



THE RELATIONSHIP BETWEEN RISK FACTORS AND CHARACTERISTICS OF PEOPLE WITH NASOPHARYNGEAL CARCINOMA

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ABSTRACT

Nasopharyngeal carcinoma (KNF) is a malignant cancer that originates from the nasopharyngeal epithelium and is one of the leading causes of cancer death in Indonesia. This disease is related to various environmental and genetic risk factors such as salted fish consumption, smoking habits, exposure to wood burning smoke, alcohol consumption, and genetic factors. Exposure to wood burning smoke contains carcinogenic compounds that can cause chronic irritation and DNA mutations in nasopharyngeal epithelial cells. This study aims to determine the relationship between salted fish consumption patterns, smoking habits, exposure to wood burning smoke, alcohol consumption, and genetic factors with the incidence of nasopharyngeal carcinoma at RSPAL dr. Ramelan Surabaya for the period March 2020 to March 2025. Cross-sectional research was carried out at RSPAL dr. Ramelan Surabaya. A total of 49 consisting of 36 patients with nasopharyngeal carcinoma and 13 non-nasopharyngeal carcinoma patients were selected by total sampling. The dependent variable is nasopharyngeal carcinoma. Independent variables were salted fish consumption patterns, exposure to wood burning smoke, smoking habits, alcohol consumption and genetics. Data was collected using questionnaires that had been tested for validity and reliability, and medical records. The data was analyzed by Chi-square test. There was a significant association between exposure to wood burning smoke and the incidence of nasopharyngeal carcinoma ($p = 0.036$). Meanwhile, salted fish consumption patterns ($p = 0.165$), smoking habits ($p = 0.586$), alcohol consumption ($p = 0.288$), and genetic factors ($p = 0.609$) showed no meaningful relationship. This shows that exposure to wood burning smoke is the most influential environmental factor on the incidence of KNF at the research site. There was a significant association between exposure to wood burning smoke and the incidence of nasopharyngeal carcinoma, while salted fish consumption patterns, smoking habits, alcohol consumption, and genetic factors did not show a significant relationship.

Keywords: alcohol; genetics; nasopharyngeal carcinoma; salted fish; smoking wood smoke

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INTRODUCTION

Nasopharyngeal carcinoma (KNF) is a malignant type of cancer that originates from epithelial cells in the nasopharyngeal area and is one of the main causes of cancer death in Indonesia. In Indonesia every year, there are around 15,000 new cases of nasopharyngeal carcinoma, with an incidence rate of around 5.6 per 100,000 population (Hardiati et al., 2022). Nasopharyngeal carcinoma is often associated with genetic and environmental risk factors, such as exposure to wood burning smoke, smoking habits, alcohol consumption, and diet, especially consumption that contains nitrosamines and is usually present in salted fish, nitrosamines are carcinogenic substances that can cause mutations in DNA (Kasim et al., 2020). Therefore, it is important to conduct further research on the relationship between these risk factors and the incidence of nasopharyngeal carcinoma.

In the Southeast Asian region, including Indonesia, the incidence rate of nasopharyngeal carcinoma is higher than in countries in Europe and America (Harahap & Priawan, 2023). Most of the new cases are found in individuals living in areas with exposure to certain carcinogens and risky food consumption patterns, such as salted fish containing nitrosamines (Arohmah et al., 2020). The high number of new cases of nasopharyngeal cancer in endemic areas such as Indonesia, which reaches 15,000 per year, confirms the importance of understanding and controlling the associated risk factors (Hardiati et al., 2022). The disease is often detected at an advanced stage because the symptoms are not typical, so the prognosis becomes poor and life expectancy decreases (Utami et al., 2022). Risk factors for nasopharyngeal carcinoma are generally divided into 3, namely genetic, environmental and agent. Various risk factors include Epstein-Barr virus (EBV) infection, exposure to environmental carcinogens such as exposure to wood burning smoke, smoking habits, alcohol, and consumption of nitrosamine-containing foods such as salted fish. In addition, geographical factors, age, gender, occupation, and socioeconomic status also affect the risk of this disease (Arohmah et al., 2020).

