



## Dietary Patterns and Physical Activity Associated with Acute Respiratory Infection Primary Care Patients in East Halmahera, Indonesia: A Cross-Sectional Study

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**Abstract.** Background: Acute respiratory infection (ARI) remains a major public health concern, particularly in primary care settings. Lifestyle factors such as dietary patterns and physical activity are increasingly recognized as potential contributors to respiratory health. Objective: This study aimed to examine the association between dietary patterns, physical activity, and ARI among primary care patients in East Halmahera, Indonesia. Methods: A cross-sectional study was conducted at a primary health care facility in East Halmahera, Indonesia, from January to February 2026, involving 106 respondents selected using a total sampling technique. Data were collected using structured questionnaires and medical records. Variables included sociodemographic characteristics, dietary patterns, physical activity, and ARI status. Data were analyzed using descriptive statistics and Chi-square tests with a significance level of  $p < 0.05$ . Results: The prevalence of ARI among respondents was 77.4%. Bivariate analysis showed that dietary patterns ( $p = 0.006$ ) and physical activity ( $p = 0.015$ ) were significantly associated with ARI. In contrast, age, gender, marital status, education level, employment status, smoking, and alcohol consumption were not significantly associated with ARI ( $p > 0.05$ ). Conclusion: Dietary patterns and physical activity were significantly associated with ARI among primary care patients in East Halmahera. These findings highlight the importance of lifestyle-related factors in addressing respiratory infections at the primary care level.

**Keywords:** Acute Respiratory Infection; Dietary Patterns; Indonesia; Physical Activity; Primary Care.

### 1. INTRODUCTION

Acute respiratory infection (ARI) remains one of the leading causes of morbidity worldwide and continues to pose a significant public health challenge, particularly in low- and middle-income countries (LMICs) (Kyu *et al.*, 2022; World Health Organization, 2025). ARI includes a spectrum of infections affecting both the upper and lower respiratory tract, ranging from mild conditions such as the common cold to severe diseases like pneumonia. Despite advances in prevention and treatment, ARI persists as a major contributor to outpatient visits and healthcare burden, especially in primary health care settings (Sirota *et al.*, 2025). In Indonesia, ARI is consistently reported as one of the most common causes of illness, reflecting ongoing challenges in disease prevention and health promotion (Kemenkes RI, 2022).

The occurrence of ARI is multifactorial, involving interactions between host, environmental, and behavioral determinants. Previous studies have highlighted the importance of environmental factors such as air pollution, housing conditions, and population density, as well as socioeconomic factors, including education and income level (Prüss-Üstün *et al.*, 2016; Schraufnagel *et al.*, 2019). In addition, biological factors such as age and immune status are known to influence susceptibility to respiratory infections (Li *et al.*, 2022). However,

increasing attention has been directed toward modifiable lifestyle factors that directly affect immune function and overall health status (Calder *et al.*, 2020).

Dietary patterns represent a key determinant of immune competence. Adequate intake of macro- and micronutrients is essential for maintaining immune system function and resistance to infection. Unhealthy dietary patterns, characterized by low consumption of fruits, vegetables, and protein sources and high intake of processed foods, may lead to nutritional deficiencies that impair immune responses and increase vulnerability to infections, including ARI (Calder *et al.*, 2020; Gombart *et al.*, 2020). Evidence suggests that poor nutritional status is associated with a higher incidence and severity of respiratory infections, highlighting the importance of balanced nutrition in disease prevention (Jayawardena *et al.*, 2020).

Physical activity is another important lifestyle factor influencing respiratory health. Regular physical activity has been shown to enhance immune function, improve lung capacity, and reduce systemic inflammation (Nieman & Pence, 2020). Conversely, insufficient physical activity may weaken the body's defense mechanisms and increase susceptibility to infectious diseases. While moderate physical activity is generally associated with protective effects, sedentary behavior has been linked to poorer health outcomes, including increased risk of respiratory infections (Hall *et al.*, 2020).

Although the role of environmental and socioeconomic factors in ARI has been widely studied, there is still limited evidence examining the combined influence of dietary patterns and physical activity on ARI, particularly among general primary care populations. Most existing studies focus on children under five years of age or specific clinical groups, leaving a gap in understanding among broader age groups accessing primary health care services (Kyu *et al.*, 2022). In addition, research in Indonesia has predominantly emphasized environmental and nutritional status factors, with less attention given to lifestyle behaviors as modifiable risk factors (Kemenkes RI, 2022).

