

# Non-Communicable Disease Morbidity Among Young Adults: A Cross-Sectional Study in Indonesia

Ika P. Asturingtyas\*<sup>1</sup>, Hadi Ashar<sup>2</sup>, Sidiq Purwoko<sup>3</sup>, Nissa N. Annashr<sup>4</sup>

<sup>1</sup> Magelang Unit for Health Research and Development, Ministry of Health, Magelang, Indonesia

<sup>2,3</sup> Research Centre for Public Health and Nutrition, National Research and Innovation Agency, Jakarta, Indonesia

<sup>4</sup> Department of Public Health, Universitas Siliwangi, Tasikmalaya, Indonesia

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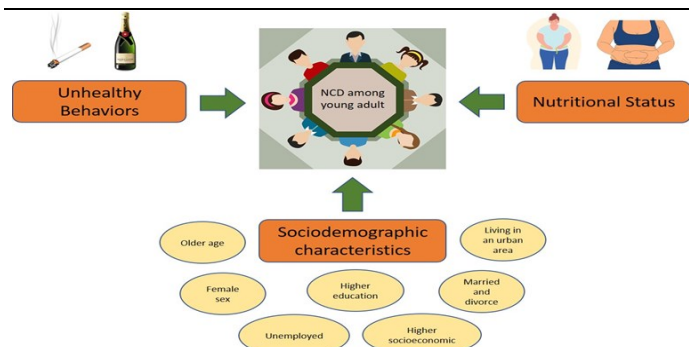
## ABSTRACT

Noncommunicable Disease (NCD) has continued to pose a significant global burden, specifically regarding morbidity among young adults which has not been well studied. Therefore, this study aimed to assess the burden of NCD among young adults and identify correlating factors. It analyzed the 2018 Indonesian Basic Health Research, a nation wide study employing a cross-sectional design and linear systematic with Two Stage Sampling. The subject involved comprised 319,355 individuals in the 18-40 age group. Data were further analyzed using bivariate and multivariate analysis with logistic regression. The analysis results showed that 6% of young adults in Indonesia had one NCD or more. Young adults with higher Waist Circumference (WC) and higher Body Mass Index (BMI) had a higher risk of NCD (OR:1.58; 95%CI:1.52-1.65 and OR: 1.14; 95%CI:1.09-1.19, respectively). Furthermore, several sociodemographic factors exhibited significant correlation including older age, female sex, unemployment, higher educational and socioeconomic status, married and divorced, as well as living in an urban area (p-value<0.05). Unhealthy behavior such as consuming alcohol and smoking also increased the risk for NCD morbidity (OR:1.20; 95%CI:1.10-1.30 and OR: 1.19; 95%CI:1.10-1.27). Therefore, it was crucial to strengthen preventive programs targeting NCD among young adults by focusing on sociodemographic characteristics. This study also emphasized the importance of campaigns aimed at improving health behavior in this age group.

## ABSTRAK

Penyakit Tidak Menular (PTM) masih menjadi beban global di seluruh dunia. Beban PTM pada usia dewasa muda belum banyak dipelajari. Oleh karena itu, penelitian ini bertujuan untuk menilai beban PTM pada kelompok umur dewasa muda dan mengidentifikasi faktor yang berhubungan. Penelitian ini menganalisis data Riset Kesehatan Dasar (Riskesdas) 2017, penelitian nasional dengan desain potong lintang dan pengambilan sampel secara Two Stage Sampling. Subyek penelitian adalah 319,000 orang dengan kelompok umur 18-40 tahun. Data dianalisis secara bivariat dan multivariat menggunakan regresi logistik. Hasil analisis menunjukkan bahwa 6% kelompok umur dewasa muda di Indonesia memiliki satu atau lebih PTM. Kelompok umur dewasa muda dengan lingkaran pinggang dan Indeks Massa Tubuh (IMT) yang tinggi memiliki risiko PTM yang lebih tinggi (OR:1.58; 95%CI:1.52-1.65 dan OR: 1.14; 95%CI:1.09-1.19). Selain itu, beberapa faktor sosiodemografis juga menunjukkan hubungan signifikan, seperti usia lebih tua, jenis kelamin perempuan, tidak bekerja, pendidikan dan status sosial ekonomi yang tinggi, menikah dan bercerai, juga tinggal di daerah perkotaan (p-value<0,05). Perilaku tidak sehat seperti konsumsi alkohol dan merokok juga meningkatkan risiko PTM (OR:1.20; 95%CI:1.10-1.30 and OR: 1.19; 95% CI:1.10-1.27). Oleh karena itu, penting untuk memperkuat program pencegahan dengan sasaran utama kelompok umur dewasa muda dengan memperhatikan karakteristik sosiodemografi. Hasil penelitian ini juga memperkuat pentingnya kampanye yang bertujuan untuk meningkatkan perilaku hidup sehat pada kelompok umur dewasa muda.

