Risk Factors Associated With Early-Onset Esophageal Cancer in Tanzania

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PURPOSE

Eastern Africa is one of several regions affected by high incidence rates of esophageal squamous cell carcinoma (ESCC). A unique epidemiologic feature of ESCC in Eastern Africa is the high incidence in young people, with one-third of cases diagnosed at age < 45 years. This study aimed to investigate risk factors for early-onset ESCC in Tanzania through a secondary analysis of a matched case-control study.

MATERIALS AND METHODS

From 2013 to 2015, ESCC cases were recruited at Muhimbili National Hospital and Ocean Road Cancer Institute in Dar es Salaam, Tanzania. Hospital controls were identified from patients with nonmalignant conditions and matched 1:1 for sex and age (± 10 years). Questionnaires were used to assess sociodemographic characteristics and environmental, dietary, and lifestyle risk exposures. Multivariate logistic regression models were used to estimate age-specific odds ratios of ESCC for exposures among participants age 30-44 and ≥ 45 years.

RESULTS

A total of 471 cases and 471 controls were enrolled. Among cases, 100 (21%) were < 45 years. Multiple exposures were identified as risk factors for early-onset ESCC, several of which were unique to this age group, including infrequent teeth cleaning, secondhand tobacco smoke exposure, and pest infestation of grain and/or nuts. Lower socioeconomic status, family history of ESCC, tobacco smoking, home-brewed alcohol consumption, home storage of grain and/or nuts, and use of firewood for cooking were associated in the older but not the younger age group. Hot beverage intake was associated with increased ESCC risk in both age groups.

CONCLUSION

Our results suggest that ESCC risk factors in Tanzania vary between age groups. With the data currently available, environmental and behavioral risk factors appear to play an important role in the high incidence of ESCC among young people.
The objective of this secondary analysis was to investigate potential etiologic factors associated with early-onset ESCC in Tanzania.

**Study Setting and Population**

The case-control study was conducted at Muhimbili National Hospital (MNH) and Ocean Road Cancer Institute (ORCI) in Dar es Salaam, Tanzania. Eligible cases were patients with newly diagnosed ESCC from 2013 to 2015 who were age ≥ 30 years. Diagnostic criteria included patients with histologically confirmed ESCC and patients diagnosed clinically based on computed tomography scan, barium swallow, or endoscopy. We used expanded diagnostic criteria allowing for nonpathologically confirmed cases given the prohibitive costs of pathology. Previous data indicate that a clinical diagnosis of EC corresponds to ESCC with >90% pretest probability in this setting.10

Eligible controls were identified from patients admitted to the MNH medical, surgical, trauma, and gynecology wards for a nonmalignant condition and were matched 1:1 with cases for sex and age (± 10 years). Nonpermanent residents of Tanzania were excluded from both groups.

**Data Collection**

Exposure data were collected through structured interviews, using questionnaires that captured established ESCC risk factors, and setting-specific putative risk factors. Full details on the standardized questionnaires were previously described.17 Exposure variables included sociodemographic factors, residential history, occupational history and related exposures, medical history, family medical history, household exposures, dietary factors, and lifestyle risk behaviors. Interviews were conducted in Swahili by trained research assistants.

**Ethics Statement**

This study was approved by institutional review boards at Muhimbili University of Health and Allied Sciences (Dar es Salaam, Tanzania), the University of California, San Francisco (UCSF, San Francisco, CA), and the National Institute for Medical Research (NIMR) of Tanzania. Written informed consent was obtained from all participants before enrollment in Swahili, the national language of Tanzania.

**Statistical Analysis**

Study participants were categorized into two age groups: 30-44 years and ≥ 45 years. Descriptive statistics were used to summarize sociodemographic factors and exposure variables for cases and controls by age group. Within each age group, univariate logistic regression models were used to test for associations between each exposure and ESCC risk. The age-specific odds ratio (OR) of ESCC and the 95% Wald CI were calculated for each exposure.

Multivariate logistic regression modeling was then used to assess the independent effect of the exposures within each age group. A multivariate model was fit with inclusion of design factors (age, sex), sociodemographic characteristics (geographic zone and a composite measure of socioeconomic status calculated using the International Wealth Index [IWI]16), retention of established ESCC risk factors,5 and exposures that were significantly associated with ESCC in the age-stratified univariate analyses. Established risk factors included in the model were tobacco use (current or former use v never), alcohol use (current or former use v never), home-brewed alcohol consumption (current or former use v never), and daily hot beverage consumption (as a continuous variable). The same model was fit to the younger age group (30-44 years) and the older age group (≥ 45 years) to examine differences in risk factors and magnitudes of associations between the two age groups. Finally, the likelihood-ratio test (LRT) was used to assess if the effect of the risk factor differs between age groups. In this analysis, the LRT was used to compare nested models of the age-adjusted main-effect exposure data with a model that included an interaction term of the main-effect exposure on age group.
Statistical analyses were performed using SAS 9.4 (SAS Institute, Inc, Cary, NC). Statistical significance was declared based on a two-sided \( P \)-value < .05. No multiple testing adjustment was conducted across the exposures.

**RESULTS**

A total of 471 ESCC cases and 471 matched controls were included in the analysis. Among cases, 21% were age 30-44 years, and 79% were age \( \geq 45 \) years. Table 1 summarizes the sociodemographic characteristics of cases and controls by age group. Results of multivariate logistic regression analyses among the younger age group (30-44 years) and the older age group (\( \geq 45 \) years) are presented in Table 2. The univariate analyses of age-specific associations of ESCC and sociodemographic factors, behavioral risk factors, and household exposures that were used to inform variable selection in multivariate modeling are presented in Appendix Tables A1-A4.

**Sociodemographic Factors**

Zone of permanent residence emerged as a risk factor in multivariate models in younger and older groups. Among the younger group, residence in the Northern Lake Zone was associated with increased risk of ESCC (adjusted OR [aOR] 12.06; 95% CI, 3.18 to 45.71). Among the older age group, residence in the Northern Lake Zone (aOR 1.57; 95% CI, 1.02 to 2.41) and the Southern Highlands-Central zone (aOR 3.24; 95% CI, 1.94 to 5.41) were each associated with increased risk. The effect of zone differed significantly between age groups (LRT \( P \)-value = .01).

Among the older age group, an IWI score in the middle or lowest tertile was associated with increased ESCC risk (low IWI: aOR 1.89; 95% CI, 1.19 to 3.01; middle IWI: aOR 1.75; 95% CI, 1.11 to 2.76). There was a similar trend among the younger age group; however, this was not statistically significant after controlling for other exposures. Family history of EC was associated with an increased risk in the older (aOR 4.03; 95% CI, 1.36 to 11.98) but not the younger age group, with a significant difference in effect between age groups (LRT \( P \)-value = .02).