According to Pulungan et al., (2023) genetic factors contribute to the occurrence of nasopharyngeal carcinoma because some people have Polymeric Immunoglobulin Receptor (PIGR) which can be a carrier of the Epstein-barr virus as a risk factor for the agent into nasopharyngeal cells. In addition, Romdhoni et al., (2023) and Koo et al., (2021) stated that alcohol consumption with a frequency of more than 7 times per week has an increased risk of developing nasopharyngeal carcinoma, when combined with smoking which can damage nasopharyngeal epithelial cells due to harmful substances. According to Arohmah et al., (2020) Exposure to smoke from wood burning for more than 10 years can increase the risk of nasopharyngeal carcinoma up to six times. In addition, food consumption patterns also play a role, especially the consumption of salted fish containing nitrosamine, an important carcinogenic substance that is a major risk factor. According to Kasim et al., (2020) People who consume salted fish more than three times a month have a 7.5 times higher risk of developing nasopharyngeal carcinoma. To date, understanding the causes of nasopharyngeal cancer is still difficult because it involves complex interactions between genetic, environmental, and behavioral factors.

The etiology of nasopharyngeal carcinoma is common in the community so that it unknowingly causes nasopharyngeal carcinoma. According to Hasbie et al., (2022) Patients often arrive late at health facilities due to non-specific initial symptoms and make delays in management so that the prognosis also becomes much worse. Nasopharyngeal carcinoma is also a cancer that develops rapidly so it needs special attention for people to be aware of their health conditions. Therefore, it is important to conduct a more in-depth survey of risk factors and patient characteristics to understand its direct relationship to the incidence of nasopharyngeal carcinoma. With these steps, it is hoped that a more effective prevention program can be developed to raise public awareness about nasopharyngeal health.

In this study, data collection was carried out through a questionnaire containing several main variables, such as salted fish consumption patterns, smoking habits, exposure to wood burning smoke, alcohol consumption, genetic factors, and respondent characteristics. The variables measured included name, age, and gender as baseline data. This data will be analyzed by observational analysis to determine the relationship between salted fish consumption patterns, smoking, exposure to wood burning smoke, alcohol, genetics to the incidence of nasopharyngeal carcinoma. Thus, this questionnaire is an important tool to obtain valid and reliable primary data.

The researcher chose RSPAL dr. Ramelan Surabaya as the location of the research because this hospital is close to the Hang Tuah campus, making it easier to conduct research. Data from October 2020 to February 2021 showed that there were 22 nasopharyngeal cancer patients at RSPAL dr. Ramelan Surabaya. (Shoffi et al., 2021). This is what attracted the author's daily to conduct research

at RSPAL dr. Ramelan Surabaya. This study aims to determine the relationship between salted fish consumption patterns, smoking habits, exposure to wood burning smoke, alcohol consumption, and genetic factors with the incidence of nasopharyngeal carcinoma at RSPAL dr. Ramelan Surabaya for the period March 2020 to March 2025.

METHOD

Research Design

The cross-sectional study was conducted at RSPAL dr. Ramelan Surabaya from August 2025 to September 2025. Data collection was carried out on independent and bound variables at the same time with the aim of determining the relationship between risk factors and characteristics of patients with nasopharyngeal carcinoma.

Subject

The population in this study is patients with nasopharyngeal carcinoma as patients at RSPAL dr. Ramelan Surabaya. A total of 49 respondents met the inclusion criteria, consisting of 36 patients with nasopharyngeal carcinoma and 13 non-nasopharyngeal carcinoma patients selected by total sampling.

Instruments Research

This study uses secondary data from the medical records of patients with nasopharyngeal carcinoma at RSPAL dr. Ramelan Surabaya. In addition, data is also collected using a questionnaire through a google form. The dependent variable is nasopharyngeal carcinoma. Independent variables were salted fish consumption patterns, exposure to wood burning smoke, smoking habits, alcohol consumption and genetics. The research ethics permit was obtained from the RSPAL Ramelan Surabaya Ethics Commission No. 83/EC/KEP/2025.

Data Analysis

Data analysis in this study was carried out based on the results of patients' medical records that have met the inclusion criteria and also questionnaires. The data was analyzed using the Chi-square test.

RESULT

Table 1, it shows that in the KNF group, the highest proportion of respondents was aged 51–60 years (30.6%), were male (77.8%), belonged to the Javanese ethnic group (88.9%), had a senior high school education (44.4%), and worked as private employees (25.0%). In the Non-KNF group, most respondents were aged 51–60 years (53.8%), were male (76.9%), belonged to the Javanese ethnic group (84.6%), had a senior high school education (53.8%), and worked as private employees (46.2%).

