Association of eating habits and cooking methods with breast tumors among childbearing aged urban women in Indonesia: A cross-sectional study

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Abstract

Background: This study aimed to determine the associations of eating habits and cooking methods with a breast tumor in childbearing aged Indonesian urban women.

Methods: This was a cross-sectional study using a research of non-communicable disease 2016 database from the ministry of health of Indonesia. In total 28558 women, aged 25 – 49 years old were retrieved from the database. Eating habits and cooking methods were measured using a validated food frequency questionnaire. A forward logistic regression analysis was used to examine the association of eating habits and cooking methods with the risk of breast tumors.

Results: Higher education level was positively associated with the incidence of breast tumor (OR = 1.10, 95%CI: 1.01-1.20, $p = 0.026$). Seafood (OR = 0.88, 95% CI: 0.80-0.96, $p = 0.006$) and fast foods (OR = 1.10, 95% CI: 1.00-1.20, $p = 0.049$) were significantly associated with the incidence of breast tumor among urban women. Roasted/smoked cooking method was positively associated with risk of breast tumor (OR = 1.27, 95%CI: 1.01 – 1.61, $p = 0.043$).

Conclusion: Our study is the first community-based study in Indonesia investigating the association of eating habits and cooking methods with the incidence of breast tumors among childbearing aged urban women. High intake of seafood was associated with a lower risk of breast tumors while fast foods and roasted/smoked cooking method belief to have a detrimental effect on a breast tumor. Prospective studies are needed to confirm the present study findings.

Introduction

Worldwide, breast cancer is the single most commonly detected cancer among women and has now become a global health burden [1, 2]. In Indonesia, the incidence of breast cancer continues to increase every year and represents the leading cause of cancer mortality among women [2]. The incident rate of breast cancer may differ by geographical location. Certain environmental and lifestyle factors including diet play a significant role to enhance breast cancer [3]. Literature has shown that diet alone, can accounts for approximately 35% of all cancer cases. Therefore, it is essential to recognize dietary habits including cooking methods for breast cancer risk [4].

For the past years, a large number of studies have evaluated the association of particular foods with their composition including eating habits with the advancement of breast cancer [5, 6]. According to the report released by World Cancer Research Fund and the American Institute for Cancer Research (WCRF/AICR) prospected an increase in breast cancer risk among women eating higher-fat diets compared with those eating lower-fat diets [7]. Eating and cooking habits extremely vary among countries or regions. Soy food, which is mainly consumed in Asia has been found to have a low risk for breast cancer among women [8], likewise, total dairy food consumption including milk also appears to be riskless [9]. In contrast, another prospective cohort study conducted in South Korea revealed that consuming high-cholesterol foods,

grilled meat, and inconsistent eating habits seems to be associated with an elevated risk of breast cancer among adult women [10].

However, most previously published studies on the association of diet and breast cancer were focus on single food items or nutrients. Investigating overall eating habits together with cooking methods might be more significant in determining breast tumor etiology rather than evaluating diets separately as a result of the complexity and combinations of food or nutrients among individuals [11, 12]. Following healthy eating habits such as fruits, vegetables, fish, olive oil and whole grains is likely to be advantageous to reduce breast cancer among middle-aged women [13]. A study has reported that moderate consumption of pan-fried/bread-coated fried white meat and well-done or stewed red meat have a minimal risk for breast cancer. Moreover, the total intake of processed/cured meat was considered for having a strong association with triple-negative tumors [14]. Preventive dietary measures to deteriorate breast cancer risk could also include the use of olive/liquid oils for cooking and quitting the use of mayonnaise as salad dressing [15]. Since limited studies using a large sample size particularly among Indonesian urban women investigating these issues, therefore in this study, we aimed to determine the associations of eating habits and cooking methods with a breast tumor on childbearing age in Indonesian women.