**Behavioral Risk Factors**

None of the lifestyle risk behaviors investigated, including consumption of alcohol, home brew, or tobacco smoking, were associated with increased ESCC risk in the younger age group. Among the older age group, smoking tobacco was associated with increased ESCC risk (aOR 2.04; 95% CI, 1.33 to 3.12). In evaluating alcohol consumption among the older group, paradoxically, current or former use of any type of alcohol appeared to have a protective effect (aOR 0.39; 95% CI, 0.23 to 0.65). Consumption of home-brewed alcohol in particular (current or former use of any type), by contrast, was associated with increased risk (OR 2.08; 95% CI, 1.26 to 3.41).

Less than daily teeth cleaning was associated with increased ESCC risk in the younger group (aOR 9.79; 95% CI, 1.90 to 50.54), but not the older age group. Intake of an increasing number of hot beverages daily was associated with increasing ESCC risk in a dose-response relationship among both age groups (younger: aOR 1.99; 95% CI, 1.13 to 3.50; older: aOR 1.60; 95% CI, 1.13 to 2.27). Daily consumption of raw greens was found to be protective in both age groups (younger: aOR 0.20; 95% CI, 0.05 to 0.88; older aOR 0.44; 95% CI, 0.23 to 0.85).

**Household Exposures**

Secondhand tobacco smoke in the home was associated with an increased risk of ESCC among the younger (aOR 2.58; 95% CI, 1.00 to 6.67) but not the older group. Firewood cooking was associated with increased ESCC risk among the older group (aOR 1.54; 95% CI, 1.00 to 2.37), but not the younger group. In-home storage of grain and/or nuts was associated with increased risk among the older group (aOR 1.68; 95% CI, 1.05 to 2.70), but not the younger group. Previous pest infection of grain and/or nuts was associated with increased risk of ESCC among the younger group (aOR 4.00; 95% CI, 1.38 to 11.59), but not the older group.

**DISCUSSION**

In this analysis, multiple exposures were identified as potential risk factors for early-onset ESCC, including poor oral hygiene, pest infection of grain and/or nuts, hot beverage intake, secondhand tobacco smoke exposure, and permanent residence in the Northern Lake Zone of Tanzania. Overall, we found that risk factors varied in their effect among different age groups. These findings suggest that the relative importance of certain risk factors for ESCC in Eastern Africa may vary across the lifespan, likely because of differences in exposure patterns by age and/or latency of effect.

To our knowledge, this is the first analytic epidemiologic study of risk factors for early-onset ESCC in Eastern Africa. Findings from this study build on earlier work from Western Kenya, which first looked into unique epidemiologic patterns that may explain the high incidence of ESCC among young people in this region. One case series included a comparative analysis of sociodemographic characteristics of patients age \( \leq 30 \) and \( > 30 \) years. In this study, Kalenjin ethnicity appeared to confer increased ESCC risk at early ages, whereas geographic region and sex both had null effect. A subsequent case series from the same institution assessed alcohol and tobacco use and family history of EC in 60 cases age \( \leq 30 \) years. Nearly half of cases had a family history of EC. Neither tobacco use nor alcohol use was common among cases.

Prior findings from Kenya of increased risk of ESCC with a specific ethnicity and with a family history of EC suggest the possibility of underlying genetic susceptibility and/or shared environmental exposures. In our analysis, family history emerged as a risk factor, but only among the older group. Although comparisons are limited by age differences
TABLE 1. Sociodemographic Factors by Age Group

| Sociodemographic Factor | Younger Group (age 30-44 years) | Older Group (age ≥ 45 years) | P |
|-------------------------|---------------------------------|-----------------------------|----|
|                         | Cases (n = 100), No. (%)        | Controls (n = 108), No. (%)  |    |
| Sex                     |                                 |                             |    |
| Male                    | 62 (62)                         | 70 (65)                     | .674 |
| Female                  | 38 (38)                         | 38 (35)                     |    |
| Ethnicity               |                                 |                             | .999 |
| Arab                    | 0                               | 0                           | .848 |
| White                   | 0                               | 0                           |    |
| African                 | 100 (100)                       | 108 (100)                   |    |
| Zone                    |                                 |                             | < .001 |
| Coastal-Zanzibar        | 58 (58)                         | 95 (88)                     |   |
| Central                 | 7 (7)                           | 4 (4)                       |   |
| Lake                    | 3 (3)                           | 3 (3)                       |   |
| Northern                | 24 (24)                         | 2 (2)                       |   |
| Southern Highlands      | 8 (8)                           | 4 (4)                       |   |
| Unknown                 | 3                               | 6                           |    |
| Education               |                                 |                             | < .001 |
| None                    | 8 (8)                           | 3 (3)                       | .003 |
| Any primary level       | 75 (75)                         | 63 (58)                     |   |
| Any secondary           | 10 (10)                         | 28 (26)                     |   |
| Postsecondary or above  | 7 (7)                           | 14 (13)                     |   |
| Unknown                 | 2                               | 6                           |    |
| Occupation              |                                 |                             | < .001 |
| Agriculture             | 40 (40)                         | 21 (19)                     | .002 |
| Business                | 19 (19)                         | 30 (28)                     |   |
| Office work             | 3 (3)                           | 13 (12)                     |   |
| Other                   | 38 (38)                         | 44 (41)                     |   |
| Unknown                 | 2                               | 6                           |    |
| Household income, TSH   |                                 |                             | .048 |
| < 150,000               | 8 (11)                          | 1 (< 1)                     |   |
| 150,001-500,000         | 7 (9)                           | 8 (10)                      |   |
| 500,001-900,000         | 16 (21)                         | 15 (19)                     |   |
| 900,001-1,200,000       | 17 (23)                         | 13 (16)                     |   |
| > 1,200,000             | 27 (36)                         | 43 (54)                     |   |
| Unknown                 | 25                              | 28                          |   |
| IWI*                    |                                 |                             | .005 |
| High (67-100)           | 24 (25)                         | 48 (45)                     |   |
| Medium (33 ≤ 67)        | 42 (43)                         | 40 (37)                     |   |
| Low (0 ≤ 33)            | 31 (32)                         | 19 (18)                     |   |
| Unknown                 | 3                               | 1                           |   |
| Family history of EC    |                                 |                             | .241 |
| No                      | 97 (97)                         | 101 (94)                    |   |
| Yes                     | 3 (3)                           | 7 (6)                       |   |
| Unknown                 | 9                               | 7                           |    |

NOTE. Statistically significant findings are highlighted as bold text.
Abbreviations: EC, esophageal cancer; IWI, International Wealth Index; TSH, Tanzanian Shillings.
*IWI scores range from 0 to 100 (low to high) and are calculated based on nine consumer durables or housing characteristics, including television, refrigerator, telephone, radio, washing machine, toilet, floor material, electricity, and drinking water source.
between study populations given our exclusion of cases age < 30 years, our findings argue against genetic factors contributing to the high burden of early-onset disease; however, this warrants further exploration and will be addressed by the multisite genome wide association study currently underway.

