

SUPPLEMENTAL TABLE 1

Comparison of Cox proportional hazard regression model and deep-learning neural network model for survival

Features	Outcome	Model	Concordance index ^a	Mean absolute error ^b
Set 1	Progression-free survival	Cox proportional hazard regression model	0.696 ± 0.072	322.2 ± 129.7
		CoxBoost	0.696 ± 0.072	30.2 ± 3.8
		CoxLasso	0.699 ± 0.070	30.4 ± 2.5
		Random Survival Forest	0.694 ± 0.073	30.0 ± 4.2
		Deep learning	0.695 ± 0.080	29.3 ± 3.4
	Overall survival	Cox proportional hazard regression	0.520 ± 0.059	37.2 ± 2.7
		CoxBoost	0.520 ± 0.059	40.9 ± 4.0
		CoxLasso	0.521 ± 0.059	40.8 ± 5.0
		Random Survival Forest	0.538 ± 0.051	33.6 ± 4.3
		Deep learning	0.538 ± 0.042	30.9 ± 3.7
Set 2	Progression-free survival	Cox proportional hazard regression	0.785 ± 0.064	329.5 ± 133.4
		CoxBoost	0.785 ± 0.063	28.8 ± 4.1
		CoxLasso	0.785 ± 0.064	29.9 ± 3.8
		Random Survival Forest	0.771 ± 0.070	29.8 ± 4.3
		Deep learning	0.787 ± 0.063	29.7 ± 3.5
	Overall survival	Cox proportional hazard regression	0.511 ± 0.045	37.6 ± 3.0
		CoxBoost	0.511 ± 0.045	39.5 ± 2.8
		CoxLasso	0.512 ± 0.049	38.9 ± 2.5
		Random Survival Forest	0.527 ± 0.053	33.6 ± 4.3
		Deep learning	0.534 ± 0.051	30.7 ± 3.7

There were 241 events for progression-free survival and 170 events for overall survival events among 768 cases.

^a A higher concordance index means a better performing model; ^b A lower mean absolute error means better a performing model.

Matsuo et al. Survival outcome prediction in cervical cancer. *Am J Obstet Gynecol* 2019.

SUPPLEMENTAL TABLE 2

Survival predictors in deep-learning model (features set 1)

Progression-free survival		Overall survival	
Features	Pvalue	Features	Pvalue
Albumin ^a	1.57E-60	Diabetes mellitus ^a	2.35E-04
Hemoglobin ^a	3.08E-54	Hispanic ^a	1.39E-03
Heart rate ^a	1.35E-31	White blood cell ^a	3.29E-03
Platelet ^a	1.06E-22	Creatinine ^a	5.95E-03
Age ^a	4.18E-10	White ^a	1.25E-02
Creatinine ^a	1.41E-08	Black ^a	1.64E-02
White blood cell ^a	4.69E-08	Hypercholesterolemia	5.36E-02
Bicarbonate ^a	6.81E-08	Body mass index	5.38E-02
Blood urea nitrogen ^a	2.81E-07	Albumin	6.44E-02
Black ^a	2.71E-05	Blood urea nitrogen	7.02E-02
Hispanic ^a	4.35E-03	Diastolic blood pressure	8.40E-02
Hypertension ^a	5.35E-03	Bicarbonate	8.98E-02
Asian	5.30E-02	Hypertension	1.37E-01
Body mass index	6.62E-02	Platelet	1.46E-01
Systolic blood pressure	1.01E-01	Asian	1.63E-01
Hypercholesterolemia	2.13E-01	Other race	1.84E-01
Other race	2.25E-01	Heart rate	1.94E-01
Diastolic blood pressure	3.14E-01	Systolic blood pressure	2.21E-01
White	4.28E-01	Age	2.29E-01
Diabetes mellitus	4.30E-01	Hemoglobin	3.50E-01

Covariates are listed based on the statistical significance.

^a Significant covariates ($P < .05$).

Matsuo et al. Survival outcome prediction in cervical cancer. Am J Obstet Gynecol 2019.

SUPPLEMENTAL TABLE 3

Survival predictors in deep-learning model (features set 2)