Methods

Study population

This cross-sectional study was used a database from a community survey of research of non-communicable disease in 2016. This survey was conducted by the Department of research and development Ministry of Health of Republic Indonesia. The major aim of this survey was to obtain the prevalence rate of women aged 25-64 years old with positive breast tumors in urban areas in Indonesia. The survey was conducted on August – September 2016 in selected 76 districts/cities from 34 provinces. Data was collected through interviews and the interviews were conducted at the participant's house by trained enumerators. The enumerators would ask a series of general and personal questions including education status and occupation. They also performed anthropometric and blood pressure measurements. In total, 39188 women were recruited. After excluded those who were ≥ 50 years old ($n=10258$) and not having breast tumor examination ($n=372$), a total of 28558 women were used for the analysis. This study was approved by Esa Unggul University's ethical review board (0180-20.175/DPKE-KEP FINAL-EA/UEU/VII/2020).

Assessment of breast tumors

In this study, the examination of breast tumors used the clinical breast examination method. Meanwhile, a pathology anatomy test was used to confirm breast tumors. A certified medical doctor or midwife carried out the clinical breast examination (inspection and palpation) at the primary healthcare clinics. They assessed breast position (asymmetric or not), the skin of the breast (normal, reddish, swollen, wet wounds or pulling), and the areola of the breast (normal, retracted, wet wounds or abnormal fluid

appears). Moreover, the palpation examination was carried out to check the lump (number, size, quadrant location, consistency, mobility, and tenderness) and the presence of enlarged lymph nodes at the armpits.

Assessment of eating habits, cooking methods, and other covariates

A validated food frequency questionnaire (FFQ) was used to assess participants eating habits and cooking methods in the last month. In the FFQ, 106 food items (Additional file 1) were categorized into twelve food groups (meats, eggs, innards organs, processed meats, seafood, milk and dairy products, fast foods, beans or legumes, light-colored vegetables, dark leafy vegetables, fruits, and oils). Meanwhile, seven types of cooking methods, namely roasted/smoked, fried, grilled, boiled, pan-fried/sautéing, steamed, and raw/fresh were also retrieved from the FFQ. Each food item and cooking method had seven response scores (1 to 7) ranged from never, 1x/month, 2-3x/month, 1-2x/week, 3-4x/week, 5-6x/week, and daily. Meats and dark-leafy vegetables consist of seven food items. Processed meats, seafood, and fast foods consist of four food items. Milk and dairy products and beans or legumes consist of nine food items. While eggs, innards organs, light-colored vegetables, fruits, and oils consist of 3, 5, 18, 30, and 6 food items respectively. The minimum and maximum consumption scores for meats, eggs, innards organs, processed meats, seafood, milk and dairy products, fast foods, beans or legumes, light-colored vegetables, dark leafy vegetables, fruits, and oils are 7-49, 3-21, 5-35, 4-28, 4-28, 9-63, 4-28, 9-63, 18-126, 7-49, 30-210, 6-42, respectively. Eating habits for each food group were categorized as low (below the median/2-quintile) and high (above the median/2-quintile). Moreover, the cooking methods were categorized as a 'regular' method if they used roasted/smoked, fried, boiled, pan-fried/sautéing, steamed, and raw/fresh cooking methods ≥ 3 -4x/week, and grilled cooking method ≥ 2 -3x/month, and 'infrequent' if otherwise [10]. Other covariates such as education status were dichotomized as low (below high school) and high (above high school). While working status was categorized as no (not working or still studying) and yes (engaged in professional working).

Data analysis

Statistical analysis was performed using STATA version 13 (STATA Corp LLC, Texas, USA). A chi-squared test was used to compare the categorical variables among the characteristics of women with breast tumors incidence. A general linear model was used to compare the eating habits score of each food group according to breast tumors incidence. Meanwhile, an adjusted (age, education, and working status) and forward selection of logistic regression was performed to determine the most dominant variables associated with breast tumors among urban women. We used forward logistic regression tests with a predictive model by selecting each independent variable. First, all independent variables that produced p-value < 0.25 were selected for further analysis. Second, variables that have met the previous selection criteria will be adjusted one by one (variables with p-value > 0.05 will be removed gradually) until there were only variables with p < 0.05 .

Results

From a total of 28558 women, 8.3% ($n = 2376$) of those had a breast tumor. Characteristics of urban women across breast tumor status are shown in Table 1. Positive breast tumor women had higher education levels (53.9%), higher consumption score of meats (11.7 ± 3.4 vs. 11.5 ± 3.2 ; $p = 0.006$), milk and dairy products (11.3 ± 3.3 vs. 11.1 ± 3.1 ; $p = 0.015$), and fast food (4.8 ± 1.7 vs. 4.7 ± 1.6 ; $p = 0.010$) but lower intake of seafood (10.0 ± 3.8 vs. 10.2 ± 3.7 ; $p = 0.011$). Additionally, positive breast tumor women used fried cooking method regularly (90.3%, $p = 0.045$).