In our study, we detected an increased risk of ESCC with a dose-response to frequency of hot beverage intake in both age groups. Other metrics investigating hot beverage exposure (preferred beverage temperature, number of times burnt tongue or mouth) showed no age-specific effects. The results differ slightly from previous case-control studies in Kenya, although comparisons are limited by the lack of harmonized exposure metrics.20,21 In one study, a preference for hot beverages was associated with ESCC.21 In another study, self-reported consumption of very hot beverages was associated with increased ESCC risk; however, other metrics of exposure, including daily number of hot beverages, had no significant effects.20 While findings across studies have been inconsistent thus far, our analysis suggests that frequent hot beverage consumption may increase risk of early-onset disease.

The potential role of poor oral health as a risk factor for ESCC in Eastern Africa has recently gained attention.21-23 Contemporaneous case-control studies in Kenya and Northern Tanzania found that infrequent teeth cleaning and the presence of missing and decayed teeth were associated with increased ESCC risk; however, other metrics of exposure, including daily number of hot beverages, had no significant effects.20 While findings across studies have been inconsistent thus far, our analysis suggests that frequent hot beverage consumption may increase risk of early-onset disease.

The table below presents aORs and 95% CIs of independent risk factors for ESCC on the basis of multivariate logistic regression within each age group.

### TABLE 2. aORs and 95% CIs of Independent Risk Factors for ESCC on the Basis of Multivariate Logistic Regression Within Each Age Group

| Risk Factor                          | Younger Group (age 30-44 years) | Older Group (age ≥ 45 years) | P*  |
|-------------------------------------|----------------------------------|------------------------------|-----|
| Sex                                 | aOR (95% CI)                     | aOR (95% CI)                 |     |
| Male                                | 1.0                              | 1.0                          |     |
| Female                              | 1.58 (0.65 to 3.83)              | 1.23 (0.80 to 1.88)          |     |
| Age at diagnosis (+1 year)          | 1.05 (0.95 to 1.15)              | 1.01 (0.99 to 1.02)          |     |
| Zone                                | 1.02 (0.95 to 1.09)              | 1.01 (0.99 to 1.02)          | .011|
| Coastal-Zanzibar                     | 1.0                              | 1.0                          |     |
| Northern Lake Zone                  | 12.06 (3.18 to 45.71)            | 1.57 (1.02 to 2.41)          |     |
| Southern Highlands-Central          | 1.96 (0.62 to 6.26)              | 3.24 (1.94 to 5.41)          |     |
| IWIb                                | .921                             | .921                         |     |
| High (67-100)                       | 1.0                              | 1.0                          |     |
| Medium (33 ≤ 67)                    | 1.41 (0.58 to 3.44)              | 1.75 (1.11 to 2.76)          |     |
| Low (0 ≤ 33)                        | 2.78 (0.90 to 8.53)              | 1.89 (1.19 to 3.01)          |     |
| Family history of EC                | .958                             | .958                         |     |
| No                                  | 0.49 (0.05 to 4.50)              | 4.03 (1.36 to 11.98)         | .022|
| Yes                                 | 1.0                              | 1.0                          |     |
| Smoking tobacco (current or former use) | aOR (95% CI)                     | aOR (95% CI)                 | .123|
| No                                  | 0.79 (0.29 to 2.11)              | 2.04 (1.33 to 3.12)          |     |
| Yes                                 | 1.0                              | 1.0                          |     |
| Alcohol (any type; current or former use) | aOR (95% CI)                     | aOR (95% CI)                 | .958|
| No                                  | 0.52 (0.22 to 1.26)              | 0.39 (0.23 to 0.65)          |     |
| Yes                                 | 1.0                              | 1.0                          |     |
| Home-brewed alcohol (any type; current or former use) | aOR (95% CI)                     | aOR (95% CI)                 | .375|
| No                                  | 1.64 (0.57 to 4.72)              | 2.08 (1.26 to 3.41)          |     |
| Yes                                 | 1.0                              | 1.0                          |     |
| Secondhand tobacco smoke in the house | aOR (95% CI)                     | aOR (95% CI)                 | .201|
| No                                  | 2.58 (1.00 to 6.67)              | 1.35 (0.87 to 2.09)          |     |
| Yes                                 | 1.0                              | 1.0                          |     |
| Firewood cooking in home            | .721                             | .721                         |     |
| No                                  | 1.21 (0.51 to 2.88)              | 1.54 (1.00 to 2.37)          |     |
| Yes                                 | 1.0                              | 1.0                          |     |
| How often teeth cleaned             | .157                             | .157                         |     |
| Daily                               | 9.79 (1.90 to 50.54)             | 1.55 (0.99 to 2.41)          |     |
| Less than daily                     | 1.05 (0.42 to 2.65)              | 1.68 (1.05 to 2.70)          |     |

(Continued on following page)
preserving grain and/or nuts were associated with increased ESCC risk in this group. Many studies have explored the relationship between dietary factors and ESCC, and raw fruit and vegetable intake has consistently been shown to have protective effects.\textsuperscript{5,31} Our findings related to household storage practices of grain and/or nuts raise the question of whether undetected contaminants or infestations may play a causative role. Further research into this exposure will likely require field study.

The geographic variability of ESCC incidence rates, globally and regionally, has been the focus of a large body of research investigating ESCC risk factors. In our study, permanent residence in the Central, Northern Lake Zone, or Southern Highlands geographic areas was found to be associated with an increased ESCC risk in non–age-stratified analyses.\textsuperscript{17} The Northern Lake Zone area emerged as the only area associated with increased risk among the youngest age group, with a strong magnitude of association, albeit with a wide CI due to small sample size. With MNH and ORCI both located in the Coastal zone, some of the elevated risk are likely attributable to referral bias. That is, patients with ESCC are more likely to travel far distances to MNH and ORCI for cancer care as compared with individuals with other medical conditions who are appropriate for care at lower-level health facilities. This is evident in the relatively few controls (12%) in the younger group from outside ORCI and MNH’s proximate catchment area. However, our study, as well as previous studies, reported a high proportion of ESCC cases occurring in the Northern Lake Zone, even when compared with other regions of similar distance to cancer referral centers.\textsuperscript{10,11} These findings, along with the high proportion of young cases from this area, raise important questions about the geographic distribution of the putative risk factors under investigation. Further investigations of behavioral risk factors and environmental exposures in this area are warranted.

The relationship between smoking tobacco and ESCC in Eastern and Southern Africa has been well-established.\textsuperscript{17,21,32-35} However, the low prevalence of tobacco use in these regions (men < 20%, women < 3%\textsuperscript{39}) casts doubt on the role of tobacco as a solitary ESCC risk factor. In our analysis, we found no association between tobacco use and early-onset disease. This finding is consistent with the previously published Kenyan case series, which found a low prevalence of smoking tobacco (15%) in cases ≤ 30 years.\textsuperscript{19} Notably, in our study, secondhand tobacco smoke exposure emerged as a risk factor in the younger group, whereas tobacco smoking emerged as a risk factor in the older group. We speculate that the difference in age-specific effects of tobacco smoking may be due to timing of smoking initiation and the latency of carcinogenic effects. Although tobacco may not be a leading ESCC risk factor in young people in Tanzania, the strong association between tobacco use and ESCC and links with secondhand smoke exposure suggest that tobacco control strategies should be considered as part of prevention efforts.

