Figure S1. GLO 1 and PKCλ gene expression is enhanced at all breast cancer tumor stages compared with that of normal tissue samples. P-values were generated using the Kruskal-Wallis test with a Steel-Dwass test. The α-level was fixed at 0.05, and P<0.05 was considered to indicate a statistically significant difference. *P<0.05, **P<0.01. GLO 1, glyoxalase 1; PKCλ, protein kinase Cλ.

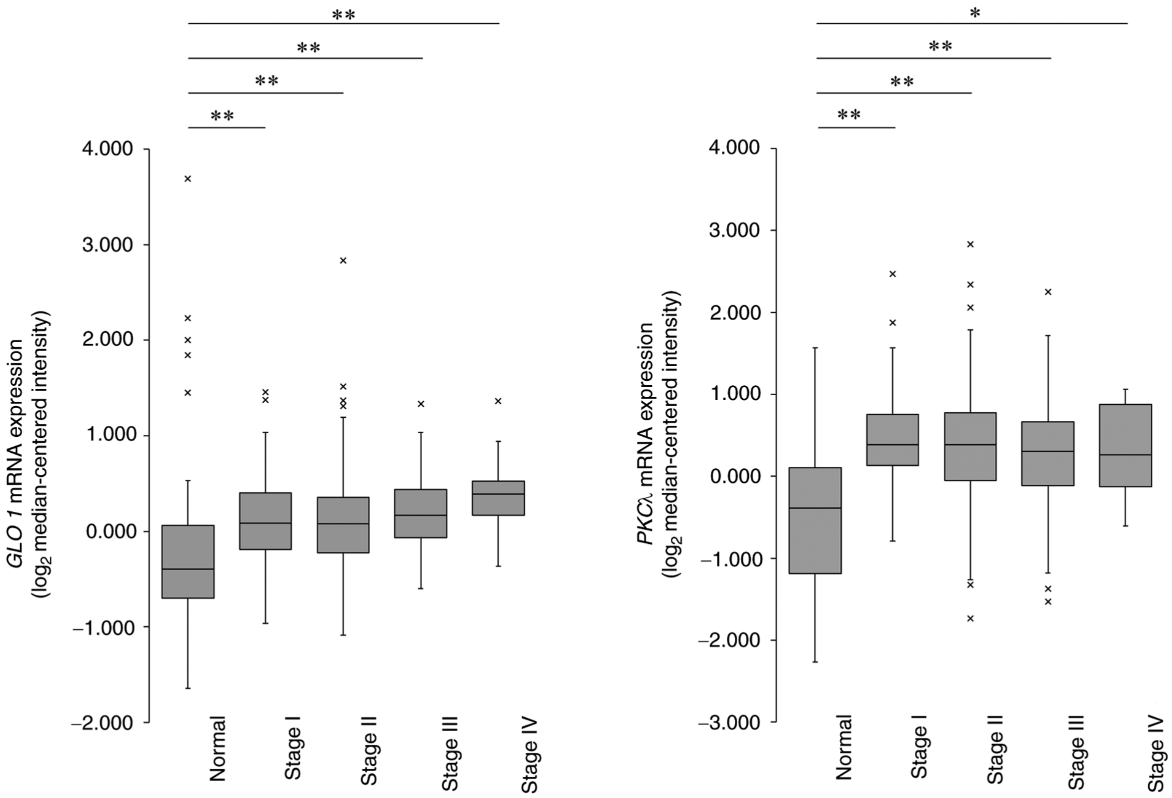

Figure S2. Kaplan-Meier analysis of *GLO 1* and *PKCλ* gene based on breast cancer subtype. P-values were calculated using a Gehan-Breslow generalized Wilcoxon test. Adjusted P-values were calculated using Holm's method for post-hoc analysis. The α-level was fixed at 0.05, and P<0.05 was considered to indicate a statistically significant difference. GLO 1, glyoxalase 1; PKCλ, protein kinase Cλ; ER, estrogen receptor; PgR, progesterone receptor; TNBC, triple-negative breast cancer.