## GRAPHICAL ABSTRACT



## Keyword

Indonesia  
morbidity  
noncommunicable disease  
young adult

## \* Correspondence

Jurusawah RT 45 RW 17, Menoreh, Salaman, Magelang  
56162, Central Java, Indonesia  
Email: [ikapuspita8845@yahoo.com](mailto:ikapuspita8845@yahoo.com)

## INTRODUCTION

The global burden of Non-Communicable Diseases (NCD) remains significantly high, and this disease category has the highest mortality rate worldwide. Data from WHO showed that in April 2021, NCD accounted for the death of 41 million people worldwide yearly, amounting to approximately 71% of the global death rate. Furthermore, 77% of NCD deaths worldwide occur in low and middle-income countries. The leading causes of these deaths include cardiovascular disease (17.9 million), cancer (9.3 million), chronic respiratory disease (4.1 million), and diabetes (1.5 million). NCD not only contributes to poverty but also reduces work productivity and the sufferer's economic level. In countries with low socioeconomic status, it increases the financial burden to a relatively high level (World Health Organization, 2021).

Indonesia, as a developing country, also faces a substantial NCD burden due to the epidemiological transition, which shifted disease patterns from communicable to non-communicable. Data from Basic Health Research (Riskesdas) showed an increasing trend of NCD over time as observed from Riskesdas studies conducted in 2007, 2013, and 2018. NCD such as cancer, stroke, kidney disease, diabetes mellitus, heart disease, and hypertension showed an upward trajectory. Additionally, the burden of NCD in young adults exhibited a similar pattern. For the age group 15-34 years, the prevalence of asthma, cancer, diabetes mellitus, heart disease, hypertension, stroke, and kidney failure was 4.4%, 1.68%, 0.27%, 1.5%, 2.86%, 2.0%, and 0.36%, respectively (Kementerian Kesehatan Republik Indonesia, 2019).

Young adulthood is a critical period of development, that significantly impacts an individual's economic security, health, and overall well-being over a long time. Individuals in this phase are key contributors to the nation's work-

force, and may also become parents who will influence the healthy development of the next generation. However, young adults have a higher risk of death and disease compared to adolescents and older adults, particularly concerning behavioral health. Risk-taking behaviors associated with death and injury across the life span tend to emerge or peak during young adulthood, with significant immediate and long-term health consequences. For example, tobacco use, low fitness, and poor nutrition increase the probability of developing NCD, such as cardiovascular and pulmonary disease, as well as cancer, later in life (Bonnie et al., 2015).

Cancer, diabetes, chronic lung disease, and cardiovascular diseases are crucial issues for the younger generation. More than two-thirds of preventable adult NCD deaths are associated with risk behavior that starts in the young age group. Tobacco use, alcohol abuse, unhealthy diets, and physical inactivity tend to increase the risk of NCD. More than 150 million young people globally consume cigarettes, 84% and 78% of young women and men do not engage in physical activity, while 11.7% drink alcohol (Hauerslev & Allen, 2018). Furthermore, being overweight or obese during childhood and young adulthood significantly aggravate the risk of premature death and physical morbidities in later life, such as cardiovascular disease, asthma, and certain types of cancer (Akseer et al., 2020). The risk of NCD escalates with higher levels of cigarette and alcohol consumption, unhealthy diet, and lack of physical activity (Hauerslev & Allen, 2018; Motuma et al., 2022; Peters et al., 2019).

Indonesia is expected to face a demographic bonus between 2030-2040, characterized by a sharp increase in the productive age population. However, the current disease burden indicates potential barriers to productivity, particularly among the young adult group. Data on ten risk factors causing death and disability in

the country showed that a poor diet ranked first among all risk factors for NCD. The other risk factors include high blood pressure, elevated fasting blood sugar, tobacco, or smoking behavior, which indicate a risk for cardiovascular disease, and diabetes. Furthermore, malnutrition and high body mass index were ranked 5th and 6th, reflecting Indonesia's double burden of nutritional impact (Setyonaluri & Aninditya, 2019).