Although previous research has demonstrated strong links between alcohol consumption and ESCC risk in many settings,\textsuperscript{5,31} findings from case-control studies in Eastern and Southern Africa have been mixed.\textsuperscript{17,21,32-35,37-40} In our age-stratified analysis, we found no association between alcohol and early-onset disease. Our findings are comparable with the Kenyan case series which found a low prevalence of alcohol consumption (15%) among ESCC cases ≤ 30 years.\textsuperscript{19} Few conclusions can be drawn from two studies alone; however, both argue against alcohol as a major risk factor for early-onset disease in Eastern Africa. Investigation of human papillomavirus (HPV) as a risk factor was not included in the original study\textsuperscript{17}; however, links between HPV and ESCC have been previously investigated.\textsuperscript{41-43} The InterSCOPE study is one of the most definitive studies to date examining the relationship between ESCC and HPV, with results suggesting that HPV is unlikely to be an important risk factor for ESCC.\textsuperscript{44,45}

A summary of the strengths and limitations of our original case-control study was previously published.\textsuperscript{17} Major limitations include recruitment from national referral centers, self-report of exposures, exclusion of study participants age ≤ 30 years, and inclusion of patients diagnosed on the basis of clinical criteria. Although > 90% of cases in Tanzania are of squamous cell histology, the inclusion of

### TABLE 2. aORs and 95% CIs of Independent Risk Factors for ESCC on the Basis of Multivariate Logistic Regression Within Each Age Group (Continued)

| Risk Factor | Younger Group (age 30-44 years) | Older Group (age ≥ 45 years) | P* |
|-------------|---------------------------------|------------------------------|----|
| Grain and/or nuts has been infected by pests | | | .171 |
| No | | | |
| Yes | 4.00 (1.38 to 11.59) | 1.03 (0.66 to 1.60) | |
| How many hot beverages daily | | .538 | |
| +1 hot drink daily | 1.99 (1.13 to 3.50) | 1.60 (1.13 to 2.27) | |
| Consumption of raw greens | | .659 | |
| Less than daily | | | |
| Daily | 0.20 (0.05 to 0.88) | 0.44 (0.23 to 0.85) | |

NOTE. Statistically significant findings are highlighted as bold text.

Abbreviations: aOR, adjusted odds ratio; EC, esophageal cancer; ESCC, esophageal squamous cell carcinoma; IWI, International Wealth Index; LRT, likelihood-ratio test.

*LRT to assess if the effect of the risk factor is different between age groups.

*IWI\textsuperscript{18} scores range from 0 to 100 (low to high) and are calculated based on nine consumer durables or housing characteristics, including television, refrigerator, telephone, radio, washing machine, toilet, floor material, electricity, and drinking water source.
adenocarcinoma cases may have attenuated the true relationship between certain risk factors and ESCC. In addition, our findings may be susceptible to selection bias due to geographic differences in residence between cases and controls. This limitation could be addressed in a future study with a multisite recruitment strategy. In our age-stratified analysis, three additional limitations arose. First, the age-matching strategy used at the time of recruitment, whereby controls were matched 1:1 with cases by age ± 10 years, limited our use of matching in age-stratified analyses, hence our use of logistic (unconditional) regression. While conditional logistic regression is more commonly used with matched case-control studies, standard logistic regression has been shown to be an appropriate alternative in this analytic context. Second, because of the few cases of early-onset ESCC, this analysis was limited by the sample size. Pooled analyses of young cases from parallel case-control studies currently underway at Eastern African sites will be needed for more robust analyses. Finally, the comparison of age-specific effects is limited by potential differences in unmeasured confounders between age groups.

In conclusion, the high incidence of ESCC in young people is unique to Eastern Africa. This epidemiologic observation offers an important opportunity to better understand ESCC risk factors. Overall, our findings suggest the presence of not one dominant risk factor, but rather a constellation of risk factors may underlie the high incidence of early-onset disease in Tanzania. These findings require replication, with further study of possible interactions between risk factors. The lack of association between family history of EC and early-onset disease is noteworthy. A multisite genome-wide association study is currently underway, which will provide further insight into the possibility of genetic susceptibility in this patient population.

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### TABLE A1. Estimates of the Association of Sociodemographic Characteristics With ESCC Within Each Age Group on the Basis of Univariate Logistic Regression

| Sociodemographic Characteristic | Younger Group (age 30-44 years) | Older Group (age ≥ 45 years) |  |
|---------------------------------|---------------------------------|-----------------------------|---|
|                                 | Cases (n = 100), No. (%)        | Controls (n = 108), No. (%)  | OR (95% CI) |
| Zone                            |                                 |                             |             |
| Coastal-Zanzibar                | 58 (58)                         | 95 (88)                     | 1           |
| Central                         | 7 (7)                           | 4 (4)                       | 2.87 (0.80 to 10.22) |
| Lake                            | 3 (3)                           | 3 (3)                       | 1.64 (0.32 to 8.39) |
| Northern                        | 24 (24)                         | 2 (2)                       | 19.65 (4.48 to 86.25) |
| Southern Highlands              | 8 (8)                           | 4 (4)                       | 3.28 (0.94 to 11.36) |
| Unknown                         | 3                               | 6                           |             |
|                                 |                                  |                             |             |
| Education                       |                                  |                             |             |
| None                            | 8 (8)                           | 3 (3)                       | 1           |
| Any primary level               | 75 (75)                         | 63 (58)                     | 0.45 (0.11 to 1.75) |
| Any secondary                   | 10 (10)                         | 28 (26)                     | 0.13 (0.03 to 0.61) |
| Postsecondary or above          | 7 (7)                           | 14 (13)                     | 0.19 (0.04 to 0.94) |
| Unknown                         | 2                               |                             |             |
|                                 |                                  |                             |             |
| Occupation                      |                                  |                             |             |
| Agriculture                     | 40 (40)                         | 21 (19)                     | 1           |
| Business                        | 19 (19)                         | 30 (28)                     | 0.33 (0.15 to 0.73) |
| Office work                     | 3 (3)                           | 13 (12)                     | 0.12 (0.03 to 0.47) |
| Other                           | 38 (38)                         | 44 (41)                     | 0.45 (0.23 to 0.90) |
| Unknown                         | 1                               |                             |             |
|                                 |                                  |                             |             |
| Household income, TSH           |                                  |                             |             |
| < 150,000                       | 8 (8)                           | 1 (1)                       | 1           |
| 150,001-500,000                 | 7 (7)                           | 8 (7)                       | 0.11 (0.01 to 1.11) |
| 500,001-900,000                 | 16 (16)                         | 15 (14)                     | 0.13 (0.01 to 1.20) |
| 900,001-1,200,000               | 17 (17)                         | 13 (12)                     | 0.16 (0.02 to 1.48) |
| > 1,200,000                     | 27 (27)                         | 43 (40)                     | 0.08 (0.01 to 0.66) |
| Unknown                         | 25                              | 28                          | 95           |
| IW i                             |                                  |                             |             |
| High (67-100)                   | 24 (25)                         | 48 (45)                     | 1           |
| Medium (33 ≤ 67)                | 42 (43)                         | 40 (37)                     | 2.1 (1.09 to 4.04) |
| Low (0 ≤ 33)                    | 31 (32)                         | 19 (18)                     | 3.26 (1.54 to 6.92) |
| Unknown                         | 3                               | 1                           | 9            |
| Family history of EC            |                                  |                             |             |
| No                              | 97 (97)                         | 101 (94)                    | 1           |
| Yes                             | 3 (3)                           | 7 (6)                       | 0.45 (0.11 to 1.78) |
| Unknown                         | 9                               | 7                           |             |

NOTE. Statistically significant findings are highlighted as bold text.