Logistic regression analysis revealed that seafood and fast food were significantly associated with the incidence of breast tumor (Table 2). Adjusted and forward logistic regression showed that seafood negatively associated with breast tumor (OR = 0.91, 95% CI: 0.84 – 0.99, $p = 0.028$ and OR = 0.88, 95% CI: 0.85 – 1.04, $p = 0.006$ respectively). In contrast, fast foods were associated with increased 10% risk of breast cancer (95% CI: 1.00 – 1.20, $p = 0.049$). Furthermore, only roasted/smoked cooking method was positively associated with the incidence of breast tumor (OR = 1.27, 95% CI: 1.01 – 1.61, $p = 0.043$) (Table 3).

Discussion

In this study, our evaluation showed that the incidence of breast tumors in Indonesia was significantly associated with higher education levels and fast foods as well as roasted/smoked cooking methods among childbearing-aged urban women. Whereas, total seafood consumption was substantially associated with a low risk of breast tumors incidence. The evidence relating to individual education level to risk for breast cancer is still unclear. Nonetheless, education differences in cancer prevalence have long been observed [16]. However, it is not well known, if such a relationship will continue to exist in Indonesia following adjustment for individual risk factors of breast tumors. The findings of this present study are similar to previous publications of elevated risk of breast tumors among women with higher education levels [17, 18]. A prospective cohort study conducted in the United State has shown that women with the least education level had a lower risk of invasive breast cancers [16]. In another study, the relationship between education level and cancer risk becomes completely insignificant after multivariate adjustment for unhealthy lifestyles [19]. Perhaps, such analysis might give a plausible description about the connection between education and cancer for public health concern. Inconsistent results have also been observed in several studies conducted to investigate the role of education level in breast tumors survival. Among the studies, one reported no relationship found between education and breast tumors [20], while others revealed a high survival rate among women with lower [21] or higher [22] education level.

Eating habits have been identified to involve both in the development and prevention of breast tumors [23] but the evidence is yet to be cleared [24]. Since breast tumors is a hormone-related malignancy, the diet may enhance its consequences through the hormonal level, anti-oxidation as well as growth factors [25, 26]. From the literature review, we noticed an increased risk of breast tumor-associated with high consumption of fast foods, which similarly concurred with our study [27]. Fast foods are typically meat-sweet diets with a large quantity of sugar and fat, prepared as baked goods, burgers, and deep-fried foods like chips, French fries, and chicken pieces [7]. Furthermore, fast foods have been linked to a diet

prepared with limited essential nutrients and frequent intake of it may lead to overconsumption of energy [28]. High energy consumption may trigger the release of essential hormonal factors such as estrogen, insulin-like growth factor (IGF)-1, and sex hormone-binding globulin, which all play a significant role in the inhibition of proliferation of cancer cells [29]. A group of researchers from Poland has reported that consuming fast food daily is threefold likely to increase the risk of breast tumors. In their study, they further discovered that refined meat including burgers, sausage, and pizza containing sodium nitrate, is transformed into nitrosamine, which is considered carcinogen [30].

Cooking methods vary among regions or countries; therefore, differences in the incidence rate of breast tumors may occur. The type of cooking methods applied for preparing diet may also have an impact on cancer cell growth. In the recent study, our findings indicated that prepared meals by roasting or smoking are associated with an elevated risk of breast tumors. The roasted or smoked cooking method involved the use of high temperatures to prepare food. During our literature review, no study specifically reported that consuming high-temperature cooked food, for example eating grilled/barbecued and smoked meat, is associated with primary prevention of breast tumors, it is however been reported that women to reduce consuming high-temperature cooked meat due to the formation of carcinogenic compounds [31]. A study conducted among US females showed that grilled/barbecued and smoked meat consumption is the main origin of polycyclic aromatic hydrocarbons (PAHs) [32] and has been regarded to increase the proportion of breast tumors [33, 34]. PAHs together with another carcinogenic mutagen such as heterocyclic amines (HCAs) are found highly in meat cooked at high temperatures [35]. HCAs are formed when muscle meat which consists of amino acids and creatinine reacts at high temperatures [36]. Meanwhile, PAHs are formed at the surface of the meat when it cooked directly on an open flame, resulting in pyrolysis of the fat. Imperfectly combusted meat also leads to carbon and hydrogen from fat react with hot coals and produce smoke [35].