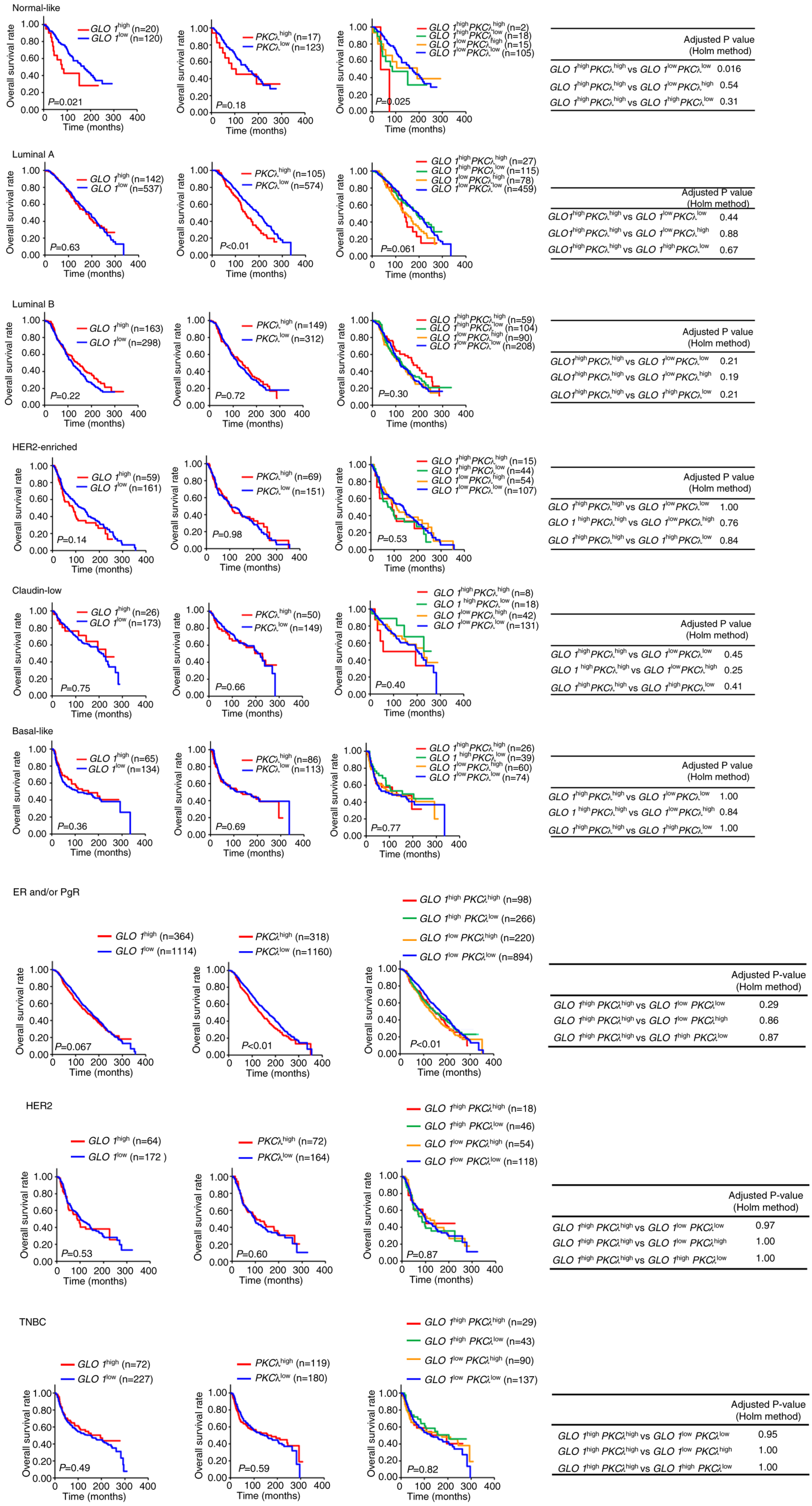

Figure S3. Basal-like type breast cancer accounts for a larger fraction of cancer classed as GLO 1^{high} *PKCλ*^{high} among the subtypes in stage III-IV breast cancer. GLO 1, glyoxalase 1; PKCλ, protein kinase Cλ.