Abbreviations: EC, esophageal cancer; ESCC, esophageal squamous cell carcinoma; IWI, International Wealth Index; OR, odds ratio; TSH, Tanzanian Shillings.

*IWI scores range from 0 to 100 (low to high) and are calculated based on nine consumer durables or housing characteristics, including television, refrigerator, telephone, radio, washing machine, toilet, floor material, electricity, and drinking water source.*
| Lifestyle Risk Behavior | Cases (n = 100), No. (%) | Controls (n = 108), No. (%) | OR (95% CI) | Cases (n = 371), No. (%) | Controls (n = 363), No. (%) | OR (95% CI) |
|------------------------|--------------------------|-----------------------------|-------------|--------------------------|-----------------------------|-------------|
| Oral health            |                          |                             |             |                          |                             |             |
| How often teeth cleaned|                          |                             |             |                          |                             |             |
| Daily                  | 89 (89)                  | 105 (97)                    | 1           | 268 (72)                 | 307 (86)                    | 1           |
| Less than daily        | 11 (11)                  | 3 (3)                       | 4.33 (1.17 to 15.99) | 102 (28)                | 52 (14)                     | 2.25 (1.55 to 3.26) |
| Experienced loss of teeth|                          |                             |             |                          |                             |             |
| No                     | 59 (59)                  | 53 (49)                     | 1           | 90 (24)                  | 113 (31)                    | 1           |
| Yes                    | 40 (40)                  | 55 (51)                     | 0.65 (0.38 to 1.13) | 280 (76)                | 250 (69)                    | 1.41 (1.02 to 1.95) |
| Smoking status         |                          |                             |             |                          |                             |             |
| Current smoking status |                          |                             |             |                          |                             |             |
| Never                  | 60 (60)                  | 75 (69)                     | 1           | 166 (45)                 | 212 (59)                    | 1           |
| Former                 | 21 (21)                  | 17 (16)                     | 1.54 (0.75 to 3.18) | 135 (36)                | 107 (30)                    | 1.61 (1.16 to 2.23) |
| Current                | 19 (19)                  | 16 (15)                     | 1.48 (0.70 to 3.13) | 70 (19)                 | 43 (12)                     | 2.08 (1.35 to 3.20) |
| Smoking tobacco (current or former use) |         |                             |             |                          |                             |             |
| No                     | 60 (60)                  | 76 (70)                     | 1           | 171 (46)                 | 217 (60)                    | 1           |
| Yes                    | 40 (40)                  | 32 (30)                     | 1.58 (0.89 to 2.81) | 200 (54)                | 145 (40)                    | 1.75 (1.31 to 2.35) |
| Alcohol use            |                          |                             |             |                          |                             |             |
| Current alcohol status |                          |                             |             |                          |                             |             |
| Never                  | 44 (44)                  | 42 (39)                     | 1           | 142 (38)                 | 128 (35)                    | 1           |
| Former (last drink > 1 year) |                |                             |             |                          |                             |             |
| Current                | 28 (28)                  | 36 (33)                     | 0.74 (0.39 to 1.42) | 116 (31)                | 93 (26)                     | 1.12 (0.78 to 1.62) |
| Home-brewed alcohol (any type; current or former use) | |                             |             |                          |                             |             |
| No                     | 72 (73)                  | 91 (85)                     | 1           | 189 (51)                 | 249 (69)                    | 1           |
| Yes                    | 26 (27)                  | 16 (15)                     | 2.05 (1.02 to 4.12) | 180 (49)                | 114 (31)                    | 2.08 (1.54 to 2.81) |
| Consumption of hot beverages |           |                             |             |                          |                             |             |
| How many hot beverages daily |           |                             |             |                          |                             |             |
| +1 hot drink daily     | —                       | —                           | 1.79 (1.11 to 2.91) | —                       | —                           | 1.36 (1.04 to 1.77) |
| Preferred beverage temperature |         |                             |             |                          |                             |             |
| Cold or room temperature | 7 (7)                  | 13 (12)                     | 1           | 50 (13)                  | 48 (13)                     | 1           |
| Hot or very hot        | 93 (93)                  | 95 (88)                     | 1.82 (0.69 to 4.76) | 321 (87)                | 315 (87)                    | 0.98 (0.64 to 1.50) |
| No. of times burnt tongue or mouth in the past year |           |                             |             |                          |                             |             |
| < 3 times              | 58 (58)                  | 69 (64)                     | 1           | 200 (54)                 | 201 (56)                    | 1           |
| 3-8 times              | 32 (32)                  | 30 (28)                     | 1.27 (0.69 to 2.33) | 129 (35)                | 139 (38)                    | 0.93 (0.68 to 1.27) |
| ≥ 9 times              | 10 (10)                  | 9 (8)                       | 1.32 (0.50 to 3.47) | 41 (11)                 | 22 (6)                      | 1.87 (1.08 to 3.26) |
| Unknown                | 1                       | 1                           |             |                          |                             |             |

(Continued on following page)
### TABLE A2. Estimates of the Association of Lifestyle Risk Behaviors With ESCC Within Each Age Group on the Basis of Univariate Logistic Regression (Continued)

| Lifestyle Risk Behavior | Younger Group (age 30-44 years) | Older Group (age ≥ 45 years) |
|------------------------|----------------------------------|-----------------------------|
|                        | Cases (n = 100), No. (%)         | Controls (n = 108), No. (%) | Cases (n = 371), No. (%) | Controls (n = 363), No. (%) |
| Ate soil or clay as a child | 80 (80) 95 (88) 1 | 312 (84) 326 (90) 1 |
| Yes                    | 20 (20) 13 (12) 1.83 (0.86 to 3.90) | 59 (16) 37 (10) 1.67 (1.07 to 2.59) |
| Previously worked on a farm | 36 (36) 53 (49) 1 | 59 (16) 121 (33) 1 |
| Yes                    | 64 (64) 55 (51) 1.71 (0.98 to 2.99) | 312 (84) 242 (67) 2.64 (1.86 to 3.77) |
| Pesticide exposure     | 88 (88) 94 (87) 1 | 298 (80) 305 (84) 1 |
| Yes                    | 12 (12) 14 (13) 0.92 (0.40 to 2.09) | 73 (20) 58 (16) 1.29 (0.88 to 1.88) |