In the elderly or geriatric population, NCD morbidity has been well-studied, but investigations are limited in the young adult group. Meanwhile, the pattern of NCD morbidity may differ between the older age group and young adults (Malecki et al., 2020). A previous study using the data from Indonesia Family Life Survey Waves 4 and 5 examined the burden of NCD multimorbidity in the country (Marthias et al., 2021). Studies about NCD morbidity in other countries include Adegbite et al. (2022) in Gabon, Charalampous et al. (2022) in Europe and Khorrami et al. (2020) in Iran. However, none of these studies assessed the burden of NCD on young adults. This study aimed to examine the significance of NCD burden among the young adult age group. The findings will assist in the implementation of early prevention efforts, as well as contribute to a better understanding of the relationship between NCD and sociodemographic characteristics, nutritional status, and correlating risk factors. This knowledge will serve as the basis for developing programs adapted for the prevention and early detection efforts to minimize the morbidity of NCD among young adults.

## METHODS

This study used secondary data sourced from Riskesdas 2018 conducted by the National Institute of Health Research and Development (NIHRD), Indonesian Ministry of Health. Riskesdas 2018 employed a cross-sectional

design and the data was obtained from the management data laboratory of NIHRD, Ministry of Health. This study was carried out from April to May 2018 in 34 provinces, 416 districts, and 98 cities in Indonesia. Moreover, the respondents were households and individuals selected using a stratified multistage random sampling method. Ethical approval was received from the Health Research Ethics Committee, Health Research, and Development Agency Number: LB.02.01/2/KE.024/2018.

The target population was households with young adult members, while the sample consisted of individuals who were young adults during the implementation of Riskesdas 2018. The young adults were categorized from the age of 18-40 years (Hurlock, 1999; Lemme, 1995). This study involved 319,355 people in the 18-40 age group, but the number of respondents for certain variables might vary due to the data completeness, which was accounted for during the multivariate analysis.

NCD morbidity was utilized as the outcome variable, while sociodemographic characteristics, behavior factors, and nutritional status were used as independent variables. Data were collected through interviews with a well-trained enumerator. NCD morbidity data were obtained by asking the respondents about their doctor's diagnosis of asthma, cancer, diabetes mellitus, heart disease, hypertension, or kidney failure. The outcome variable was categorized into "Yes" if the respondent had a minimum of one NCD. Sociodemographic characteristics included variables such as age, sex, education, occupation, marital status, socioeconomic status, and residential area, while behavior factors were unhealthy foods and alcohol consumption, fruit and vegetables, smoking, as well as physical activity. Meanwhile, the nutritional status variables included Body Mass Index (BMI) and Waist Circumference (WC). Data on sociodemographic and behavioral factors

**Table 1**  
*Sociodemographic Characteristics and The Burden of NCD in Young Adult*

Variable	n	%
Sociodemographic characteristics		
Age in years (n=319,355)		
30-40	150,282	47.1
18-30	169,073	52.9
Sex (n=319,355)		
Female	159,096	49.8
Male	160,259	50.2
Education (n=319,355)		
Low	154,409	48.4
Middle	129,110	40.4
High	35,836	11.2
Occupation status (n=319,355)		
Unemployed	112,827	35.3
Employed	306,528	64.7
Marital status (n=319,355)		
Divorced	6,979	2.2
Married	211,867	66.3
Single	100,509	31.5
Socioeconomic status (n=282,221)		
Low	98,522	30.9
Medium	114,696	35.9
High	70,003	21.9
Residential area (n=319,355)		
Urban	181,272	56.8
Rural	138,083	43.2
NCD Burden		
Hypertension	7,370	2.3
Asthma	7,122	2.2
Heart disease	2,749	0.9
Diabetes mellitus	973	0.3
Kidney failure	668	0.2
Stroke	468	0.1
Cancer	419	0.1
NCD morbidity	17,476	5.8
NCD multimorbidity	1,200	0.4

Note: n= total respondents; %= percentage

were collected using interviews, while nutritional status variables' data were obtained through measurement. The variables obtained from the data management team were then categorized. BMI was categorized as higher if  $>22.9 \text{ kg/m}^2$ , while WC was considered higher if  $\geq 90$  cm for males and  $\geq 90$  for females.

