An individualized breast cancer risk assessment model for women attending screening in BreastScreen Norway

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BACKGROUND

The results of the effectiveness of population-based screening are controversial in terms of the balance between mortality reduction and adverse effects. In order to improve it, studies have proposed personalized screening strategies based on woman's individual breast cancer risk. There is, therefore, a need to create individual risk prediction models through the analysis of large population-based databases. We developed a model that could be used to classify women targeted for mammography screening according to individual breast cancer risk.

METHODS

We conducted a retrospective cohort study of 57,411 women screened in 4 counties of BreastScreen Norway between 2007 and 2019, and followed up until 2022. We used partly conditional Cox regression to estimate the adjusted hazard ratios for the different risk factors. We calculate the 4-year absolute breast cancer risk estimates, we validated the model using bootstrap resampling by means of the Expected-to-Observed ratio (E/O) and the area under the ROC curve (AUC) and we plotted the effect of each variable in the risk estimation.

RESULTS

The model slightly overestimated the risk with an E/O of 1.10 (95%CI: 1.09-1.11) and the AUC was 62.9% (95%CI: 60.8%-65.2%).

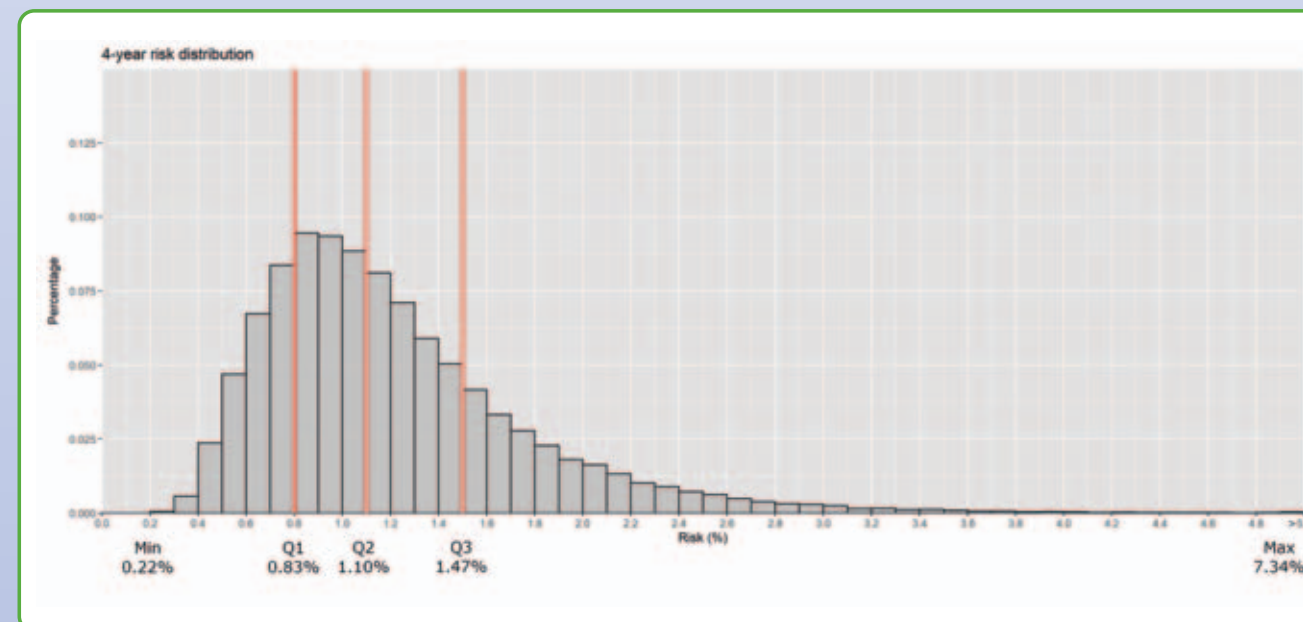**Figure 1. Distribution of the 4-year absolute breast cancer risk estimates.**