In the context of East Halmahera, Indonesia, ARI remains a common health problem encountered in primary health care facilities. This region is characterized by geographical challenges, limited access to health services in certain areas, and varying socioeconomic conditions that may influence health behaviors and disease risk. Dietary habits in rural and semi-urban communities are often influenced by food availability, cultural practices, and economic constraints, which may affect nutritional quality. Similarly, patterns of physical activity may vary depending on occupational demands and lifestyle transitions. These contextual factors highlight the importance of examining ARI determinants within specific local settings to generate relevant and applicable evidence. Given the high burden of ARI and

the potential importance of lifestyle factors, it is essential to investigate how dietary patterns and physical activity contribute to ARI occurrence in real-world primary care settings. Understanding these relationships can inform the development of targeted, behavior-based interventions to reduce ARI incidence and improve population health. Therefore, this study aimed to analyze the association between dietary patterns and physical activity with acute respiratory infection among primary care patients in East Halmahera, Indonesia, using a cross-sectional approach. The findings are expected to provide evidence to support lifestyle-based prevention strategies and strengthen health promotion efforts at the primary care level.

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## **2. METHODS**

### **Study Design and Setting**

This study employed a cross-sectional design conducted at a primary health care facility in East Halmahera, Indonesia. Data collection was carried out over a two-month period from January to February 2026. Prior to data collection, official permission was obtained from the local health authorities and the management of the primary health care facility

### **Study Population and Sample**

The study population consisted of patients who visited a primary health care facility in East Halmahera, Indonesia, during the study period. A total of 106 respondents were included using a total sampling approach, in which all eligible individuals meeting the inclusion criteria during the data collection period were recruited. Inclusion criteria comprised individuals who were willing to participate, able to communicate effectively, and who provided informed consent. Respondents with incomplete data were excluded from the analysis.

### **Variables and Measurements**

The dependent variable in this study was the history of acute respiratory infection (ARI), categorized as ARI and non-ARI. Independent variables included sociodemographic characteristics (age group, gender, marital status, education level, and employment status) and lifestyle factors (smoking habits, alcohol consumption, dietary pattern, and physical activity). Age was grouped into adolescents (<20 years), young adults (20–35 years), older adults (36–50 years), and the elderly (>50 years). Education level was categorized into low and higher

education. Lifestyle variables were classified into dichotomous categories based on standard behavioral definitions. Data were collected using a structured questionnaire and patient records available at the health center.

### **Data Analysis**

Data were analyzed using IBM SPSS version 26. Descriptive statistics were used to summarize the characteristics of respondents, presented as frequencies and percentages. Bivariate analysis was conducted to examine the association between independent variables and ARI status using the Chi-square test. A p-value of less than 0.05 was considered statistically significant.

### **Ethical Considerations**

This study adhered to ethical principles for research involving human participants. All participants were informed about the purpose and procedures of the study before data collection. Participation was voluntary, and written informed consent was obtained from each respondent. The confidentiality and anonymity of participants' information were strictly maintained throughout the study process. Administrative approval for this study was granted by the relevant authorities at a primary health care facility in East Halmahera, Indonesia, under reference number 445/023/PKM-LB/III/2026.

## **3. RESULT**

Table 1 describes the sociodemographic and lifestyle characteristics of the respondents (n = 106). The largest proportion of participants was in the adolescent group (<20 years) (34.0%), followed by young adults and older adults (each 22.6%), and the elderly (20.8%). The distribution by sex was almost equal, with 50.9% male and 49.1% female. Most respondents were married (62.3%) and had a low level of education (67.9%). Regarding employment status, 66.0% were employed. In terms of lifestyle factors, 64.2% reported not smoking, and 64.2% reported not consuming alcohol. A healthy dietary pattern was reported by 68.9% of respondents, and 83.0% engaged in adequate physical activity. The proportion of respondents with a history of acute respiratory infection (ARI) was 77.4%, while 22.6% had no history of ARI.

**Table 1.** Distribution of Sociodemographic and Lifestyle Characteristics of Respondents in a Primary Health Care Facility in East Halmahera, Indonesia (n = 106) (Source: Primary data, 2026).