Table 1.
Characteristics Sample

Characteristics sample	KNF		Non KNF	
	f	%	f	%
Age				
11 - 20 years	4	11.1	0	0.0
21 – 30 years old	3	8.3	0	0.0
31 – 40 years old	3	8.3	1	7.7
41 – 50 years old	8	22.2	1	7.7
51 – 60 years old	11	30.6	7	53.8
61 – 70 years old	6	16.7	2	15.4
71 – 80 years old	1	2.8	2	15.4
Gender				
Male	28	77.8	10	76.9
Women	8	22.2	3	23.1

Characteristics sample	KNF		Non KNF	
	f	%	f	%
Tribe				
Chinese	1	2.8	0	0.0
Javanese	32	88.9	11	84.6
Mature	2	5.6	2	15.4
Nias	1	2.8	0	0.0
Education				
SD	2	5.6	3	23.1
Junior High School	6	16.7	1	7.7
High School	16	44.4	7	53.8
S1	12	33.3	2	15.4
Jobs				
No/not working	6	16.7	0	0.0
Farm/plantation workers	4	11.1	2	15.4
Teacher	1	2.8	0	0.0
Housewives	6	16.7	1	7.7
Private employees	9	25.0	6	46.2
Retirees	2	5.6	1	7.7
PNS	2	5.6	0	0.0
Retired	1	2.8	0	0.0
Driver	1	2.8	0	0.0
TNI/Polri	1	2.8	2	15.4
Self-employed	3	8.3	0	0.0
Journalist	0	0.0	1	7.7

Table 2.
Univariate Results

Variable	f	%
Genetics		
Yes	6	16.7
No	30	83.3
History of Salted Fish Consumption		
Yes	33	91.7
No	3	8.3
Frequency of Salted Fish Consumption		
≥3x a month	20	60.6
<3x a month	13	39.4
Smoking History		
Yes	19	52.8
No	17	47.2
The Number of Cigarettes Consumed Per Day		
>20 Bars	3	15.8
11-20 Stems	4	21.1
1-10 Bars	12	63.2
History of Alcohol Consumption		
Yes	11	30.6
No	25	69.4
Frequency of Alcohol Consumption Per Month		
≥4x	3	27.3
1-3x	2	18.2
<1x	6	54.5
Wood Burning Smoke Exposure		
Yes	16	44.4
No	20	55.6

Table 2, it shows that most respondents did not have a genetic history (83.3%). Nearly all respondents had consumed salted fish (91.7%), with the majority consuming it ≥3 times per month (60.6%). More than half of the respondents had a smoking history (52.8%), and most were light

smokers consuming 1–10 cigarettes per day (63.2%). Most respondents did not consume alcohol (69.4%), and among those who did, the majority consumed alcohol less than once per month (54.5%). More than half of the respondents were not exposed to wood-burning smoke (55.6%).

Based on Table 3, the results of the contingency coefficient correlation test show that most of the risk factors studied did not show a statistically significant association with the incidence of nasopharyngeal carcinoma (KNF). Genetic history had a very weak contingency coefficient value ($C = 0.073$) with a p value = 0.609, indicating no significant association between genetic history and KNF occurrence. The history of salted fish consumption also showed no meaningful association ($C = 0.195$; $p = 0.165$), nor did the frequency of salted fish consumption ($C = 0.236$; $p = 0.075$) although the proportion of KNF incidence was higher in respondents with consumption ≥ 3 times a month. The variables of smoking ($C = 0.078$; $p = 0.586$) and the number of cigarettes consumed per day ($C = 0.066$; $p = 0.620$) also did not show a significant correlation with the incidence of KNF. History of alcohol consumption ($C = 0.150$; $p = 0.288$) and frequency of alcohol consumption ($C = 0.165$; $p = 0.156$) had no statistically significant relationship, although the proportion of KNF tended to be higher in the alcohol consumption group. In contrast, the history of wood burning smoke exposure showed a meaningful association with the incidence of KNF ($C = 0.286$; $p = 0.036$), with weak to moderate association strength, where the proportion of KNF incidence was higher in respondents exposed to smoke compared to those who were not exposed. These findings suggest that exposure to wood burning smoke is the risk factor that plays the most role in the incidence of KNF in the study population compared to other factors.