NOTE. Statistically significant findings are highlighted as bold text.
Abbreviations: ESCC, esophageal squamous cell carcinoma; OR, odds ratio.
### TABLE A3. Estimates of the Association of Household Exposures and ESCC Within Each Age Group on the Basis of Univariate Logistic Regression

#### Younger Group (age 30-44 years) vs. Older Group (age ≥ 45 years)

| Household Exposure | Cases (n = 100), No. (%) | Controls (n = 108), No. (%) | OR (95% CI) | Cases (n = 371), No. (%) | Controls (n = 363), No. (%) | OR (95% CI) |
|--------------------|--------------------------|-----------------------------|-------------|--------------------------|-----------------------------|-------------|
| **Secondhand tobacco smoke in the house** | | | | | | |
| No                 | 69 (70)                  | 89 (83)                     | 1           | 259 (71)                 | 284 (79)                   | 1           |
| Yes                | 30 (30)                  | 18 (17)                     | **2.15 (1.11 to 4.17)** | 106 (29)                 | 76 (21)                    | **1.53 (1.09 to 2.15)** |
| Unknown            | 1                        | 1                           |             | 6                        | 3                           |             |
| **Cooking site**   | | | | | | |
| Indoors, ventilated | 60 (60)                  | 71 (66)                     | 1           | 166 (45)                 | 180 (50)                   | 1           |
| Indoors, unventilated | 4 (4)                   | 1 (1)                       | **4.73 (0.52 to 43.50)** | 12 (3)                   | 8 (2)                      | **1.63 (0.65 to 4.08)** |
| Outdoors           | 36 (36)                  | 36 (33)                     | **1.18 (0.67 to 2.10)** | 191 (52)                 | 174 (48)                   | **1.19 (0.89 to 1.60)** |
| Unknown            | 2                        | 1                           |             | 2                        | 1                           |             |
| **Firewood cooking in home** | | | | | | |
| No                 | 41 (41)                  | 66 (61)                     | 1           | 74 (20)                  | 142 (39)                   | 1           |
| Yes                | 59 (59)                  | 42 (39)                     | **2.26 (1.30 to 3.94)** | 297 (80)                 | 221 (61)                   | **2.58 (1.85 to 3.59)** |
| **Slept near a burning fire during childhood** | | | | | | |
| No                 | 45 (45)                  | 55 (51)                     | 1           | 110 (30)                 | 140 (39)                   | 1           |
| Yes                | 55 (55)                  | 53 (49)                     | **1.27 (0.74 to 2.19)** | 260 (70)                 | 223 (61)                   | **1.48 (1.09 to 2.02)** |
| Unknown            | 1                        | 1                           |             | 1                        | 1                           |             |
| **Grain/nut preserved** | | | | | | |
| No                 | 34 (34)                  | 52 (48)                     | 1           | 59 (16)                  | 116 (32)                   | 1           |
| Yes                | 66 (66)                  | 56 (52)                     | **1.80 (1.03 to 3.16)** | 312 (84)                 | 247 (68)                   | **2.48 (1.74 to 3.54)** |
| **Grain/nut has been infected by pests** | | | | | | |
| No                 | 67 (69)                  | 91 (86)                     | 1           | 259 (71)                 | 284 (81)                   | 1           |
| Yes                | 30 (31)                  | 15 (14)                     | **2.72 (1.35 to 5.44)** | 104 (29)                 | 66 (19)                    | **1.73 (1.22 to 2.46)** |
| Unknown            | 3                        | 2                           |             | 8                        | 13                          |             |
| **Water source**   | | | | | | |
| Borehole or well   | 27 (27)                  | 22 (20)                     | 1           | 114 (31)                 | 100 (28)                   | 1           |
| Water from spring  | 0 (0)                    | 1 (1)                       | —           | 0                        | 3 (1)                      | —           |
| Rain water or surface water | 1 (1) | 2 (2) | 0.41 (0.03 to 4.80) | 16 (4) | 6 (2) | 2.34 (0.88 to 6.21) |
| Piped water in house or bottled water | 71 (72) | 83 (77) | 0.70 (0.37 to 1.33) | 241 (65) | 253 (70) | 0.84 (0.61 to 1.15) |
| Unknown            | 1                        | 1                           |             | 1                        | 1                           |             |

**NOTE.** Statistically significant findings are highlighted as bold text.

Abbreviations: ESCC, esophageal squamous cell carcinoma; OR, odds ratio.
### Table A4. Estimates of the Association of Self-Reported Food Frequency and ESCC Within Each Age Group on the Basis of Univariate Logistic Regression