<b>Variable</b>	<b>Frequence</b>	<b>Percent</b>
<b>Age Group</b>		
Adolescent (<20)	36	34,0
Young Adults (20-35 years)	24	22,6
Older Adults (36-50 years)	24	22,6
Elderly (> 50 years)	22	20,8
<b>Gender</b>		
Male	54	50,9
Female	52	49,1
<b>Marital Status</b>		
Married	66	62,3
Unmarried	40	37,7
<b>Education Level</b>		
Low Education (no formal education, elementary school, and junior high school)	62	67,9
Higher Education (senior high school and university)	34	32,1
<b>Employment Status</b>		
Employed	70	66,0
Unemployed	36	34,0
<b>Smoking Habits</b>		
Yes	38	35,8
No	68	64,2
<b>Alcohol Consumption</b>		
Yes	38	35,8
No	68	64,2
<b>Dietary Pattern</b>		
Healthy	73	68,9
Unhealthy	33	31,1
<b>Physical Activity</b>		
Adequate	88	83,0
Inadequate	18	17,0
<b>History of Acute Respiratory Infection</b>		
ARI	82	77,4
Non-ARI	24	22,6

Table 2 presents the bivariate analysis of sociodemographic and lifestyle factors in relation to ARI status. The distribution of ARI and non-ARI cases across age groups showed no statistically significant difference ( $p = 0.948$ ). Similarly, no significant differences were observed by gender ( $p = 0.916$ ), marital status ( $p = 0.651$ ), education level ( $p = 0.881$ ), or employment status ( $p = 0.941$ ). For behavioral variables, smoking status ( $p = 0.438$ ) and alcohol consumption ( $p = 0.438$ ) were not significantly associated with ARI status. In contrast, dietary pattern and physical activity showed statistically significant differences between ARI

and non-ARI groups. The distribution of ARI cases differed by dietary pattern ( $p = 0.006$ ) and by physical activity level ( $p = 0.015$ ).

**Table 2.** Bivariate Analysis of Sociodemographic and Lifestyle Factors Associated with Acute Respiratory Infection among Patients in a Primary Health Care Facility in East Halmahera, Indonesia (n = 106).

Variable	History of Acute Respiratory Infection			
	ARI		Non-ARI	
	n	%	n	%
<b>Age Group</b>				
Adolescent (<20)	28	26,4	8	7,5
Young Adults (20-35 years)	19	17,9	5	4,7
Older Adults (36-50 years)	19	17,9	5	4,7
Elderly (> 50 years)	16	15,1	6	5,7
<b><i>p-value</i></b>				<b>.948</b>
<b>Gender</b>				
Male	42	39,6	12	11,3
Female	40	37,7	12	11,3
<b><i>p-value</i></b>				<b>0.916</b>
<b>Marital Status</b>				
Married	52	49,1	14	13,2
Unmarried	30	28,3	10	9,4
<b><i>p-value</i></b>				<b>0.651</b>
<b>Education Level</b>				
Low Education (no formal education, elementary school, and junior high school)	56	52,8	16	16,1
Higher Education (senior high school and university)	26	24,5	8	7,5
<b><i>p-value</i></b>				<b>0.881</b>
<b>Employment Status</b>				
Employed	54	50,9	16	15,1
Unemployed	28	26,4	8	7,5
<b><i>p-value</i></b>				<b>0.941</b>
<b>Smoking Habits</b>				
Yes	31	29,2	7	6,6
No	51	48,1	17	16,0
<b><i>p-value</i></b>				<b>0.438</b>
<b>Alcohol Consumption</b>				
Yes	31	29,2	7	6,6
No	51	48,1	17	16,0
<b><i>p-value</i></b>				<b>0.438</b>
<b>Dietary Pattern</b>				
Healthy	62	58,5	11	10,4
Unhealthy	20	18,9	13	12,3
<b><i>p-value</i></b>				<b>0.006*</b>
<b>Physical Activity</b>				
Adequate	72	67,9	16	15,1
Inadequate	10	9,4	8	7,5
<b><i>p-value</i></b>				<b>0.015*</b>

**Notes:** ARI = Acute Respiratory Infection. Data are presented as frequency (n) and percentage (%). Bivariate analysis was performed to examine the association between independent variables and history of ARI using the Chi-square test. A p-value < 0.05 was considered statistically significant. Variables with statistically significant associations are indicated with an asterisk (\*).

#### **4. DISCUSSIONS**

This study aimed to examine the association between dietary patterns and physical activity with the incidence of acute respiratory infection (ARI) among patients in a primary health care setting. The findings revealed that dietary patterns and physical activity were significantly associated with ARI, whereas sociodemographic factors, smoking habits, and alcohol consumption were not significantly related. The high prevalence of ARI observed in this study (77.4%) indicates that ARI remains a substantial public health burden at the primary care level. This finding is consistent with global evidence showing that respiratory infections continue to be among the leading causes of morbidity worldwide, particularly in low- and middle-income countries (GBD 2021 Respiratory Infections Collaborators, 2024; Safiri *et al.*, 2022). This persistent burden highlights gaps in prevention strategies and underscores the need for comprehensive approaches addressing both clinical and behavioral determinants.