Table 3.

Results of the contingency coefficient correlation test risk factors for the occurrence of nasopharyngeal carcinoma

Variable	Category	KNF Incident			Contingency coefficient (C)	p
		KNF	Non KNF	Total		
		f (%)	f (%)	f (%)		
Genetic history	Yes	6 (66.7%)	3 (33.3%)	9 (100%)	0.073	0.609
	No	10 (25.0%)	30 (75.0%)	40 (100%)		
History of salted fish consumption	Yes	33 (76.7%)	10 (23.3%)	43 (100%)	0.195	0.165
	No	3 (50.0%)	3 (50.0%)	6 (100%)		
Frequency of consumption of salted fish	No consumption	3 (50.0%)	3 (50.0%)	6 (100%)	0.236	0.075
	<3x in a month	20 (71.4%)	8 (28.6%)	28 (100%)		
	$\geq 3x$ in a month	13 (86.4%)	2 (13.3%)	15 (100%)		
Smoking	Yes	19 (70.4%)	8 (29.6%)	27 (100%)	0.078	0.586
	No	17 (77.3%)	5 (22.7%)	22 (100%)		
The number of cigarettes consumed per day	No smoking	17 (77.3%)	5 (22.2%)	22 (100%)	0.066	0.620
	1-10 sticks	12 (70.6%)	5 (29.4%)	17 (100%)		
	11-20 sticks	4 (66.7%)	2 (33.3%)	6 (100%)		
	> 20 rods	3 (75.0%)	1 (25.0%)	4 (100%)		
History of alcohol consumption	Yes	11 (84.6%)	2 (15.4%)	13 (100%)	0.150	0.288
	No	25 (69.4%)	11 (30.6%)	36 (100%)		
Frequency of alcohol consumption	No consumption	25 (69.4%)	11 (30.6%)	36 (100%)	0.165	0.156
	< 1x per month	6 (75.0%)	2 (25.0%)	8 (100%)		
	1-3x per month	2 (100.0%)	0 (0.0%)	2 (100%)		
	$\geq 4x$ per month	3 (100.0%)	0 (0.0%)	3 (100%)		
Smoke exposure history	Yes	22 (64.7%)	12 (35.3%)	34 (100%)	0.286	0.036
	No	14 (93.3%)	1 (6.7%)	15 (100%)		

DISCUSSION

Sociodemographic Overview of Respondents by Age

Based on the results of the study, the most respondents with nasopharyngeal carcinoma (KNF) were in the age group of 51–60 years, which was 11 people (30.6%). Meanwhile, in the non-KNF group, the highest age was also in the range of 51–60 years, namely 7 people (53.8%). These results show that KNF is more common in the late adult to elderly age group, namely over 40 years old. This is

in accordance with research by Faiq et al., (2024) which states that the risk of KNF increases at the age of 40–60 years due to decreased immune function, cumulative exposure to environmental carcinogens, and physiological changes in tissues that facilitate DNA mutations. This theory is also in accordance with Shoffi et al., (2021) who stated that KNF patients are dominant in the age group over 40 years old, illustrating that the carcinogenesis process takes place gradually and is influenced by many factors. This process takes a long time to eventually develop into a disease, so often the diagnosis is established at an advanced stage. Epstein-Barr Virus (VEB) infection in the nasopharyngeal epithelial tissue is one of the main risk factors for KNF, with a latency period that can reach 20–25 years before it causes clinical symptoms. Thus, it can be concluded that age is one of the important predisposing factors in the occurrence of KNF, where the incidence increases with age.

Sociodemographic Overview of Respondents by Gender

Most of the respondents in this study were men, both in the KNF (77.8%) and non-KNF (76.9%) groups. Meanwhile, female respondents amounted to 22.2% in the KNF group and 23.1% in the non-KNF group. These results show that men have a higher proportion of KNF cases than women. This theory is in line with the research of Sulaiman, (2022) carried out in Cianjur and research at Dr Soetomo Surabaya Hospital by Utomo and Romdhoni, (2023), namely that men have a higher frequency than women. In addition, men tend to have higher levels of exposure to carcinogenic environmental factors than women. However, in a study carried out at Pelamonia Makassar Hospital by Yusuf et al., (2023) at Pelamonia Makassar Hospital, the most gender was female, namely 57.5 percent. This may happen because it is also influenced by environmental factors such as women's cooking habits in the kitchen so that they are more often exposed to wood burning smoke. This indicates that environmental and behavioral factors contribute greatly to the difference in incidence rates between the sexes.