| Frequency of Consumption | Younger Group (age 30-44 years) | Older Group (age ≥ 45 years) |
|--------------------------|---------------------------------|-------------------------------|
|                          | Cases (n = 100), No. (%)        | Controls (n = 108), No. (%)   | Cases (n = 371), No. (%)        | Controls (n = 363), No. (%)   | OR (95% CI)                  |
| Rice                     |                                 |                               |                                |                                |                              |
| < 1 time per week        | 32 (32)                         | 23 (21)                       | 1                              | 152 (41)                       | 117 (32)                     | 1                             |
| 1-2 times/wk             | 23 (23)                         | 35 (33)                       | 0.47 (0.22 to 1.00)            | 132 (36)                       | 131 (36)                     | 0.78 (0.55 to 1.09)           |
| 3-5 times/wk             | 37 (37)                         | 38 (36)                       | 0.70 (0.35 to 1.41)            | 78 (21)                        | 76 (21)                      | 0.79 (0.53 to 1.18)           |
| Daily                    | 8 (8)                           | 11 (10)                       | 0.52 (0.18 to 1.50)            | 9 (2)                          | 37 (10)                      | 0.19 (0.09 to 0.40)           |
| Wheat/bread/pasta        |                                 |                               |                                |                                |                              |                               |
| < 1 time per week        | 29 (29)                         | 27 (25)                       | 1                              | 176 (47)                       | 196 (54)                     | 1                             |
| 1-2 times/wk             | 29 (29)                         | 27 (25)                       | 1.00 (0.48 to 2.10)            | 94 (25)                        | 64 (18)                      | 1.64 (1.12 to 2.39)           |
| 3-5 times/wk             | 36 (36)                         | 40 (37)                       | 0.84 (0.42 to 1.67)            | 92 (25)                        | 83 (23)                      | 1.23 (0.86 to 1.77)           |
| Daily                    | 6 (6)                           | 13 (12)                       | 0.43 (0.14 to 1.29)            | 9 (2)                          | 20 (6)                       | 0.50 (0.22 to 1.13)           |
| Unknown                  | 1                               | 2                             |                                |                                |                              |                               |
| Chipsi (fried potato)    |                                 |                               |                                |                                |                              |                               |
| < 1 time per week        | 51 (51)                         | 46 (43)                       | 1                              | 266 (72)                       | 240 (66)                     | 1                             |
| 1-2 times/wk             | 23 (23)                         | 32 (30)                       | 0.65 (0.33 to 1.26)            | 65 (18)                        | 80 (22)                      | 0.73 (0.51 to 1.06)           |
| 3-5 times/wk             | 20 (20)                         | 17 (16)                       | 1.06 (0.50 to 2.27)            | 25 (7)                         | 22 (6)                       | 1.03 (0.56 to 1.87)           |
| Daily                    | 6 (6)                           | 12 (11)                       | 0.45 (0.16 to 1.30)            | 15 (4)                         | 19 (5)                       | 0.71 (0.35 to 1.43)           |
| Unknown                  | 1                               | 2                             |                                |                                |                              |                               |
| Beans                    |                                 |                               |                                |                                |                              |                               |
| < 1 time per week        | 9 (9)                           | 6 (6)                         | 1                              | 22 (6)                         | 24 (7)                       | 1                             |
| 1-2 times/wk             | 8 (8)                           | 4 (4)                         | 1.33 (0.27 to 6.50)            | 20 (5)                         | 25 (7)                       | 0.87 (0.38 to 1.99)           |
| 3-5 times/wk             | 28 (28)                         | 38 (36)                       | 0.49 (0.16 to 1.54)            | 90 (24)                        | 106 (29)                     | 0.93 (0.49 to 1.76)           |
| Daily                    | 55 (55)                         | 59 (55)                       | 0.62 (0.21 to 1.86)            | 239 (64)                       | 205 (57)                     | 1.27 (0.69 to 2.34)           |
| Unknown                  | 1                               | 3                             |                                |                                |                              |                               |
| Cooked greens            |                                 |                               |                                |                                |                              |                               |
| < 1 time per week        | 12 (12)                         | 10 (9)                        | 1                              | 43 (12)                        | 55 (15)                      | 1                             |
| 1-2 times/wk             | 19 (19)                         | 17 (16)                       | 0.93 (0.32 to 2.70)            | 81 (22)                        | 81 (22)                      | 1.28 (0.77 to 2.12)           |
| 3-5 times/wk             | 30 (30)                         | 26 (24)                       | 0.96 (0.36 to 2.59)            | 134 (36)                       | 91 (25)                      | 1.88 (1.17 to 3.04)           |
| Daily                    | 39 (39)                         | 54 (50)                       | 0.60 (0.24 to 1.53)            | 113 (30)                       | 135 (37)                     | 1.07 (0.67 to 1.71)           |
| Unknown                  | 1                               | 1                             |                                |                                |                              |                               |
| Raw greens               |                                 |                               |                                |                                |                              |                               |
| < 1 time per week        | 40 (40)                         | 27 (25)                       | 1                              | 152 (41)                       | 106 (29)                     | 1                             |
| 1-2 times/wk             | 43 (43)                         | 53 (49)                       | 0.55 (0.29 to 1.03)            | 143 (39)                       | 143 (40)                     | 0.70 (0.50 to 0.98)           |
| 3-5 times/wk             | 13 (13)                         | 13 (12)                       | 0.68 (0.27 to 1.68)            | 55 (15)                        | 68 (19)                      | 0.56 (0.37 to 0.87)           |
| Daily                    | 4 (4)                           | 15 (14)                       | 0.18 (0.05 to 0.60)            | 21 (6)                         | 44 (12)                      | 0.33 (0.19 to 0.59)           |
| Unknown                  | 1                               | 2                             |                                |                                |                              |                               |

(Continued on following page)
| Frequency of Consumption | Younger Group (age 30-44 years) | Older Group (age ≥ 45 years) |
|--------------------------|-------------------------------|------------------------------|
|                          | Cases (n = 100), No. (%) | Controls (n = 108), No. (%) | OR (95% CI) | Cases (n = 371), No. (%) | Controls (n = 363), No. (%) | OR (95% CI) |
| Pickled vegetables       |                               |                              |             |                             |                              |             |
| < 1 time per week        | 53 (53)                       | 64 (59)                      | 1           | 210 (57)                     | 196 (54)                      | 1           |
| 1-2 times/wk             | 32 (32)                       | 26 (24)                      | 1.49 (0.79 to 2.80) | 100 (27)                     | 96 (27)                      | 0.97 (0.69 to 1.37) |
| 3-5 times/wk             | 10 (10)                       | 7 (6)                        | 1.73 (0.61 to 4.84) | 40 (11)                       | 42 (12)                      | 0.89 (0.55 to 1.43) |
| Daily                    | 5 (5)                         | 11 (10)                      | 0.55 (0.18 to 1.68) | 20 (5)                        | 28 (8)                       | 0.67 (0.36 to 1.22) |
| Unknown                  |                               |                              |             | 1                             |                              |             |
| Fruit                    |                               |                              |             | 1                             |                              |             |
| < 1 time per week        | 14 (14)                       | 14 (13)                      | 1           | 63 (17)                       | 62 (17)                      | 1           |
| 1-2 times/wk             | 27 (27)                       | 21 (20)                      | 1.29 (0.50 to 3.27) | 97 (26)                       | 94 (26)                      | 1.02 (0.65 to 1.59) |
| 3-5 times/wk             | 40 (40)                       | 31 (29)                      | 1.29 (0.54 to 3.10) | 150 (41)                      | 87 (24)                      | 1.70 (1.09 to 2.63) |
| Daily                    | 19 (19)                       | 40 (38)                      | 0.48 (0.19 to 1.19) | 60 (16)                       | 119 (33)                     | 0.50 (0.31 to 0.79) |
| Unknown                  | 2                             |                              |             | 1                             |                              |             |
| Smoked fish              |                               |                              |             | 1                             |                              |             |
| < 1 time per week        | 23 (23)                       | 25 (23)                      | 1           | 94 (25)                       | 92 (25)                      | 1           |
| 1-2 times/wk             | 38 (38)                       | 27 (25)                      | 1.53 (0.72 to 3.24) | 118 (32)                      | 112 (31)                     | 1.03 (0.70 to 1.52) |
| 3-5 times/wk             | 33 (33)                       | 44 (41)                      | 0.82 (0.40 to 1.68) | 142 (38)                      | 106 (29)                     | 1.31 (0.89 to 1.92) |
| Daily                    | 6 (6)                         | 11 (10)                      | 0.59 (0.19 to 1.86) | 16 (4)                        | 53 (15)                      | 0.30 (0.16 to 0.55) |
| Unknown                  | 1                             |                              |             | 1                             |                              |             |
| Smoked meat              |                               |                              |             | 1                             |                              |             |
| < 1 time per week        | 53 (53)                       | 46 (43)                      | 1           | 194 (52)                      | 158 (44)                     | 1           |
| 1-2 times/wk             | 30 (30)                       | 37 (35)                      | 0.70 (0.38 to 1.31) | 112 (30)                      | 138 (38)                     | 0.66 (0.48 to 0.92) |
| 3-5 times/wk             | 16 (16)                       | 19 (18)                      | 0.73 (0.34 to 1.58) | 55 (15)                       | 59 (16)                      | 0.76 (0.50 to 1.16) |
| Daily                    | 1 (1)                         | 5 (5)                        | 0.17 (0.02 to 1.54) | 10 (3)                        | 8 (2)                        | 1.02 (0.39 to 2.64) |
| Unknown                  | 1                             |                              |             | 1                             |                              |             |
| Stewed/boiled meat       |                               |                              |             | 1                             |                              |             |
| < 1 time per week        | 14 (14)                       | 15 (14)                      | 1           | 78 (21)                       | 68 (19)                      | 1           |
| 1-2 times/wk             | 47 (48)                       | 32 (30)                      | 1.57 (0.67 to 3.70) | 134 (36)                      | 143 (40)                     | 0.82 (0.55 to 1.22) |
| 3-5 times/wk             | 35 (36)                       | 54 (50)                      | 0.69 (0.30 to 1.61) | 138 (37)                      | 129 (36)                     | 0.93 (0.62 to 1.40) |
| Daily                    | 2 (2)                         | 6 (6)                        | 0.36 (0.06 to 2.07) | 20 (5)                        | 19 (5)                       | 0.92 (0.45 to 1.86) |
| Unknown                  | 2                             |                              |             | 1                             |                              |             |
| Milk                     |                               |                              |             | 1                             |                              |             |
| Never                    | 5 (5)                         | 2 (2)                        | 1           | 10 (3)                        | 11 (3)                       | 1           |
| < 1 time per week        | 47 (48)                       | 50 (49)                      | 0.38 (0.07 to 2.03) | 197 (56)                      | 194 (57)                     | 1.12 (0.46 to 2.69) |
| 1-2 times/wk             | 29 (30)                       | 27 (26)                      | 0.43 (0.08 to 2.40) | 91 (26)                       | 72 (21)                      | 1.39 (0.56 to 3.46) |
| 3-5 times/wk             | 16 (16)                       | 23 (23)                      | 0.28 (0.05 to 1.62) | 56 (16)                       | 61 (18)                      | 1.01 (0.40 to 2.56) |
| Daily                    | 2 (2)                         | 6 (6)                        | 0.13 (0.01 to 1.32) | 12 (3)                        | 19 (5)                       | 0.69 (0.23 to 2.13) |
| Unknown                  | 1                             |                              |             | 5                             |                              |             |