Due to the complex sampling design employed by Riskesdas 2018, which involved stratification, it was necessary to account for the weight in the data analysis. A univariate analysis was conducted to provide an overview of the

sociodemographic characteristics and the burden of NCD morbidity. The data obtained were presented in terms of total amount (n) and percentage (%). For the bivariate analysis, a chi-squared test was used to examine the differences in NCD morbidity proportions based on the independent variables. Meanwhile, the multivariate analysis employed logistic regression to investigate factors associated with NCD morbidity in young adults. Variables included in the multivariate were those with a p-value of  $<0.25$  in the bivariate analysis. The significance level

**Table 2***NCD Morbidity Based on Sociodemographic Characteristics, Behavioral Risk Factors, and Nutritional Status*

Variables	NCD Morbidity				P-value
	Yes		No		
	n	%	n	%	
<b>Sociodemographic characteristics</b>					
Age in years (n=319,355)					
30-40	11,397	7.58	138,885	92.42	0.000*a
18-30	7,079	2.22	161,994	95.81	
Sex (n=319,355)					
Female	11,349	7.13	147,747	92.87	0.000*a
Male	7,128	4.45	153,131	95.55	
Education (n=319,355)					
Low	9,281	6.01	145,218	93.99	0.000*a
Middle	6,874	5.32	122,236	94.68	
High	2,321	6.48	33,515	93.52	
Occupation status (n=319,355)					
Unemployed	7,517	6.66	105,310	93.34	0.000*a
Employed	10,960	5.31	195,568	94.69	
Marital status (n=319,355)					
Divorced	477	6.83	6,502	93.17	0.000*a
Married	14,156	6.68	197,711	93.32	
Single	3,844	3.82	96,665	96.18	
Socioeconomic status (n=282,221)					
Low	5,372	5.45	93,150	94.55	0.000*a
Medium	6,757	5.89	107,939	94.11	
High	4,457	6.37	65,546	93.63	
Residential area (n=319,355)					
Urban	11,355	6.26	169,917	93.74	0.000*a
Rural	7,121	5.16	130,962	94.84	
<b>Behavioral Risk Factors</b>					
Consuming unhealthy foods (n=319,355)					
Everyday	61	5.52	1,044	94.48	0.000*a
Sometimes	8,555	5.58	144,661	94.42	
Rarely	9,842	5.97	154,952	94.03	
Never	18	7.50	222	92.50	
Consuming fruits and vegetables (n=319,355)					
Lacking	17,800	5.75	292,012	94.25	0.000*a
Enough	677	7.09	8,866	92.91	
Smoking (n=319,355)					
Yes, every day	4,263	4.32	94,307	95.68	0.000*a
Yes, not every day	1,432	5.73	23,579	94.27	
Never	12,781	6.53	182,993	93.47	
Physical activity (n=319,355)					
Lacking	3,487	5.38	61,294	94.62	0.000*a
Enough	14,989	5.89	239,584	94.11	
Alcohol consumption (n=319,355)					
Yes	821	5.14	15,143	94.86	0.000*a
No	17,665	5.82	285,736	94.18	
<b>Nutritional status</b>					
Body Mass Index (n=317,767)					
>22.9 kg/m <sup>2</sup>	11,616	7.36	146,259	92.64	0.000*a
≤22.9 kg/m <sup>2</sup>	6,784	4.24	153,108	95.76	
Waist circumference (319,355)					
Higher	2,972	12.04	21,716	87.96	0.000*a
Normal	15,504	5.26	279,163	94.74	

Note: \* = P-values < 0.05 will be considered significant; a = P-values < 0.25 will be included in the multivariate analysis  
n = total respondents; % = percentage