Sociodemographic Overview of Respondents by Ethnicity

Based on the results of the study, the majority of KNF respondents came from the Javanese tribe as many as 32 people (88.9%), followed by the Madura tribe as many as 2 people (5.6%), the Chinese tribe 1 person (2.8%), and the Nias tribe 1 person (2.8%). In the non-KNF group, the Javanese also dominated (84.6%), followed by Madura (15.4%). The dominance of the Javanese tribe is most likely due to research conducted in the Surabaya area, East Java, so that the largest population does indeed come from ethnic Javanese. The results of this study are in accordance with Shoffi et al., (2021) that KNF patients at RSPAL dr. Ramelan is dominated by the Javanese tribe. Meanwhile, research in Nepal by Pandit et al., (2024) the Janajatis tribe has the highest frequency. According to research by Rosyidi et al., (2024), ethnic distribution can affect the level of susceptibility to KNF due to genetic differences. However, in the context of this study, the differences between tribes do not seem striking because the majority come from the same ethnicity.

Sociodemographic Picture of Respondents Based on Education

The results showed that the education level of the KNF respondents was 16 people in high school (44.4%), followed by 12 people (33.3%) in S1 in high school, 6 people in junior high school (16.7%), and 2 people in elementary school (5.6%). In the non-KNF group, the majority also had a high school education (53.8%). This is directly proportional to the research of Shoffi et al., (2021) which stated that the most education of KNF patients at RSPAL dr. Ramelan Surabaya is high school while at Dr. Soetomo Surabaya Hospital is elementary school. These results illustrate that most of the KNF patients at RSPAL dr. Ramelan Surabaya have a high to upper secondary education level, which shows that there is a good level of educational awareness. However, this is not necessarily directly proportional to the preventive behavior of exposure to carcinogens. According to Farhaeni and Martini, (2023), education level plays an important role in a person's ability to understand health risks and prevent disease. However, in the context of KNF, environmental exposure such as wood smoke or smoking habits can occur unknowingly, even

though the level of education is already high. Thus, health education about KNF risk factors still needs to be delivered comprehensively at all levels of education.

Sociodemographic Overview of Respondents by Occupation

Based on the results of the study, the most jobs of KNF respondents were 9 private employees (25.0%), followed by 6 people (16.7%), 6 housewives (16.7%), farm/plantation workers 4 people (11.1%), self-employed 3 people (8.3%), while other jobs such as teachers, drivers, civil servants, retired officers, and the TNI/Polri were below 3% each. Meanwhile, in the non-KNF group, the most jobs were also private employees (46.2%), followed by the TNI/Polri (15.4%), and farm/plantation workers (15.4%).

The results of this study are in line with the research of Shoffi et al., (2021) at RSPAL dr. Ramelan Surabaya and Utomo & Romdhoni, (2023) at Dr. Soetomo Hospital stated that the most jobs are dominated by self-employed or private employees. Private employees and laborers tend to be at risk of KNF because they are associated with work pressure that triggers stress so that the immune system decreases and triggers the reactivation of EBV (Sausen et al., 2021). However, this is not in line with the research of Pratiwi & Nuaba, (2022) carried out at Denpasar Bali hospital that the most dominating work of KNF patients is farmers. This difference may also be due to geographical factors that dominate certain occupations in a region.

Relationship of Genetic Factors with the Incidence of Nasopharyngeal Carcinoma

The results showed ($p = 0.609$) that H1 was rejected and H0 was accepted, i.e. there was no relationship between genetic factors and the incidence of nasopharyngeal carcinoma. The results of this study are in line with Hsu et al., (2025) who identified genetics in various ethnicities and produced genetic results that were insignificant with nasopharyngeal carcinoma. Based on this, the insignificance of the relationship between genetic factors and KNF in this study may be due to the limitations of the method and the number of samples, as well as differences in genetic characteristics between populations. These results show that the genetic role of KNF is complex and interacts with environmental or viral factors and cannot be evaluated through a family history approach alone. Therefore, further research needs to be carried out with direct molecular genetic approaches, such as the analysis of HLA, PIGR genes or other genes that play a role in the immune response to EBV infection. Thus, the relationship between genetic variation and the incidence of KNF can be assessed more accurately in the Indonesian population.