(Continued on following page)
TABLE A4. Estimates of the Association of Self-Reported Food Frequency and ESCC Within Each Age Group on the Basis of Univariate Logistic Regression (Continued)

| Frequency of Consumption | Younger Group (age 30-44 years) |  |  | Older Group (age ≥ 45 years) |  |  |
|--------------------------|---------------------------------|----------------|-----------------|------------------------------|----------------|-------------------|
|                          | Cases (n = 100), No. (%)        | Controls (n = 108), No. (%) | OR (95% CI) | Cases (n = 371), No. (%)     | Controls (n = 363), No. (%) | OR (95% CI) |
| Spicy chilies            |                                 |                                |             |                              |                                |            |
| < 1 time per week        | 33 (33)                         | 42 (39)                        | 1           | 119 (32)                     | 137 (38)                       | 1            |
| 1-2 times/wk             | 12 (12)                         | 15 (14)                        | 1.02 (0.42 to 2.47) | 43 (12)                     | 59 (16)                       | 0.84 (0.53 to 1.33) |
| 3-5 times/wk             | 25 (25)                         | 18 (17)                        | 1.77 (0.83 to 3.77) | 92 (25)                     | 103 (28)                      | 1.03 (0.71 to 1.49) |
| Daily                    | 30 (30)                         | 33 (31)                        | 1.16 (0.59 to 2.27) | 117 (32)                     | 64 (18)                       | **2.10 (1.42 to 3.11)** |
| Maize meal               |                                 |                                |             |                              |                                |            |
| < 1 time per week        | 1 (1)                           | 0 (0)                          | NC           | 8 (2)                        | 10 (3)                        | 1            |
| 1-2 times/wk             | 4 (4)                           | 4 (4)                          | NC           | 10 (3)                       | 15 (4)                        | 0.83 (0.24 to 2.84) |
| 3-5 times/wk             | 28 (28)                         | 33 (31)                        | NC           | 76 (20)                      | 82 (23)                       | 1.16 (0.43 to 3.09) |
| Daily                    | 67 (67)                         | 70 (65)                        | NC           | 277 (75)                     | 256 (71)                      | 1.35 (0.53 to 3.48) |
| Cassava                  |                                 |                                |             |                              |                                |            |
| < 1 time per week        | 38 (38)                         | 36 (34)                        | 1            | 158 (43)                     | 164 (45)                      | 1            |
| 1-2 times/wk             | 25 (25)                         | 18 (17)                        | 1.32 (0.62 to 2.81) | 77 (21)                     | 78 (22)                       | 1.02 (0.70 to 1.50) |
| 3-5 times/wk             | 25 (25)                         | 39 (36)                        | 0.61 (0.31 to 1.20) | 89 (24)                     | 70 (19)                       | 1.32 (0.90 to 1.93) |
| Daily                    | 12 (12)                         | 14 (13)                        | 0.81 (0.33 to 1.99) | 47 (13)                      | 49 (14)                       | 1.00 (0.63 to 1.57) |
| Groundnuts/peanuts       |                                 |                                |             |                              |                                |            |
| < 1 time per week        | 43 (43)                         | 53 (50)                        | 1            | 158 (43)                     | 161 (45)                      | 1            |
| 1-2 times/wk             | 43 (43)                         | 39 (36)                        | 1.36 (0.75 to 2.45) | 149 (40)                     | 151 (42)                      | 1.01 (0.73 to 1.38) |
| 3-5 times/wk             | 10 (10)                         | 10 (9)                         | 1.23 (0.47 to 3.23) | 51 (14)                      | 38 (11)                       | 1.37 (0.85 to 2.20) |
| Daily                    | 4 (4)                           | 5 (5)                          | 0.99 (0.25 to 3.90) | 13 (4)                       | 11 (3)                        | 1.20 (0.52 to 2.77) |
| Salted foods             |                                 |                                |             |                              |                                |            |
| < 1 time per week        | 3 (3)                           | 7 (7)                          | 1            | 16 (4)                       | 24 (7)                        | 1            |
| 1-2 times/wk             | 1 (1)                           | 2 (2)                          | 1.17 (0.07 to 18.35) | 11 (3)                       | 12 (3)                        | 1.37 (0.49 to 3.87) |
| 3-5 times/wk             | 6 (6)                           | 2 (2)                          | 7.00 (0.86 to 56.89) | 13 (4)                       | 36 (10)                       | 0.54 (0.22 to 1.33) |
| Daily                    | 90 (90)                         | 96 (90)                        | 2.19 (0.55 to 8.72) | 331 (89)                     | 290 (80)                      | 1.71 (0.89 to 3.29) |
| Unknown                  | 1                               | 1                              |              | 1                            | 1                             |              |

NOTE. Statistically significant findings are highlighted as bold text.
Abbreviations: ESCC, esophageal squamous cell carcinoma; NC, not calculable; OR, odds ratio.