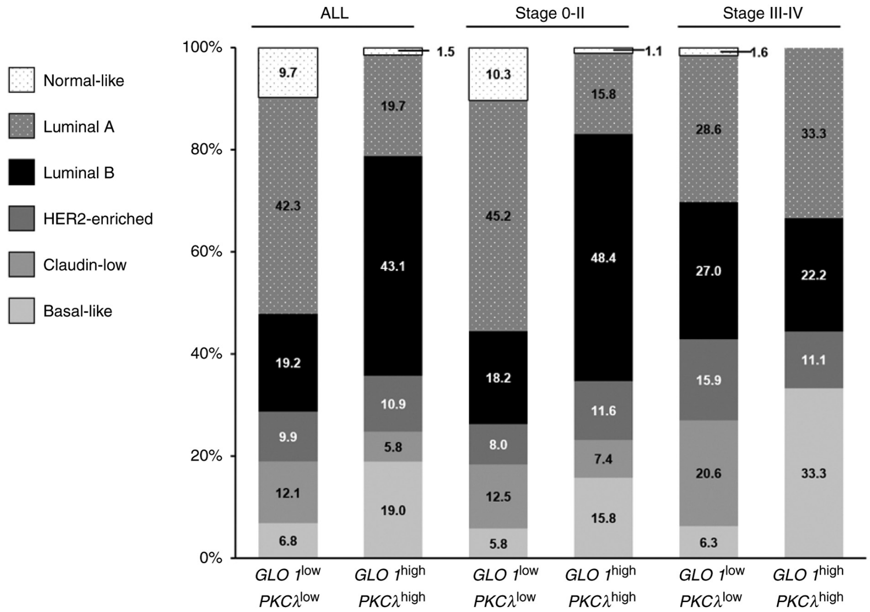

Figure S4. Correlation between *GLO 1* and *PKCλ* expression in breast cancer subtypes. r and P-values are indicated. P-values were generated using a non-correlation test. The α-level was fixed at 0.05, and $P<0.05$ was considered to indicate a statistically significant difference. GLO 1, glyoxalase 1; PKCλ, protein kinase Cλ; r, Pearson's correlation coefficient; ER, estrogen receptor; PgR, progesterone receptor; TNBC, triple-negative breast cancer.