The Relationship between Salted Fish Consumption Patterns and the Incidence of Nasopharyngeal Carcinoma

The results of the analysis showed ($p = 0.165$) that H1 was rejected and H0 was accepted, this means that there was no significant association between salted fish consumption and the incidence of nasopharyngeal carcinoma. The results of the analysis of the mean frequency ($p = 0.075$) ($p > 0.05$), also showed that there was no association or H1 was rejected and H0 was accepted between the frequency of consumption of salted fish more than 3 times a month with nasopharyngeal carcinoma. These findings are different from several studies in the Asian region that state that salted fish consumption is one of the main risk factors for KNF, especially if consumed more than 3 times a month (Kasim et al., 2020; Pangestu et al., 2023). In theory, salted fish contains nitrosamine, a carcinogenic compound formed from the reaction between nitrites/nitrates and amines during the salting or drying process of fish. Nitrosamines can cause DNA mutations in nasopharyngeal epithelial cells, which then trigger abnormal cell growth (Bilondatu, 2022). However, this study is in line with Julianingrum, (2021) who reviewed several literature studies and stated that the relationship between salted fish consumption and the incidence of nasopharyngeal carcinoma is inconsistent, and only has a relationship in the South China region. The insignificance of the results in this study may be due to several factors, including the frequency of respondents consuming salted fish is relatively homogeneous between KNF and Non-KNF patients and recall bias because

consumption data was obtained through a retrospective questionnaire. Although not statistically significant, the consumption factor of salted fish still needs to be considered because it has the potential to trigger nasopharyngeal carcinoma.

The Relationship of Smoking Habits with the Incidence of Nasopharyngeal Carcinoma

This study showed ($p = 0.586$) that H_1 was rejected and H_0 was accepted, meaning that smoking habits were not significantly related to the incidence of KNF. The number of cigarettes consumed per day ($p = 0.620$) is stated ($p > 0.05$) which means that there is no relationship or H_1 Rejected and H_0 accepted between the number of cigarettes consumed per day and the incidence of nasopharyngeal carcinoma. This suggests that in the study population, smoking was not a major risk factor. The results of this study are in line with Romdhoni et al., (2023) who stated that smoking does not have a significant relationship with the incidence of nasopharyngeal carcinoma. In theory, cigarette smoke contains more than 4,000 harmful chemicals, including benzopenrene, tar, carbon monoxide, and tobacco-specific nitrosamines (TSNA) that can trigger genetic mutations in the nasopharyngeal epithelium.

Several studies state that active smokers have twice the risk of experiencing KNF than non-smokers, especially the risk increases if they consume more than 20 cigarettes per day (Alimin et al., 2024). Descriptively, there are indeed more KNF respondents who smoke, but the proportion is almost the same as non-KNF respondents, so the difference is not large enough to cause statistical significance. Thus, these results cannot be interpreted as not smoking not a risk factor for KNF, but rather because the conditions of exposure to smoking in both groups are relatively similar, so the effect is not statistically visible. Therefore, the results of this study do not show that smoking is the main risk factor for KNF, but it does show that in this study population, smoking is not strong enough to be the main determinant due to the almost balanced characteristics of exposure in both groups. This confirms the importance of considering multifactorial interactions in understanding the etiology of KNF, in which environmental, genetic, and viral infection factors play a complex role. The results of this study reinforce the view that a single behavioral factor such as smoking is not necessarily a major determinant of KNF, and further research with larger sample sizes, as well as analysis of smoking duration and intensity is needed to clarify possible causal relationships.

Relationship between Alcohol Consumption and the Incidence of Nasopharyngeal Carcinoma

The results showed a history of alcohol consumption ($p = 0.288$) ($p > 0.05$) which means that H_1 was rejected and H_0 was accepted, that alcohol consumption was not significantly related to the incidence of KNF. In addition, the frequency ($p = 0.156$) i.e. ($p > 0.05$) indicates no relationship or H_1 is rejected and H_0 is accepted. This study is in line with the research of Feng et al., (2021) in South China which produced results that there was no or insignificant relationship between alcohol consumption and the incidence of nasopharyngeal carcinoma. However, the results of this study are not in line with Zhang et al., (2023) in China and Koo et al., (2021) in Korea who stated that alcohol consumption increases the risk of KNF.

