Aim of the study: To analyse trends in the incidence rates of adenocarcinoma and squamous cell carcinoma of the oesophagus (ACE and SCC, respectively) in white women between 1992 and 2010.

Material and methods: We used data from the Surveillance, Epidemiology, and End Results (SEER) program to identify cases of esophageal cancer. Age-adjusted incidence rates (IR) were calculated for ACE and SCC for two different time periods (1992–1996 and 2006–2010) and stratified by age, stage, and histologic type. We used joinpoint analysis to detect changes in rates between 1992 and 2010.

Results: Between the time periods 1992–1996 and 2006–2010, the age-adjusted incidence rates for SCC in white women decreased from 1.2/100,000 to 0.8/100,000 person-years, and for ACE it increased from 0.5/100,000 to 0.7/100,000 person-years. Similar to white men, the increase in the incidence of ACE was consistent for all stages and all age groups in white women. However, it was most pronounced in women aged 45–59 years, where the incidence of ACE (0.9/100,000 person-years) in 2006–2010 exceeded the incidence of SCC (0.6/100,000 person-years). On jointpoint regression analysis, an inflection point was seen in 1999 for ACE, indicating a slower rate of increase for ACE after 1999 (annual percentage change of 8.00 before 1999 vs. 0.88 starting in 1999).

Conclusions: The incidence of ACE is increasing in white women, irrespective of age or stage. Indeed, ACE is now more common than SCC in white women between 45 and 59 years of age.

Key words: esophageal cancer, incidence, white women, SEER.
whereas from 1999 to 2010 the APC was a non-significant increase of 0.88 ($p = 0.33$). To find the APC in ACE IRs for the entire period from 1992 to 2010, the Joinpoint application was configured to fit the data with no inflection points. This yielded an APC of 2.92 ($p < 0.05$).

The decrease in the incidence of SCC and increase in the incidence of ACE was consistent across stage and age at diagnosis (Table 1). During the 2006–2010 time period, the age-adjusted IR of ACE had become almost equal to that of SCC among white women (Table 1). The increased IRs of ACE were most pronounced in women aged 45–59 years, where the IRs of ACE in 2006–2010 were more than that of SCC (0.9/100,000 person-years for ACE vs. 0.6/100,000 person-years for SCC).

### Discussion

Between 1992 and 2010, the incidence of ACE rose steadily in white women of all age groups, making it as common as SCC in white women overall and the most common histology of EC in white women aged 45–59 years.

Various risk factors have been described for the development of ACE in both sexes, including obesity, symptomatic gastro-esophageal reflux disease (GERD), Barrett’s esophagus (BE), and decreased consumption of fruits and vegetables [7]. Increasing prevalence of obesity, GERD, and BE have paralleled the increasing rates of ACE in men [8–11]. We noted a similar relationship between the prevalence of obesity and IRs of ACE among white women. While the prevalence of obesity among white women in the US remained relatively constant from 1960 to 1980, it showed a rapid rise over the next two decades, i.e. 22.9% (1988–1994) and 30.1% (1999–2000) [12], before slowing down at the turn of the century (33.4% in 2009–2010) [13]. Our results similarly indicated that the rapid increase in

![Fig. 1. Age-adjusted incidence rates (points) and regression lines for squamous cell carcinoma and adenocarcinoma for diagnoses made from 1992 to 2010 in white women](image)

### Table 1. Incidence of squamous cell carcinoma and adenocarcinoma of the esophagus in white women in 13 SEER registries