**Table 3**  
*Multivariate Analysis Factors Correlated to NCD Morbidity in Young Adult*

Variables	OR (95%CI)	P-value
Age in years		
30-40	1.62 (1.56-1.68)	0.000*
18-30	Ref	
Sex		
Female	1.28 (1.21-1.35)	0.000*
Male	Ref	
Education		
Low	0.93 (0.88-0.98)	0.010*
Middle	0.99 (0.94-1.05)	0.920
High	Ref	
Occupation status		
Unemployed	1.22 (1.17-1.26)	0.000*
Employed	Ref	
Marital status		
Divorced	1.19 (1.13-1.25)	0.000*
Married	1.26 (1.13-1.25)	0.000*
Single	Ref	
Socioeconomic status		
Low	0.95 (0.91-0.99)	0.010*
Medium	0.89 (0.85-0.93)	0.000*
High	Ref	
Residential area		
Urban	1.19 (1.15-1.23)	0.000*
Rural	Ref	
Consume fruits and vegetables		
Lacking	0.85 (0.78-0.93)	0.000*
Enough	Ref	
Smoking		
Every day	1.19 (1.10-1.27)	0.000*
Not every day	0.95 (0.89-1.00)	0.070
Never	Ref	
Alcohol consumption		
Yes	1.20 (1.10-1.30)	0.000*
No	Ref	
Body Mass Index		
>22.9 kg/m <sup>2</sup>	1.14 (1.09-1.19)	0.000*
≤22.9 kg/m <sup>2</sup>	Ref	
Waist circumference		
Higher	1.58 (1.52-1.65)	0.000*
Normal	Ref	

Note: \*= P-values < 0.05 will be considered significant; OR = Odds Ratio; CI = Confident Interval

was set at a p-value of less than 0.05 and a 95 % confidence interval (CI).

## RESULTS

Table 1 summarizes the sociodemographic characteristics and the burden of NCD morbidity in young adults. A total of 319,355 subjects in the 18-40 age group met the inclusion criteria for this study. The majority of the subjects were 18-30 years old (52.9%), males (50.2%), and

had a low education level (48.4%) with the highest level being elementary school. In terms of employment, the majority were employed (64.7%), had a medium level of socioeconomic status (35.9%), and resided in the urban area (56.8%).

Table 1 showed that the most common NCD suffered by the subject were hypertension (2.3%), and asthma (2.2%). Other NCD included heart disease (9%), diabetes mellitus (3%),

kidney failure (0.2%), stroke (1%), and cancer (1%). A total of 17,478 subjects (5.8%) had a minimum of one NCD indicating that six out of every 100 young adults in Indonesia had at least one NCD. The results also showed that about 4 out of every 100 young adults had more than one NCD or multimorbidity.

Table 2 shows the burden of NCD morbidity based on independent variables, including sociodemographic characteristics, behavioral risk factors, and nutritional status. The bivariate analysis results showed that all independent variables had a significant correlation with NCD morbidity ( $P$ -value $<0.05$ ). Consequently, all variables were included in the multivariate analysis to identify those that significantly correlated with NCD morbidity.

The multivariate analysis results in table 3 showed that 12 variables had a significant relationship with NCD morbidity. Sociodemographic factors with significant correlation included young adults 30-40 years old (OR=1.62, 95%CI:1.56-1.68), females (OR:1.28, 95% CI:1.21-1.35), unemployed (OR:1.22; 1.17-1.36), divorced and married (OR:1.19; 95% CI:1.13-1.25 and 1.26; 95%CI:1.13-1.25), and resided in an urban area (OR:1.19; 95%CI:1.15-1.23). Among these variables, two were protective factors, including low and medium socioeconomic status (OR:0.95; 95%CI:0.91-0.99 and OR:0.89; 95%CI:0.85-0.93) and low-level education (OR:0.93; 95%CI:0.88-0.98).

In terms of behavioral factors, alcohol consumption (OR:1.20; 95%CI:1.10-1.30) and smoking daily (OR:1.19;95%CI: 1.10-1.27) correlated significantly with NCD morbidity. However, consuming adequate amounts of fruit and vegetables were found to be a protective factor (OR:0.85; 95%CI:0.78-0.93). Nutritional status, including BMI  $>22.9$  kg/m<sup>2</sup> and higher waist circumference, significantly correlated with NCD morbidity (OR: 1.14; 95%CI:1.09-1.19 and OR:1.58; 95%CI:1.52-1.65), while

unhealthy food consumption and physical activity had no significant correlation.

## DISCUSSION

The prevalence of NCD morbidity and multimorbidity among young adult groups remains a significant problem in Indonesia. A systematic review in low-income and middle-income countries showed a large variation in the prevalence ranging from 0.7%–81.3% (Asogwa et al., 2022). The presence of hypertension at a young age increases the risk of cardiovascular disease in middle age. It also contributes to an earlier onset of coronary heart disease, heart failure, stroke, and transient ischemic attacks (Hinton et al., 2020).

