy did not significantly influence 90-day surgery-related morbidity in early-stage cervical cancer. This suggests that while minimally invasive surgery has been associated with decreased morbidity, the choice between minimally invasive and open surgery should be considered carefully, taking into account individual patient factors and tumor characteristics. Furthermore, the long-term outcomes presented by Di Donato et al. (Di Donato et al., 2023) support the notion that for low-risk patients, laparoscopic radical hysterectomy does not result in worse 10-year outcomes compared to the open approach. This evidence challenges the prevailing skepticism towards minimally invasive surgery following the LACC trial

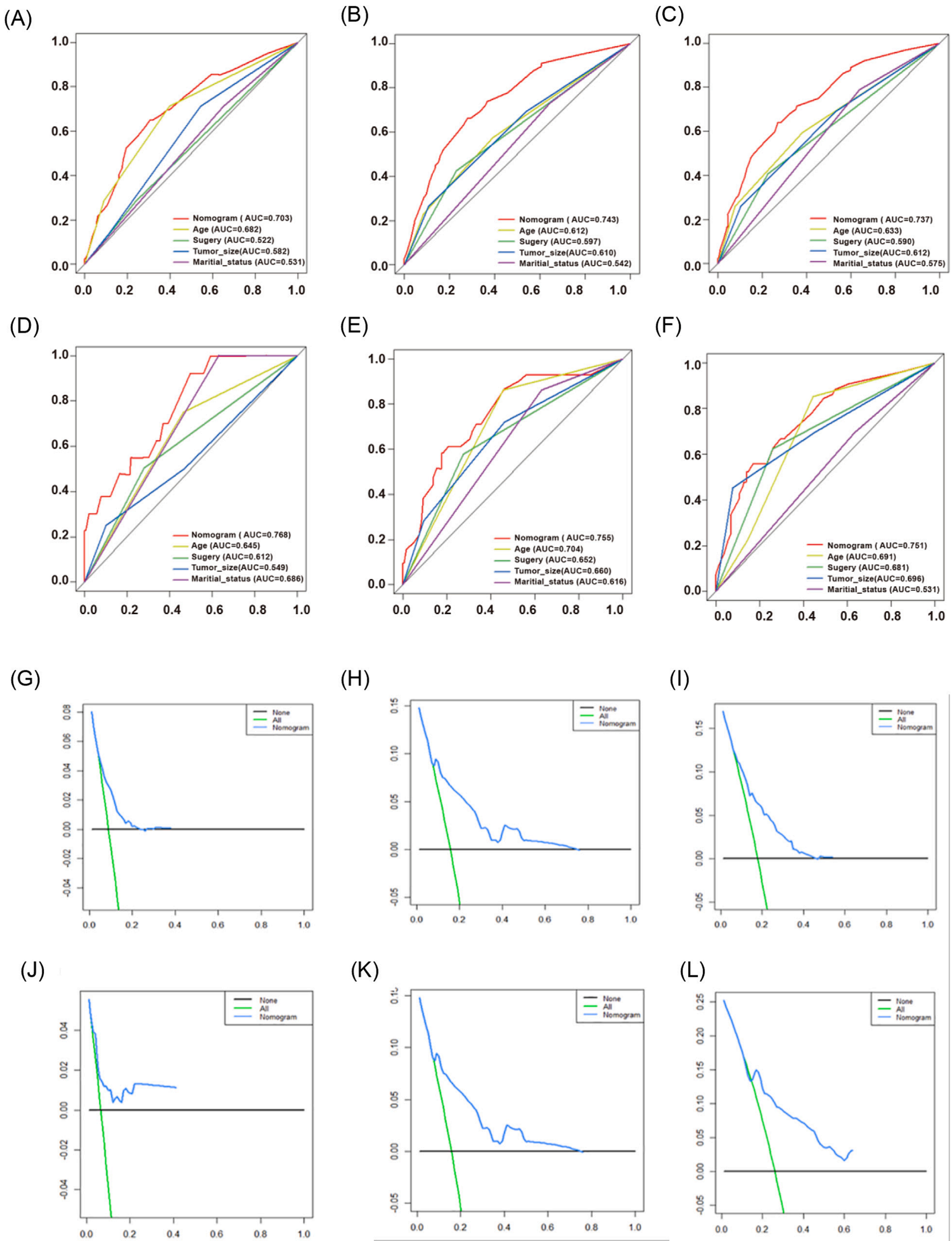

Fig. 2. Comparative ROC analysis and decision curve of the nomogram for predicting survival in elderly early-stage cervical cancer from the SEER database during 2004–2015. ROC curves comparing the predictive performance for the 12-month (A, D), 24-month (B, E), and 36-month (C, F) overall survival rates in the training and validation cohorts, respectively. (G-L) DCA for the prognostic nomogram in predicting the overall survival of elderly early-stage cervical cancer patients from the SEER database during 2004–2015. DCA for the 12-month (G, J), 24-month (H, K), and 36-month (I, L) overall survival rates in the training and validation cohorts, respectively. Abbreviation: ROC**,** receiver operating characteristic; DCA**,** decision curve analysis;