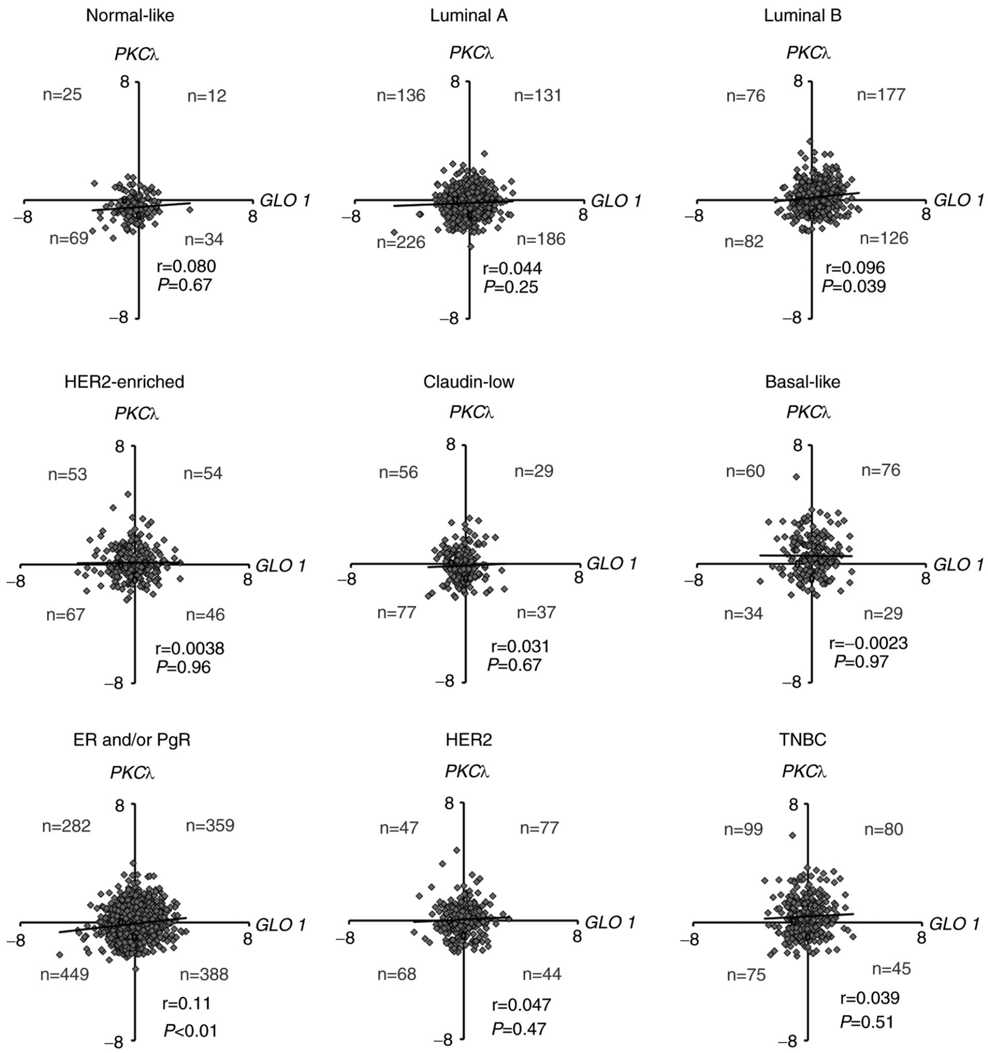

Table SI. Clinicopathological data of the 99 patients with breast cancer.

Variable	Value
Median age, years (range)	59 (34-82)
Tumor size, n (%)	
Tis	6 (6)
T1	34 (34)
T2	46 (46)
T3	3 (3)
T4	2 (2)
Unknown	8 (8)
Nodal metastasis, n (%)	
N0	59 (60)
N1-3	38 (38)
Unknown	2 (2)
TNM stage, n (%)	
0	6 (6)
1	24 (24)
2	37 (37)
3	3 (3)
4	2 (2)
Unknown	27 (27)
ER, n (%)	
Positive	74 (75)
Negative	24 (24)
Unknown	1 (1)
PgR, n (%)	
Positive	54 (55)
Negative	44 (44)
Unknown	1 (1)
HER2, n (%)	
Positive	63 (64)
Negative	35 (35)
Unknown	1 (1)
TNBC, n (%)	6 (6)

ER, estrogen receptor; PgR, progesterone receptor; TNBC, triple-negative breast cancer.

Table SII. Clinicopathological data of the 1,904 patients with breast cancer.

Variable	Value
Median age, years (range)	61.8 (21.9-96.3)
Tumor stage, n (%)	
0	4 (0.2)
I	475 (24.9)
II	800 (42.0)
III	115 (6.0)
IV	5 (0.3)
Unknown	501 (26.3)
Tumor size, n (%)	
0-20 mm	594 (31.2)
≥20 mm	1,292 (67.9)
Unknown	18 (0.9)
Pam50 + Claudin-low subtype, n (%)	
Normal-like	140 (7.4)
Luminal A	679 (35.7)
Luminal B	461 (24.2)
HER2-enriched	220 (11.6)
Claudin-low	199 (10.5)
Basal-like	199 (10.5)
ER, n (%)	
Positive	1,459 (76.6)
Negative	445 (23.4)
PgR, n (%)	
Positive	1,009 (53.0)
Negative	895 (47.0)
HER2, n (%)	
Positive	236 (12.4)
Negative	1,668 (87.6)
ER and/or PgR, n (%)	1,478 (77.6)
Triple negative, n (%)	299 (15.7)

ER, estrogen receptor; PgR, progesterone receptor; Pam50, a minimal gene set for classifying 'intrinsic' subtypes of breast cancer.

Table SIII. Association between the clinicopathological parameters and *GLO 1* and *PKCλ* gene expression in 1,904 patients.