Progression-free survival		Overall survival	
Features	Pvalue	Features	Pvalue
Hemoglobin ^a	2.15E-38	Albumin ^a	3.37E-06
Albumin ^a	3.87E-38	Bicarbonate ^a	1.59E-05
Sage IVB ^a	1.53E-37	Hispanic ^a	1.69E-03
Stage IIIB ^a	7.00E-30	Stage IIA ^a	5.83E-03
Stage IB1 ^a	7.62E-30	Body mass index ^a	6.10E-03
Stage IA1 ^a	4.75E-27	Stage IA1 ^a	2.50E-02
Heart rate ^a	8.12E-19	White blood cell ^a	4.52E-02
Platelet ^a	4.00E-15	Diastolic blood pressure	5.68E-02
Creatinine ^a	3.06E-08	Hemoglobin	6.10E-02
White blood cell ^a	4.21E-08	White	6.18E-02
Blood urea nitrogen ^a	1.10E-07	Diabetes mellitus	6.64E-02
Age ^a	1.02E-06	Heart rate	7.42E-02
Bicarbonate ^a	1.39E-05	Black	8.59E-02
Stage IVA ^a	8.64E-05	Asian	9.46E-02
Black ^a	8.58E-04	Other histologic condition	1.11E-01
Hypertension ^a	1.44E-03	Creatinine	1.17E-01
Hispanic ^a	1.51E-03	Blood urea nitrogen	1.35E-01
Stage IIB ^a	6.82E-03	Platelet	1.63E-01
Other histologic condition ^a	9.65E-03	Systolic blood pressure	1.66E-01
Body mass index ^a	1.47E-02	Hypertension	1.66E-01
Asian ^a	2.10E-02	Stage IIIA	1.68E-01
Adenocarcinoma ^a	3.56E-02	Stage IIIB	1.83E-01
Stage IB2	2.12E-01	Stage IIB	1.84E-01
Systolic blood pressure	2.27E-01	Age	1.91E-01
Hypercholesterolemia	3.08E-01	Squamous	1.99E-01
Squamous	3.19E-01	Adenosquamous	2.16E-01
Diastolic blood pressure	3.65E-01	Stage IB1	2.24E-01
Stage IIA	4.58E-01	Hypercholesterolemia	2.36E-01
Diabetes mellitus	4.78E-01	Adenocarcinoma	2.54E-01
White	4.84E-01	Stage IVB	3.28E-01
Stage IIIA	4.87E-01	Stage IVA	3.73E-01
Adenosquamous	5.88E-01	Stage IB2	3.95E-01

Covariates are listed based on the statistical significance.

^a Significant covariates ($P < .05$).

Matsuo et al. Survival outcome prediction in cervical cancer. Am J Obstet Gynecol 2019.

SUPPLEMENTAL TABLE 4

Univariable analysis for survival outcome

Features	Progression-free survival		Overall survival	
	Hazard ratio (95% confidence interval)	<i>P</i> value ^a	Hazard ratio (95% confidence interval)	<i>P</i> value ^a
Age, y	1.02 (1.01–1.03)	<.001	1.02 (1.01–1.03)	.003
Ethnicity		.001		<.001
White	1		1	
Black	1.97 (1.05–3.67)		2.34 (1.16–4.70)	
Hispanic	0.84 (0.52–1.37)		0.72 (0.40–1.28)	
Asian	1.27 (0.72–2.23)		1.29 (0.67–2.49)	
Histologic condition		.043		.002
Squamous cell	1		1	
Adenocarcinoma	0.89 (0.63–1.26)		0.72 (0.46–1.11)	
Adenosquamous	1.02 (0.54–1.93)		0.72 (0.29–1.75)	
Other	2.23 (1.24–4.00)		2.80 (1.51–5.19)	
Stage		<.001		<.001
I	1		1	
II	3.25 (2.22–4.78)		3.98 (2.39–6.62)	
III	6.15 (4.27–8.87)		8.15 (5.06–13.1)	
IV	20.9 (14.0–31.1)		30.0 (18.2–49.4)	
Primary hysterectomy		<.001		<.001
No	1		1	
Yes	0.15 (0.10–0.25)		0.10 (0.05–0.19)	
Radiotherapy		.003		
No	1			
Yes	1.57 (1.17–2.11)			
Primary chemotherapy		.001		<.001
No	1		1	
Yes	5.17 (3.82–7.00)		6.37 (4.53–8.95)	
Laboratory test				
White blood cell, 10 ⁹ /L	1.06 (1.03–1.10)	.001	1.07 (1.03–1.11)	.001
Platelet, 10 ⁹ /L	1.003 (1.002–1.004)	<.001	1.004 (1.003–1.005)	<.001
Hemoglobin, g/dL	0.82 (0.78–0.86)	<.001	0.81 (0.76–0.85)	<.001
Blood urea nitrogen, mg/dL	1.02 (1.01–1.03)	<.001	1.02 (1.01–1.03)	<.001
Creatinine, mg/dL	1.17 (1.11–1.24)	<.001	1.18 (1.11–1.25)	<.001
Bicarbonate, mEq/L	0.92 (0.88–0.95)	<.001	0.89 (0.85–0.93)	<.001
Albumin, g/dL	0.39 (0.31–0.48)	<.001	0.30 (0.23–0.38)	<.001
Heart rate, beats/min	1.03 (1.02–1.04)	<.001	1.03 (1.02–1.04)	<.001

All the covariates that are shown in Table 1 were examined; the covariates with *P*<.05 are shown in this Table.

^a Considered significant.

Matsuo et al. Survival outcome prediction in cervical cancer. *Am J Obstet Gynecol* 2019.