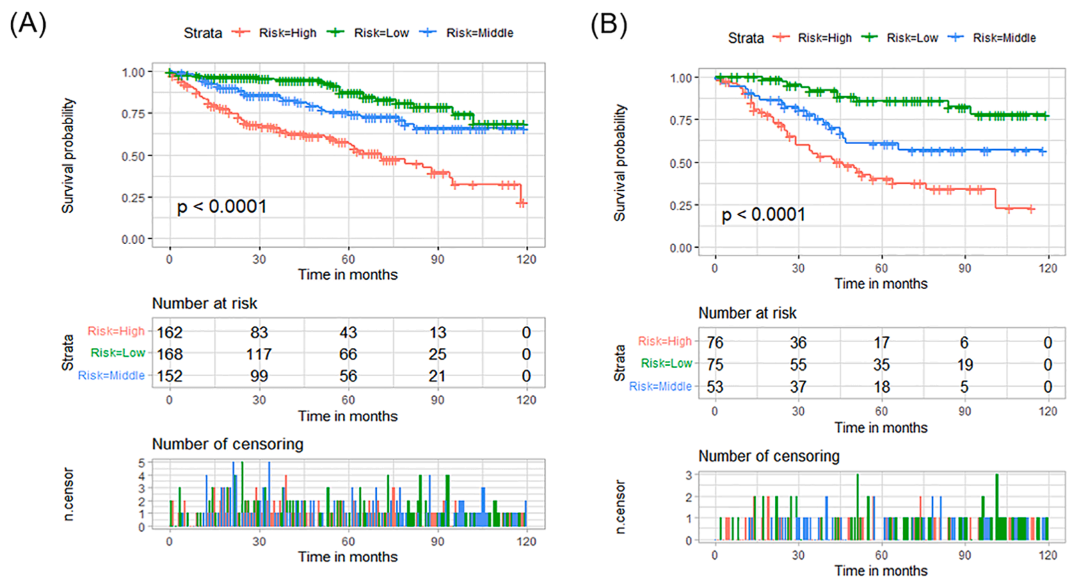

Fig. 3. Survival outcomes by risk subgroups based on the prognostic nomogram in elderly early-stage cervical cancer patients from the SEER database during 2004–2015. Survival curves and censoring cases for the (A) training and (B) validation cohorts.

and suggests that patient selection is crucial in determining the optimal surgical approach. Considering the evolving landscape of cervical cancer treatment, it is important to integrate these insights into clinical practice. Tailoring surgical approaches to individual patient profiles—considering factors such as age, tumor size, and overall health—can enhance treatment outcomes while minimizing complications. This patient-centric approach, supported by current evidence and our study's findings, emphasizes the need for a thorough evaluation of surgical options in cervical cancer management.

Elderly women, due to the natural aging process and the presence of multiple comorbidities, may have a higher risk of surgical complications and mortality compared to their younger patients. Consequently, many elderly patients diagnosed with early-stage cervical cancer are more inclined to undergo radiation therapy. A study conducted by Elisabeth et al. (Diver et al., 2018) revealed that older cervical cancer patients (aged > 65 years) are less likely to undergo surgery and more likely to receive radiation therapy when compared to younger patients (aged ≤ 65 years). However, recent advancements in surgical techniques and medical equipment have reduced age as a significant barrier to surgery. Although in our study 74.49 % of elderly early-stage cervical cancer patients chose surgical treatment, it is crucial to conduct comprehensive preoperative assessments to evaluate the patient's suitability for surgery and consider the potential need for adjuvant radiation therapy post-operatively to minimize the risk of treatment-related complications. A personalized treatment plan should be developed accordingly.

Moreover, Cox proportional hazards models and Kaplan-Meier survival curve analysis identified age, tumor diameter, marital status and surgical intervention as independent prognostic factors for elderly early-stage cervical cancer patients. Using these factors, we constructed a Nomogram predictive model, assigning scores to each indicator. The cumulative score corresponds to the probability of survival at 12, 24, and 36 months for each patient. Moreover, we validated the model, demonstrating its effectiveness in assessing the long-term prognosis of elderly early-stage cervical cancer patients. However, it's important to acknowledge the limitations of this study, including the retrospective nature of the data derived from the SEER database, which may have limited variables and been influenced by factors such as ethnicity and region. Additionally, further stratified analysis of treatment modalities is needed, and there may be some data bias and research limitations. Future research endeavors could involve a comprehensive analysis of cervical cancer patient data from multiple medical centers in China, especially using international databases, to enhance the predictive value and generalizability of this model.

In conclusion, our research provides a tailored prognostic nomogram model for elderly individuals diagnosed with early-stage cervical cancer. By considering age, tumor diameter, marital status and surgical intervention, clinicians can better estimate the patient's likelihood of survival at different time intervals. Overall, our proposed predictive tool provides a valuable resource for personalized treatment decisions and risk stratification, which could be used as a reference for improving the management and outcomes of elderly early-stage cervical cancer patients.

5. Ethics approval and consent to participate

This study utilized data obtained from the SEER*Stat software version 8.3.6, which consists of de-identified patient information. Accordingly, the research is classified as exempt from the need for ethical approval by the institutional review board of our institution, as it involves the use of publicly available, anonymized databases. Our study is also in compliance with the guidelines for the protection of human subjects, ensuring the safety and privacy of individuals, does not require patient informed consent and adheres to the principles outlined in the Declaration of Helsinki for medical research involving human subjects.

CRediT authorship contribution statement

Ernan Li: Writing – review & editing, Writing – original draft, Visualization, Validation, Software, Resources, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Huanjuan Ni:** Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Software, Resources, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

The datasets used and/or analyzed during the current study are available from the corresponding author upon reasonable request.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.pmedr.2024.102700.

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