Dietary patterns were significantly associated with ARI. Individuals with unhealthy dietary habits were more likely to develop ARI, which can be explained by the critical role of nutrition in immune system function. Adequate intake of micronutrients such as vitamins A, C, D, and zinc is essential for maintaining immune defense mechanisms. Poor dietary quality may impair immune responses, increasing susceptibility to infections. Previous studies have consistently shown that inadequate nutritional status is linked to higher incidence and severity of respiratory infections (Butler & Barrientos, 2020; Calder *et al.*, 2020). These findings reinforce the importance of nutritional interventions as part of ARI prevention strategies.

Physical activity also showed a significant association with ARI. Regular physical activity has been shown to enhance immune surveillance, improve pulmonary function, and reduce systemic inflammation. Conversely, insufficient physical activity may weaken immune responses and increase vulnerability to infections. Evidence suggests that moderate exercise reduces the risk of respiratory infections, whereas sedentary behavior increases susceptibility (Nieman & Pence, 2020; Sallis *et al.*, 2021). These findings highlight the importance of promoting physical activity as a preventive health behavior.

In contrast, sociodemographic variables were not significantly associated with ARI in this study. This suggests that lifestyle-related factors may play a more direct role in ARI occurrence within this population. However, broader evidence indicates that socioeconomic conditions influence health outcomes through access to resources, healthcare services, and environmental quality (Prüss-Üstün *et al.*, 2016). The lack of association in this study may reflect sample homogeneity or contextual factors specific to the study setting. Smoking and alcohol consumption were also not significantly associated with ARI. Although smoking is a well-established risk factor for respiratory diseases, the absence of a significant relationship may be due to limitations in measurement or sample distribution. Previous studies indicate that smoking increases susceptibility to respiratory infections by impairing mucociliary clearance and immune responses (Vardavas & Nikitara, 2020). Therefore, these findings should be interpreted cautiously. Overall, this study highlights the importance of modifiable lifestyle factors, particularly dietary patterns and physical activity, in influencing ARI risk. Integrating these factors into preventive strategies may enhance the effectiveness of public health interventions.

This study has several limitations. First, the cross-sectional design limits the ability to establish causal relationships between independent variables and ARI. Second, lifestyle-related data were self-reported, which may introduce recall bias and social desirability bias. Third, the study was conducted in a single primary health care center, limiting the generalizability of the findings. Fourth, environmental factors such as air quality, housing conditions, and ventilation were not included, although they are known to influence ARI risk. Finally, potential confounders such as body mass index (BMI), comorbidities, and immune status were not controlled in the analysis.

The findings of this study have important implications for public health practice. First, health promotion programs should prioritize improving dietary patterns and increasing physical activity as key strategies for ARI prevention. Second, primary health care providers should integrate lifestyle counseling into routine services to identify and manage individuals at higher risk. Third, community-based interventions focusing on behavioral change may be effective in reducing ARI incidence. Finally, policymakers should consider incorporating lifestyle-based prevention strategies into public health programs to reduce the burden of respiratory infections.

## 5. CONCLUSIONS

This study demonstrates that dietary patterns and physical activity are significantly associated with the incidence of acute respiratory infection (ARI) among primary care patients

in East Halmahera, Indonesia. Individuals with unhealthy dietary patterns and inadequate physical activity were found to have a higher likelihood of experiencing ARI. These findings highlight the critical role of modifiable lifestyle factors in influencing susceptibility to respiratory infections. In contrast, sociodemographic characteristics, including age, gender, marital status, education level, and employment status, as well as behavioral factors such as smoking and alcohol consumption, were not significantly associated with ARI in this study. This suggests that, within the context of this population, lifestyle-related factors may have a more direct and measurable impact on ARI occurrence than broader social determinants. The high prevalence of ARI observed further emphasizes the ongoing burden of respiratory infections at the primary health care level. This underscores the need for strengthened preventive strategies that go beyond clinical management and focus on promoting healthy behaviors. Interventions aimed at improving dietary quality and encouraging regular physical activity should be prioritized as part of comprehensive ARI prevention programs. From a public health perspective, these findings support the integration of lifestyle-based interventions into routine primary care services. Health education, behavioral counseling, and community-based programs that promote balanced nutrition and active lifestyles may contribute significantly to reducing the incidence of ARI.

Future research is recommended to employ longitudinal or cohort designs to better establish causal relationships and to include additional variables such as environmental exposures, nutritional status, and comorbid conditions. A more comprehensive approach will enhance understanding of ARI determinants and support the development of more effective and targeted interventions. In conclusion, addressing modifiable lifestyle factors particularly dietary patterns and physical activity represents a key strategy in reducing the burden of acute respiratory infections and improving overall population health outcomes in primary care settings.

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