According to previous studies, the causes and factors contributing to NCD are multifaceted. The positive association of multimorbidity with age and female sex was consistent with a systematic review and meta-analysis of articles reporting prevalence, determinants, and patterns of multimorbidity of NCD among adults aged  $>18$  years in Low Middle-Income Countries (LMICs). The results showed that the prevalence of multimorbidity increased with age, and higher odds of multimorbidity were found among women than men (Asogwa et al., 2022). Aging plays a dominant role in the pattern of chronic disease. Since these risk factors cannot be modified, individuals must find a way to balance these conditions as they age (Hui, 2017).

Another study also showed that NCD was more common in women (De-Wet-Billings & Frade, 2022). In Bangladesh, the prevalence of selected behavioral and clinical risk factors was higher among women than men (Mridha et al., 2019). This may be influenced by social customs associated with reduced physical mobility for women, leading to disparities in physical activity levels. Women also have a higher likelihood of obesity than men, which could

increase their vulnerability to NCD, particularly diabetes (Pan American Health Organization, 2022). However, another study conducted in Dubai showed a different result with the male group being more associated with NCD (Alnakhi et al., 2021).

Based on the results, higher education was associated with a higher likelihood of living with at least one NCD. This result was in line with a study conducted in Bangladesh which showed an increased tendency for young adults with higher education levels to suffer from one NCD (Rasul et al., 2019). This is because individuals with a higher education level tend to make lifestyle choices, including dietary preferences, based on considerations beyond health (Brennan et al., 2020; Effendi et al., 2022). In contrast, a study conducted in Columbia showed that low education among young adults increased their tendency to develop NCD compared to those with higher education (Camacho et al., 2020).

The results showed that unemployed young adults had a higher likelihood of NCD morbidity. This was in line with a study conducted in Korea, where unemployed people were considered to have a higher risk for NCD morbidity (Kwon et al., 2020) but a different study carried out in Nigeria presented contrasting findings. It showed that the prevalence of NCD morbidity among young respondents who were employed increased every year, specifically among office workers (Olawuyi & Adeoye, 2018). In contrast, the results indicated that the group with a higher economic level had a greater risk of NCD morbidity.

The increased risk among individuals with higher socioeconomic status can be attributed to potential lifestyle adjustments towards unhealthy lifestyle behaviors such as smoking, alcohol consumption, and eating junk food (Biswas et al., 2019). These behaviors may be influenced by increased access to infor-

mation and the use of media (Jung et al., 2022). Additionally, unemployed young adults may experience mental health problems due to pressure and stigma from their environment. When combined with unhealthy lifestyle factors such as smoking, poor diet, and the use of drugs, these conditions can trigger the emergence of NCD at a young age (Akseer et al., 2020).

Furthermore, married and divorced young adults showed a higher risk of NCD morbidity than unmarried. A study conducted on the Kenyan population found that married adults, particularly women, had a higher risk of NCD (Wekesah et al., 2018). Another study carried out in Nepal also stated that divorced women were more susceptible to NCD (Bista et al., 2020). Divorced individuals or those who have lost a partner have higher health risks. The quest for satisfaction in their lives could influence their health status. Furthermore, marital status satisfaction and social roles also affect health (Segawa et al., 2021). A study in Dubai reported that unmarried individuals were associated with NCD (Alnakhi et al., 2021).

Based on the results obtained, urban residents had a higher likelihood of having NCD morbidity. A study in South India showed that obesity prevalence was significantly higher among nurses in urban areas. This was attributed to unhealthy lifestyles, particularly lack of physical activity, vegetable and fruit consumption, and easy access to processed foods (Kayaroganam et al., 2022). Furthermore, a study in Myanmar showed that, on average, metabolic risk factors such as obesity and diabetes were significantly higher in urban compared to rural residents. The average BMI based on age, fasting blood sugar level, blood cholesterol level, triglycerides level, and high lipoprotein density were significantly worse in urban than rural areas (Htet et al., 2016).