|                | 1992–1996 | 2006–2010 |
|----------------|-----------|-----------|
|                | Rate (95% CI) | Count | Rate (95% CI) | Count |
| Squamous cell carcinoma |          |         |          |         |
| Age            |           |         |           |         |
| < 45 years     | < 0.1     | 924     | < 0.1     | 731     |
| 45–59 years    | 0.9 (0.7–1.1) | 98     | 0.6 (0.5–0.8) | 102     |
| 60–74 years    | 5.5 (5–6)  | 441     | 3.3 (2.9–3.7) | 277     |
| 75+ years      | 7.5 (6.7–8.3) | 369   | 6.3 (5.7–7)  | 347     |
| Stage          |           |         |           |         |
| Localized      | 0.4 (0.3–0.4) | 290    | 0.2 (0.2–0.3) | 189     |
| Regional       | 0.4 (0.3–0.4) | 264    | 0.3 (0.2–0.3) | 238     |
| Distant        | 0.2 (0.2–0.2) | 133    | 0.2 (0.2–0.2) | 181     |
| Unstaged       | 0.3 (0.3–0.3) | 237    | 0.1 (0.1–0.2) | 123     |
| Adenocarcinoma |           |         |           |         |
| Age            |           |         |           |         |
| < 45 years     | < 0.1     | 8       | < 0.1     | 9       |
| 45–59 years    | 0.4 (0.3–0.5) | 42     | 0.9 (0.7–1)  | 143     |
| 60–74 years    | 1.6 (1.3–1.9) | 127   | 2.7 (2.4–3.1) | 228     |
| 75+ years      | 3.7 (3.2–4.3) | 186   | 4.8 (4.2–5.4) | 273     |
| Stage          |           |         |           |         |
| Localized      | 0.1 (0.1–0.1) | 92     | 0.2 (0.2–0.2) | 161     |
| Regional       | 0.1 (0.1–0.1) | 86     | 0.2 (0.2–0.3) | 189     |
| Distant        | 0.1 (0.1–0.1) | 85     | 0.3 (0.2–0.3) | 235     |
| Unstaged       | 0.1 (0.1–0.2) | 100    | 0.1 (0.1–0.1) | 68      |
ACE IR rates levelled off around 1999 (Fig. 1). This trend possibly reflects increased detection of ACE in obese women, because obesity and obesity-associated lifestyle are known to exacerbate symptomatic GERD. The contribution of other known risk factors for ACE in men is less well understood in women. For example, women with BE are two times less likely to develop ACE than are their male counterparts [13].

It has been reported that the increasing incidence of ACE in white males has slowed down since 1996 [14]. In this study we found a similar slowing of the increasing incidence for white females. Relatively small numbers in each category limits further analysis of stage-specific analysis of IR trends in white women.

Use of newer technology (such as endoscopic ultrasound) has improved the staging of EC in recent years; however, stage migration due to improved staging is unlikely to explain these results because the IRs for all stages of ACE have increased while those of ‘unstaged’ have remained constant (Table 1). Similarly, any change of classification of gastric cardia cancers to esophageal cancers cannot explain the increase in the IRs of EC because the IRs of gastric cardia cancer also increased during the study period (data not shown).

A significant finding of our analysis is the remarkable increase in ACE IR in relatively young white women (age 45–59 years), such that ACE is now more common than SCC in this age group. One possible explanation could be differences in healthcare-seeking behaviour in this age group and thereby a higher likelihood of being diagnosed with an underlying cancer. However, one would expect this to lead to a higher proportion of early stage ACE at diagnosis in 45-59 year old white women. The small numbers in each age group did not allow for stage specific analysis in the current study. Alternative explanations such as age-specific risk factor distribution, must also be examined. This is important because localised EC (both ACE and SCC) is potentially curable, especially in younger patients (age 45–65 years). Along with advanced imaging, improved surgical techniques and the use of neoadjuvant therapy survival rates for oesophageal carcinoma have significantly improved over the last three decades [6, 15].

In summary, our study shows that the IRs of ACE have increased in white women for all age and stage groups, making ACE as common as SCC. ACE IRs have increased dramatically in women between 45–59 years of age, making it the most common histological subtype of EC in this age group. This study is limited by the relatively small number of incident ACE cases in white women, which does not allow us to draw any conclusions about time trends based on the stage of disease. In addition, trends in ACE IRs could not be analysed for women of other racial groups due to small numbers. Although the IRs and numbers diagnosed each year remain small compared with other more common cancers, it will be interesting to monitor and seek explanations for the changing ES patterns among white women, particularly those in the age group 45–59 years.

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