A meta-analysis by Koo et al., (2021) reported that an increased risk of head and neck cancer, including nasopharyngeal cancer, was seen in individuals who consumed alcohol with high frequency, i.e. drinking almost every day or ≥ 7 times per week. Meanwhile, low-frequency alcohol consumption such as only a few times a month did not show a significant increase in the risk of nasopharyngeal cancer. In this study, most of the respondents were classified as not consuming alcohol, so very low alcohol exposure did not have the effect of affecting the risk of nasopharyngeal cancer. Thus, the results of this study show that although alcohol can theoretically play a role as a carcinogenic factor, in the context of this study population the effect is not proven to be significant on the incidence of KNF. These results support the view that KNF is a multifactorial disease, in which the role of alcohol consumption does not stand alone but interacts with other risk factors. Further research with larger sample sizes, stratification based on type and intensity of alcohol

consumption, and control of confounding factors such as smoking habits and EBV infection is needed to determine a more accurate relationship.

Relationship of Wood Burning Smoke Exposure to Nasopharyngeal Carcinoma Incidence

The results showed ($p = 0.036$) that H1 was accepted and H0 was rejected, suggesting that there was a relationship between exposure to wood burning smoke and the incidence of nasopharyngeal carcinoma. These results are in line with a literature review study from Arohmah et al., (2020) which stated that exposure to wood smoke for more than 10 years can increase the risk of KNF by up to six times. The results of this study are also in line with Mofidi et al., (2022) who conducted a study in Canada and found that there is a significant relationship between exposure to wood burning smoke and the incidence of KNF. However, these results are not in line with Omar et al., (2023) who conducted a study at Queen Sabah Hospital, East Malaysia, who stated that there is no association between exposure to wood burning smoke and nasopharyngeal carcinoma.

Wood burning smoke contains a variety of harmful compounds such as polycyclic aromatic hydrocarbons (PAHs), benzene, formaldehyde, and fine particulate matter (PM_{2.5} and PM₁₀) which are carcinogenic. These substances can irritate the nasopharyngeal mucosa, causing chronic inflammation, oxidative stress, as well as damaging the DNA of nasopharyngeal epithelial cells. Thus, the results of this study strengthen the evidence that exposure to wood burning smoke is an important risk factor in the incidence of KNF in Indonesia. Prevention efforts need to be focused on educating the public about the dangers of wood smoke and promoting the use of clean fuels.

Research Limitations

This study has a number of limitations that need to be considered in the interpretation of the results. The observational design of the study with a cross-sectional approach meant that the cause-and-effect relationship between risk factors and the incidence of nasopharyngeal carcinoma (KNF) could not be directly determined. In addition, the relatively small number of samples, namely 36 KNF patients and 13 non-KNF respondents, as well as the imbalance between the case and control groups have the potential to reduce the statistical test power. Data collection that relies on questionnaires and medical records also opens up opportunities for recalls bias and information bias, especially in behavioral variables such as the frequency of salted fish consumption, alcohol consumption, and smoking habits. The genetic aspects in this study were only assessed based on family history without molecular genetic testing, so they did not fully reflect the actual genetic predisposition. This study also did not include the Epstein–Barr Virus (EBV) factor which is known to play an important role in the pathogenesis of KNF. In addition, other environmental factors such as air pollution, exposure to industrial dust, and a history of chronic respiratory tract infections have not been comprehensively evaluated. Another limitation is the limited generalization of research results because the research was only conducted at RSPAL dr. Ramelan Surabaya with certain population characteristics. However, taking into account these limitations, the results of this study still provide a meaningful picture of the main risk factors for KNF in the study area, especially related to the role of wood burning smoke exposure.

CONCLUSION

This study concluded that exposure to wood burning smoke was the only factor that had a significant relationship with the incidence of KNF. Meanwhile, genetic factors, salted fish consumption, smoking habits, and alcohol consumption did not show a statistically significant relationship with the incidence of KNF in this study. In terms of patient characteristics, KNF sufferers are most commonly found in the age group of 51–60 years, dominated by the male gender, with the most tribe being the Javanese tribe. In addition, the last level of education that is most prevalent is high school, and the most dominant type of occupation in KNF patients is private employees. These findings provide an overview of the profile of KNF patients in the study area and

confirm the importance of environmental factors, especially exposure to wood burning smoke, as the main risk factors.

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