Among the seafood, fish is the most common for consumption globally, including Indonesia. Increasing evidence has emerged showing an increased risk of breast tumors linked with the intake of seafood (like fresh-water fish and marine fish), which is not in support of other literature conducted distinctively [37-39]. Our results are, however, similar to other publications, in which breast cancer risk is reduced with high seafood consumption [40]. Seafood such as fish (oily fish or fish oils) is regarded as the major source of n-3 polyunsaturated fatty acids (n-3 PUFA), which can effectively deteriorate the risk of breast tumors among women [41, 42]. In addition, fish oil or a diet rich in eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) may also inhibit metastases development and further suppress tumor progression [43-45]. However, the epidemiologic evidence showing the relationship between seafood and breast tumors risk is limited to our understanding.

Our study has certain strengths: it is the first study to examine the association of eating habits and cooking methods among childbearing Indonesian urban women. Second, the sample size was selected from 34 provinces in Indonesia, thus it may represent all areas of the Indonesian archipelago. However, several limitations should also be mentioned. First, the cross-sectional study design limits us to identify the causality of the results. Second, potential misclassification bias of self-reported FFQ may occur and

the questionnaire included only frequency information, not portion size. Therefore, the intake amount for each participant could not be calculated. Finally, the adjustment for confounding variables was modest in our study. Additional residual confounding variables such as energy and protein intake, genetic or family history, and nutritional status may affect the present findings.

Conclusions

In summary, higher education levels, consumption of fast foods, and roasted/smoked cooking methods were identified as major risk factors associated with the incidence of breast tumors among childbearing aged urban women living in Indonesia. In contrast, only seafood was discovered having reduced risk for breast tumors. The current study appears to provide the possible high- and low-risk factors associated with breast tumors incidence in Indonesia. Therefore, it is substantial to establish awareness and disseminate information about good eating habits and cooking methods to minimize the risks of breast tumors. The findings of this study suggest that changes in eating habits and cooking methods might impact how breast tumors generate. However, the relationship between eating habits and cooking methods in breast tumors is complicated, more studies might be required for clear evidence.

Abbreviations

WCRF/AICR, World Cancer Research Fund and the American Institute for Cancer Research; FFQ, Food Frequency Questionnaire; IGF-1, Insulin-like Growth Factor 1; PAHs, Polycyclic Aromatic Hydrocarbons; HCAs, Heterocyclic Amines; n-3 PUFA, n-3 Polyunsaturated Fatty Acids; EPA, Eicosapentaenoic Acid; DHA, Docosahexaenoic Acid.

Declarations

Author's contributions:

ALK, IC, KCP and MS conceived and designed the study; IC, KCP, and MS managed and retrieved the data; ALK and IC analyzed the data and performed the statistical analysis; ALK, IC, AWJ, and RP wrote the manuscript. All authors have read and approved the final version of the manuscript.

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This research received no external funding.

Conflict of interest:

The authors declare no conflict of interest.

Ethics approval:

The Esa Unggul University's ethical review board (0180-20.175/DPKE-KEP FINAL-EA/UEU/VII/2020) approved the study and all methods were performed in accordance with the relevant guidelines and regulations.

Consent to participate:

All the participants signed a written informed consent authorized by the Department of research and development Ministry of Health of Republic Indonesia.

Consent for publication:

The data provided by the department of research and development, Ministry of Health of Republic Indonesia to the researchers did not include any personal information and all participants were adults.

Availability of data and material:

The data that support the findings of this study are restricted for research use only. The data are not publicly available. Data are available for the authors upon reasonable request and with permission of the department of research and development, Ministry of Health of Republic Indonesia.