In contrast to other studies, inadequate consumption of fruit and vegetables was unexpect-



edly found as a protective factor for NCD morbidity. According to previous studies, inadequate consumption of fruit and vegetables increased the risk for NCD (Kaur & Aeri, 2019; Wang et al., 2021). This study was conducted using a cross-sectional design, meaning that the consumption of fruits and vegetables as well as NCD morbidity were not assessed simultaneously. Most individuals with NCD morbidity lacked fruit and vegetable consumption in the past and made dietary improvements to prevent their NCD from worsening. This study did not find a significant relationship between the consumption of unhealthy foods, low physical activity, and NCD morbidity. This could be attributed to the behavior improvement observed in people diagnosed with NCD.

This study also proved that young adults who smoke had a greater risk for NCD morbidity. The result was in line with a study conducted in India (Joshi et al., 2021; Mishra et al., 2022) wherein tobacco use was higher in NCD patients in the clinic. Increasing age was also associated with a higher chance of having severe complications (Bhatt et al., 2021). Cigarette smoke contains various complex chemical components, hence, it contributes to multiple and highly variable effects on public health. Various references showed the side effects of smoking on different body organs, leading to the development of multiple types of cancer, chronic obstructive airway disease, and cardiovascular disease (Ayodapo & Ibisola, 2021).

Furthermore, alcohol consumption was found to be associated with an increased risk for NCD morbidity. Previous studies in Ethiopia and India proved that people who consumed alcohol had a higher chance of NCD (Demilew & Firew, 2019; Mishra et al., 2022). According to the World Health Organization (WHO), alcohol consumption contributed to 1.7 million deaths caused by NCD in 2016. In

particular, the risk of heart disease, hypertension, hemorrhagic stroke, and other nonischemic outcomes tends to increase due to the quantity and alcohol consumption patterns in society (World Health Organization, 2018). Alcohol contributed to increased triglyceride levels in the body, which caused a decrease in insulin sensitivity (Demilew & Firew, 2019).

Central obesity, a commonly observed cardiometabolic risk factor, significantly increased the likelihood of developing NCD. Based on the results, high BMI and WC escalated the risk of NCD morbidity in young adults. A study carried out in India in 2021 showed that people with obesity were 2.3 times more likely to have NCD multimorbidity, while a high WC was associated with a 2.1 higher risk (Bramhankar et al., 2021). Moreover, a cohort study conducted in Poland reported that participants with obesity had 2.5-fold higher odds for diabetes and hypertension, as well as a two-fold increased risk for CHD than non-obese individuals (Zatońska et al., 2021).

Central adiposity was linked to the increased risk of NCD, as excess adipose tissues contributed an elevation in the release of pro-inflammatory cytokines, leading to a higher risk of CVDs. Furthermore, it escalated the risk of insulin resistance, hyper-insulinemia, and glucose intolerance. Visceral obesity tends to also enhance cardiac output with the continuous release of adipokines and cytokines into the bloodstream, leading to hypertension and other related heart problems. High amounts of free fatty acid can sensitize oncogenic signals and act as fuel for cancer cells promoting tumor cell growth. Increased energy intake and excretory load in abdominal obesity may cause severe kidney damage (Dhawan & Sharma, 2020).

Understanding the burden of NCD in young adults is essential to control and reduce its prevalence. A more effective approach in-

volves targeting modifiable risk factors specific to the type of NCD, as well as closely monitoring progress, trends, and associated risks. This will enable individuals diagnosed with one NCD to prevent further disease progression (De-Wet-Billings & Frade, 2022). By identifying the high-risk group and the risk factors, targeted prevention strategies can be implemented, particularly among young adults.

## CONCLUSIONS

Based on the results, the young age group in Indonesia is plagued with the problem of NCD with some having a burden of more than 2 cases. Various sociodemographic factors including older age, women, unemployed, higher educational and socioeconomic status, married and divorced, as well as living in an urban area, play a role in NCD morbidity among young adults. Unhealthy behavior such as alcohol consumption and smoking as well as higher waist circumference and BMI also increased the risk for NCD morbidity. However, this study had certain limitations, particularly due to its use of cross-sectional data, which prevented the establishment of a causal association between risk factors and NCD morbidity. Future studies are recommended to employ case-cohort or cohort design to better elucidate the causality between the risk factors and NCD. This study further provides information about the burden of NCD morbidity among young adults in Indonesia and the correlating factors.

