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New study explores the link between education level and risk of breast cancer by subtype in the EPIC cohort

Lyon, France, 11 April 2025 – A new study conducted by scientists from the International Agency for Research on Cancer (IARC), in collaboration with leading research institutions, provides a detailed analysis of the link between education level and breast cancer risk, focusing on different breast cancer subtypes. This research, which analyses data from more than 311 000 women within the European Prospective Investigation into Cancer and Nutrition (EPIC) cohort, is by far the most extensive on the topic to date. The findings were published in the *International Journal of Cancer*.[1]

“Understanding how social factors, like the level of education, influence the risk of different breast cancer subtypes is crucial, because it provides insights not only into the etiology of the disease and how we can prevent it but also into the broader inequalities that affect health outcomes across different communities,” says IARC scientist Dr Margherita Pizzato, the lead author of the study.

The new analysis shows that the association between education level and breast cancer incidence varies by tumour subtype. Women with the highest education level have an approximately 40% higher risk of in situ breast cancer (a non-invasive lesion confined to the breast ducts or lobules, with an excellent prognosis) and a 20% higher risk of invasive breast cancer, compared with women with the lowest education level.

Estrogen receptor (ER) status is important because invasive tumours in which the cells have estrogen receptors and may grow in response to estrogen (ER-positive tumours) are more often associated with a favourable prognosis. This study found that the association between education level and risk of ER-positive breast cancer aligns with the overall trend, i.e. women with the highest education level have a 20% higher risk of ER-positive breast cancer compared with women with the lowest education level. ER-negative breast cancer, in which the cells lack estrogen receptors, is a more aggressive subtype and is often associated with fewer treatment options and poorer prognosis. The study found no significant association between education level and risk of ER-negative breast cancer.

Beyond ER status, this research is the first to individually examine the relationship between education level and breast cancer risk across different cellular expression levels of progesterone receptor (PR) and human epidermal growth factor receptor 2 (HER2). Compared with women with a lower education level, women with

[1] Pizzato M, McCormack V, Dossus L, Al-Alem U, Delpierre C, Lamy S, et al. (2025). Education level and risk of breast cancer by tumor subtype in the EPIC cohort. *Int J Cancer*. Published online 1 April 2025. https://doi.org/10.1002/ijc.35413

a higher education level had a higher risk of developing the PR-positive, PR-negative, HER2-positive, and HER2-negative subtypes, although with varying magnitudes of increased risk.

The researchers found that differences in reproductive and lifestyle risk factors explained only about 30–40% of the differences in breast cancer risk by education level. In a more detailed analysis, the contribution of each risk factor was quantified and, consistent with previous research, parity – specifically in terms of older age at first pregnancy and fewer total pregnancies – emerged as a major explanatory factor for the excess risk of breast cancer observed among highly educated women. Other key factors included high alcohol consumption and increased use of estrogen–progestin therapy, both of which contributed to the elevated risk of breast cancer among highly education women.

Although many of the ways in which education level affects the risk of different breast cancer subtypes have been identified, others are still not fully understood. Differences in screening attendance are also likely to play a role and could partially explain the higher risk of ER-positive breast cancer observed among highly educated women. This study further contributes to the understanding of the complex nature of breast cancer in terms of its social gradient and etiology.

“This study is the first comprehensive analysis of this scale looking at how socioeconomic factors, like education level, are associated with the risk of breast cancer subtypes. The higher risk of ER-positive and other good-prognosis subtypes among highly educated women partly reflects their childbearing and lifestyle patterns, as well as their greater participation in screening programmes,” says IARC scientist Dr Salvatore Vaccarella, a co-author of the study.

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The International Agency for Research on Cancer (IARC) is part of the World Health Organization. Its mission is to coordinate and conduct research on the causes of human cancer, the mechanisms of carcinogenesis, and to develop scientific strategies for cancer control. The Agency is involved in both epidemiological and laboratory research and disseminates scientific information through publications, meetings, courses, and fellowships. If you wish your name to be removed from our press release emailing list, please write to com@iarc.who.int.