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Tables

Table 1. Characteristics of study participants according to breast tumor status

	All (<i>n</i> = 28558)	Breast tumor		<i>p</i> ^a
		Negative (<i>n</i> = 26182)	Positive (<i>n</i> = 2376)	
Age, years	38.4 ± 6.6	38.4 ± 6.6	38.6 ± 6.6	
Education level				0.028
Low	13788 (48.3)	12692 (48.5)	1096 (46.1)	
High	14770 (51.7)	13490 (51.5)	1280 (53.9)	
Working status				0.05
No	18222 (63.8)	16750 (64.0)	1472 (62.0)	
Yes	10336 (36.2)	9432 (36.0)	904 (38.0)	
Alcohol drinking				0.368
No	27695 (97.0)	25398 (97.0)	2297 (96.7)	
Yes	863 (3.0)	784 (3.0)	79 (3.3)	
Food consumption score				
Meats	11.5 ± 3.3	11.5 ± 3.2	11.7 ± 3.4	0.006
Eggs	7.6 ± 3.2	7.6 ± 3.2	7.7 ± 3.3	0.242
Innards organs	5.8 ± 1.5	5.8 ± 1.5	5.9 ± 1.6	0.096
Processed meats	5.8 ± 2.3	5.8 ± 2.3	5.9 ± 2.3	0.473
Seafood	10.2 ± 3.7	10.2 ± 3.7	10.0 ± 3.8	0.011
Milk and dairy products	11.1 ± 3.1	11.1 ± 3.1	11.3 ± 3.3	0.015
Beans or legumes	19.0 ± 4.9	19.0 ± 4.9	19.0 ± 4.9	0.554
Light colored vegetables	35.5 ± 12.6	35.5 ± 12.6	35.7 ± 12.7	0.609
Dark-leafy vegetables	15.3 ± 4.4	15.3 ± 4.4	15.4 ± 4.5	0.861
Fruits	44.6 ± 12.3	44.6 ± 12.3	44.5 ± 12.3	0.877
Oils	13.4 ± 2.8	13.4 ± 2.8	13.5 ± 3.0	0.500
Fast foods	4.8 ± 1.6	4.7 ± 1.6	4.8 ± 1.7	0.010
Cooking method^b				
Roasted/smoked				0.035
Infrequent	27756 (97.2)	25463 (97.2)	2293 (96.5)	

Regular	802 (2.8)	719 (2.8)	83 (3.5)	
Deep-fried				0.045
Infrequent	2449 (8.6)	2219 (8.5)	230 (9.7)	
Regular	26109 (91.4)	23963 (91.5)	2146 (90.3)	
Grilled				0.066
Infrequent	25384 (88.9)	23299 (89.0)	2085 (87.8)	
Regular	3174 (11.1)	2883 (11.0)	291 (12.2)	
Boiled				0.998
Infrequent	13943 (48.8)	12783 (48.8)	1160 (48.8)	
Regular	14615 (51.2)	13399 (51.2)	1216 (51.2)	
Pan-fried/Sautéing				0.589
Infrequent	11846 (41.5)	10848 (41.4)	998 (42.0)	
Regular	16712 (58.5)	15334 (58.6)	1378 (58.0)	
Steamed				0.093
Infrequent	27005 (94.6)	24776 (94.6)	2229 (93.8)	
Regular	1553 (5.4)	1406 (5.4)	147 (6.2)	
Raw/fresh				0.564
Infrequent	16254 (56.9)	14915 (57.0)	1339 (56.4)	
Regular	12304 (43.1)	11267 (43.0)	1037 (43.64)	
Data are presented as number (percentage) for categorical variables and mean $\pm$ standard deviation (SD) for continuous variables.				
^a P-value was analyzed by chi-square for categorical variables and a general linear model for continuous variables.				
^b 'Regular' method if they used roasted/smoked, fried, boiled, pan-fried/sautéing, steamed, and raw/fresh cooking methods $\geq$ 3-4x/week, and grilled cooking method $\geq$ 2-3x/month, and 'infrequent' if otherwise				