Figure 2. Impact of substracting each variable from the model on 4-year absolute risk predictions.
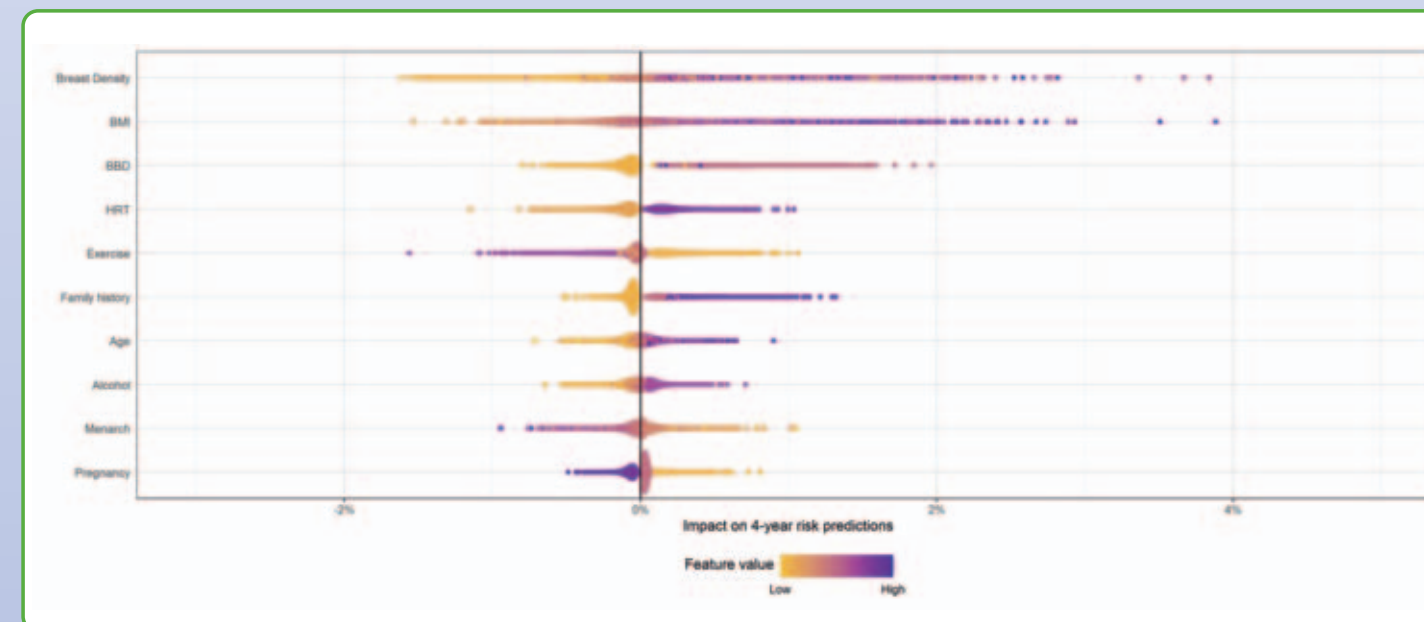

CONCLUSION

We designed and validated a risk prediction model to estimate the breast cancer risk in women participating in the breast cancer screening program in Norway. The model could be key for designing risk-based personalized screening strategies to improve the risk-benefit balance of mammography screening.

Table 1. Partly conditional Cox proportional hazards model results showing the hazard ratios of the risk factors for breast cancer.

	Women-years	aHR (95%CI)
Age	375.078	1.01 (1.00-1.03)
Body mass index	375.078	1.06 (1.04-1.08)
Age at menarche	375.078	0.95 (0.91-1.00)
Mammographic density		
VDG 1	126.951	0.59 (0.51-0.69)
VDG 2	137.639	Ref.
VDG 3	93.305	1.37 (1.20-1.56)
VDG 4	17.182	1.71 (1.33-2.20)
Family history of breast cancer		
No	289.289	Ref.
Yes, 2nd degree	50.082	1.17 (0.98-1.41)
Yes, 1st degree	35.707	1.34 (1.10-1.63)
Benign breast disease		
No	319.891	Ref.
Yes, prior self-reported	53.430	1.55 (1.31-1.83)
Yes, clinician-reported	1.757	1.42 (1.02-1.98)
Alcohol intake		
No	59.153	0.94 (0.76-1.16)
Yes, 5 or less units/month	94.432	Ref.
Yes, 6-10 units/month	93.789	1.06 (0.88-1.28)
Yes, more than 10 units/month	127.704	1.14 (0.96-1.36)
Exercise		
Never	104.381	Ref.
0-1h/week	88.429	0.80 (0.67-0.96)
2-3h/week	135.002	0.83 (0.70-0.97)
+4h/week	47.266	0.65 (0.51-0.83)
Pregnancy		
Never	31.225	1.10 (0.88-1.38)
1 o 2	188.424	Ref.
3 or more	155.429	0.91 (0.79-1.04)
Hormone replacement therapy		
No	226.166	Ref.
Yes	148.912	1.30 (1.13-1.48)

aHR: Adjusted Hazard Ratio. 95%CI: 95% Confidence Interval. VDG: Volpara Density Grade.

Conflict of interest: All authors declare that they have no conflicts of interest.

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