Characteristics	*GLO 1*^{low}	*GLO 1*^{high}	P-value	*PKCλ*^{low}	*PKCλ*^{high}	P-value	*GLO 1*^{low} *PKCλ*^{low}	*GLO 1*^{high} *PKCλ*^{high}	P-value
Age, years									
<61.77	720	232	0.53	700	252	0.14	537	69	0.82
≥61.77	708	244		728	224		552	68	
Tumor stage									
0-II	972	307	0.07	952	327	0.89	740	95	0.77
III-IV	85	39		93	31		63	9	
Tumor size, mm									
0-20	456	136	0.15	456	136	0.16	360	40	0.34
≥20	955	337		956	336		715	96	

P-values were calculated using the χ^2 test. GLO 1, glyoxalase 1; PKCλ, protein kinase Cλ.

Table SIV. Multivariable Cox regression analysis of the association between *GLO 1* and *PKCλ* expression based on breast cancer subtype.

Comparison	Hazard ratio[a] (95% confidence interval)	P-value
Normal-like		
$GLO\ 1^{high}$ vs. $GLO\ 1^{low}$	1.64 (0.87-3.06)	0.12
$PKC\lambda^{high}$ vs. $PKC\lambda^{low}$	1.72 (0.86-3.45)	0.13
$GLO\ 1^{high}\ PKC\lambda^{high}$ vs. $GLO\ 1^{low}\ PKC\lambda^{low}$	9.11 (2.07-40.15)	<0.01
$GLO\ 1^{high}\ PKC\lambda^{high}$ vs. $GLO\ 1^{low}\ PKC\lambda^{high}$	2.83 (0.49-16.37)	0.25
$GLO\ 1^{high}\ PKC\lambda^{high}$ vs. $GLO\ 1^{high}\ PKC\lambda^{low}$	3.21 (0.63-16.48)	0.16
Luminal A		
$GLO\ 1^{high}$ vs. $GLO\ 1^{low}$	1.20 (0.92-1.55)	0.17
$PKC\lambda^{high}$ vs. $PKC\lambda^{low}$	1.26 (0.96-1.64)	0.09
$GLO\ 1^{high}\ PKC\lambda^{high}$ vs. $GLO\ 1^{low}\ PKC\lambda^{low}$	1.81 (1.10-2.97)	0.02
$GLO\ 1^{high}\ PKC\lambda^{high}$ vs. $GLO\ 1^{low}\ PKC\lambda^{high}$	1.35 (0.76-2.39)	0.30
$GLO\ 1^{high}\ PKC\lambda^{high}$ vs. $GLO\ 1^{high}\ PKC\lambda^{low}$	1.54 (0.89-2.65)	0.12
Luminal B		
$GLO\ 1^{high}$ vs. $GLO\ 1^{low}$	0.85 (0.67-1.07)	0.17
$PKC\lambda^{high}$ vs. $PKC\lambda^{low}$	1.04 (0.81-1.33)	0.77
$GLO\ 1^{high}\ PKC\lambda^{high}$ vs. $GLO\ 1^{low}\ PKC\lambda^{low}$	0.78 (0.54-1.14)	0.21
$GLO\ 1^{high}\ PKC\lambda^{high}$ vs. $GLO\ 1^{low}\ PKC\lambda^{high}$	0.61 (0.40-0.93)	0.02
$GLO\ 1^{high}\ PKC\lambda^{high}$ vs. $GLO\ 1^{high}\ PKC\lambda^{low}$	0.84 (0.55-1.26)	0.40
HER2-enriched		
$GLO\ 1^{high}$ vs. $GLO\ 1^{low}$	1.32 (0.93-1.89)	0.12
$PKC\lambda^{high}$ vs. $PKC\lambda^{low}$	0.94 (0.67-1.33)	0.73
$GLO\ 1^{high}\ PKC\lambda^{high}$ vs. $GLO\ 1^{low}\ PKC\lambda^{low}$	1.22 (0.64-2.30)	0.54
$GLO\ 1^{high}\ PKC\lambda^{high}$ vs. $GLO\ 1^{low}\ PKC\lambda^{high}$	1.30 (0.66-2.58)	0.45