Table 2. Logistic regression of eating habits and incidence of breast tumor

	Adjusted logistic regression		Forward logistic regression	
	OR (95% CI)	<i>P</i>	OR (95% CI)	<i>P</i>
<i>Meats</i>				
Low	1.00		1.00	
High	1.02 (0.94 – 1.11)	0.605	1.00 (0.91 – 1.10)	0.969
<i>Eggs</i>				
Low	1.00		1.00	
High	1.08 (0.99 – 1.18)	0.072	1.09 (0.99 – 1.20)	0.069
<i>Innards organs</i>				
Low	1.00		1.00	
High	1.04 (0.95 – 1.13)	0.444	1.03 (0.93 – 1.14)	0.572
<i>Processed meats</i>				
Low	1.00		1.00	
High	0.98 (0.90 – 1.07)	0.705	0.94 (0.85 – 1.04)	0.234
<i>Seafood</i>				
Low	1.00		1.00	
High	0.91 (0.84 – 0.99)	0.028	0.88 (0.80 – 0.96)	0.006
<i>Milk and dairy products</i>				
Low	1.00		1.00	
High	1.07 (0.99 – 1.17)	0.105	1.06 (0.97 – 1.16)	0.167
<i>Beans or legumes</i>				
Low	1.00		1.00	
High	1.02 (0.94 – 1.11)	0.658	1.01 (0.92 – 1.11)	0.835
<i>Light-colored vegetables</i>				
Low	1.00		1.00	
High	0.99 (0.92 – 1.09)	0.973	0.98 (0.88 – 1.10)	0.760
<i>Dark-leafy vegetables</i>				
Low	1.00		1.00	
High	1.02 (0.93 – 1.11)	0.693	1.02 (0.92 – 1.12)	0.720

<i>Fruits</i>				
Low	1.00		1.00	
High	1.01 (0.93 – 1.10)	0.871	0.99 (0.89 – 1.10)	0.911
<i>Oils</i>				
Low	1.00		1.00	
High	0.98 (0.90 – 1.07)	0.677	0.98 (0.90 – 1.08)	0.732
<i>Fast foods</i>				
Low	1.00		1.00	
High	1.11 (1.02 – 1.22)	0.018	1.10 (1.00 – 1.20)	0.049
^a adjusted by age, education level, and working status Low: < median/2-quintile scores of 11.0 (meats), 7.0 (eggs), 5.0 (innards organs), 5.0 (processed meats), 10.0 (seafood), 9.0 (milk and dairy products), 18.0 (beans or legumes), 33.0 (light colored vegetables), 15.0 (dark-leafy vegetables), 41.0 (fruits), 12.0 (oils), and 4.0 (fast foods); high if otherwise.				

Table 3. Logistic regression of cooking methods and incidence of breast tumor

	Adjusted logistic regression ^a		Forward logistic regression	
	OR (95% CI)	<i>P</i>	OR (95% CI)	<i>P</i>
<i>Roasted/smoked</i>				
Infrequent	1.00		1.00	
Regular	1.28 (1.01 – 1.61)	0.04	1.27 (1.01 – 1.61)	0.043
<i>Deep-fried</i>				
Infrequent	1.00		1.00	
Regular	0.86 (0.74 – 0.99)	0.038	0.87 (0.75 – 1.01)	0.066
<i>Grilled</i>				
Infrequent	1.00		1.00	
Regular	1.12 (0.99 – 1.28)	0.079	1.10 (0.96 – 1.26)	0.168
<i>Boiled</i>				
Infrequent	1.00		1.00	
Regular	0.99 (0.91 – 1.08)	0.894	0.99 (0.91 – 1.09)	0.911
<i>Pan-fried/Sautéing</i>				
Infrequent	1.00		1.00	
Regular	0.98 (0.90 – 1.06)	0.586	0.98 (0.90 – 1.07)	0.637
<i>Steamed</i>				
Infrequent	1.00		1.00	
Regular	1.16 (0.97 – 1.38)	0.100	1.13 (0.94 – 1.35)	0.186
<i>Raw/fresh</i>				
Infrequent	1.00		1.00	
Regular	1.01 (0.93 – 1.10)	0.821	1.03 (0.94 – 1.12)	0.550
^a adjusted by age, education level, and working status “Infrequent” was defined as $\leq$ 1-2 times/week (roasted/smoked, fried, boiled, pan-fried/sautéing, steamed, raw/fresh) and $\leq$ 2-3 times/month (grilled) while “regular” if otherwise.				

Supplementary Files

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- [SupplementaryTable1.docx](#)