$GLO\ 1^{high}\ PKC\lambda^{high}$ vs. $GLO\ 1^{high}\ PKC\lambda^{low}$	0.96 (0.48-1.92)	0.91
Claudin-low		
$GLO\ 1^{high}$ vs. $GLO\ 1^{low}$	0.87 (0.45-1.69)	0.68
$PKC\lambda^{high}$ vs. $PKC\lambda^{low}$	1.06 (0.66-1.71)	0.80
$GLO\ 1^{high}\ PKC\lambda^{high}$ vs. $GLO\ 1^{low}\ PKC\lambda^{low}$	1.47 (0.59-3.69)	0.41
$GLO\ 1^{high}\ PKC\lambda^{high}$ vs. $GLO\ 1^{low}\ PKC\lambda^{high}$	1.42 (0.53-3.83)	0.48
$GLO\ 1^{high}\ PKC\lambda^{high}$ vs. $GLO\ 1^{high}\ PKC\lambda^{low}$	2.16 (0.62-7.52)	0.23
Basal-like		
$GLO\ 1^{high}$ vs. $GLO\ 1^{low}$	0.86 (0.57-1.30)	0.48
$PKC\lambda^{high}$ vs. $PKC\lambda^{low}$	1.08 (0.74-1.58)	0.68
$GLO\ 1^{high}\ PKC\lambda^{high}$ vs. $GLO\ 1^{low}\ PKC\lambda^{low}$	0.96 (0.53-1.77)	0.91
$GLO\ 1^{high}\ PKC\lambda^{high}$ vs. $GLO\ 1^{low}\ PKC\lambda^{high}$	1.01 (0.54-1.90)	0.96
$GLO\ 1^{high}\ PKC\lambda^{high}$ vs. $GLO\ 1^{high}\ PKC\lambda^{low}$	1.27 (0.63-2.55)	0.50
ER and/or PgR		
$GLO\ 1^{high}$ vs. $GLO\ 1^{low}$	1.09 (0.94-1.28)	0.26
$PKC\lambda^{high}$ vs. $PKC\lambda^{low}$	1.26 (1.08-1.47)	<0.01
$GLO\ 1^{high}\ PKC\lambda^{high}$ vs. $GLO\ 1^{low}\ PKC\lambda^{low}$	1.21 (0.93-1.57)	0.16
$GLO\ 1^{high}\ PKC\lambda^{high}$ vs. $GLO\ 1^{low}\ PKC\lambda^{high}$	0.89 (0.66-1.19)	0.43
$GLO\ 1^{high}\ PKC\lambda^{high}$ vs. $GLO\ 1^{high}\ PKC\lambda^{low}$	1.06 (0.79-1.42)	0.69
HER2		
$GLO\ 1^{high}$ vs. $GLO\ 1^{low}$	1.03 (0.71-1.49)	0.86
$PKC\lambda^{high}$ vs. $PKC\lambda^{low}$	0.90 (0.63-1.27)	0.54
$GLO\ 1^{high}\ PKC\lambda^{high}$ vs. $GLO\ 1^{low}\ PKC\lambda^{low}$	0.83 (0.43-1.62)	0.59
$GLO\ 1^{high}\ PKC\lambda^{high}$ vs. $GLO\ 1^{low}\ PKC\lambda^{high}$	0.90 (0.44-1.84)	0.77
$GLO\ 1^{high}\ PKC\lambda^{high}$ vs. $GLO\ 1^{high}\ PKC\lambda^{low}$	0.81 (0.39-1.70)	0.58
TNBC		
$GLO\ 1^{high}$ vs. $GLO\ 1^{low}$	0.89 (0.61-1.30)	0.55
$PKC\lambda^{high}$ vs. $PKC\lambda^{low}$	1.03 (0.75-1.42)	0.84
$GLO\ 1^{high}\ PKC\lambda^{high}$ vs. $GLO\ 1^{low}\ PKC\lambda^{low}$	0.98 (0.56-1.72)	0.95
$GLO\ 1^{high}\ PKC\lambda^{high}$ vs. $GLO\ 1^{low}\ PKC\lambda^{high}$	1.06 (0.59-1.90)	0.86
$GLO\ 1^{high}\ PKC\lambda^{high}$ vs. $GLO\ 1^{high}\ PKC\lambda^{low}$	1.26 (0.64-2.47)	0.50

[a]Hazard ratio adjusted by age estimated using Cox proportional hazard model. GLO 1, glyoxalase 1; PKCλ, protein kinase Cλ; ER, estrogen receptor; PgR, progesterone receptor; TNBC, triple-negative breast cancer.