Addressing the burden of NCD morbidity among young adults is imperative, as these individuals are considered to be in their productive years. The presence of NCD in young adulthood will impact the quality of life in old age, or even result in premature mortality among the younger generation. Preventive efforts aimed at reducing the prevalence of NCD should prioritize high-risk groups within the young adult population. Furthermore, existing

programs, such as the NCD Integrated Development Post, must be strengthened. Health promotion efforts targeting this group also need to be intensified, such as a healthy lifestyle campaign.

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## AUTHORS' CONTRIBUTIONS

Ika Puspita Asturiningtyas, SKM, MPH, is an Epidemiologist in the Magelang Unit for Health Research and Development, Ministry of Health, Indonesia. Hadi Ashar, SKM, MPH, and Sidiq Purwoko, M. Kes are researchers at Research Centre for Public Health and Nutrition, National Research and Innovation Agency, Jakarta, Indonesia. Nissa Noor Annashr, SKM, MKM, is a lecturer in the Department of Public Health, Faculty of Health Science, Universitas Siliwangi, Tasikmalaya, Indonesia.

## AUTHORS' INFORMATION

Ika Puspita Asturiningtyas, SKM, MPH, is an Epidemiologist in the Magelang Unit for Health Research and Development, Ministry of Health, Indonesia. Hadi Ashar, SKM, MPH, and Sidiq Purwoko, M. Kes are researchers at Research Centre for Public Health and Nutrition, National Research and Innovation Agency, Jakarta, Indonesia. Nissa Noor Annashr, SKM, MKM, is a lecturer in the Department of Public Health, Faculty of Health Science, Universitas Siliwangi, Tasikmalaya, Indonesia.

## COMPETING INTERESTS

The authors confirm that all of the text, figures, and tables in the submitted manuscript work are original work created by the authors and that there are no competing professional, financial, or personal interests from other parties.

## REFERENCES

- Adegbite, B. R., Edoa, J. R., Agbo Achimi Abdul, J. B. P., Epola, M., Mevyann, C., Dejon-Agobé, J. C., Zinsou, J. F., Honkpehedji, Y. J., Mpagama, S. G., Alabi, A. S., Kremsner, P. G., Klipstein-Grobusch, K., Adegnika, A. A., & Grobusch, M. P. (2022). Non-communicable disease co-morbidity and associated factors in tuberculosis patients: A cross-sectional study in Gabon. *EClinicalMedicine*, 45, 101316. <https://doi.org/10.1016/j.eclinm.2022.101316>
- Akseer, N., Mehta, S., Wigle, J., Chera, R., Brickman, Z. J., Al-Gashm, S., Sorichetti, B., Vandermorris, A., Hipgrave, D. B., Schwalbe, N., & Bhutta, Z. A. (2020). Non-communicable diseases among adolescents: current status, determinants, interventions and policies. *BMC Public Health*, 20(1), 1–20. <https://doi.org/10.1186/s12889-020-09988-5>

- Alnakhi, W. K., Mamdouh, H., Hussain, H. Y., Ibrahim, G. M., Ahmad, A. S., Ali, R., & Abdulle, A. (2021). The socio-demographic characteristics associated with non-communicable diseases among the adult population of dubai: Results from dubai household survey 2019. *Healthcare (Switzerland)*, *9*(9). <https://doi.org/10.3390/healthcare9091139>
- Asogwa, O. A., Boateng, D., Marzà-Florensa, A., Peters, S., Levitt, N., Van Olmen, J., & Klipstein-Grobusch, K. (2022). Multimorbidity of non-communicable diseases in low-income and middle-income countries: a systematic review and meta-analysis. *BMJ Open*, *12*(1), e049133. <https://doi.org/10.1136/BMJOPEN-2021-049133>
- Ayodapo, A., & Ibisola, B. (2021). Smoking and Non-Communicable Diseases in Sub-Saharan Africa: The Nigeria Scenario. In *Lifestyle and Epidemiology - Poverty and Cardiovascular Diseases a Double Burden in African Populations [Working Title]*. IntechOpen. <https://doi.org/10.5772/intechopen.96693>
- Bhatt, G., Goel, S., Grover, S., Kaur, N., & Singh, S. (2021). A cross sectional study to assess tobacco use and its correlates among patients attending non-communicable disease clinics of a Northern Jurisdiction in India Garima. *Journal of Family Medicine and Primary Care*, *10*(8), 2915–2922. <https://doi.org/10.4103/jfmpe.jfmpe>
- Bista, B., Dhungana, R. R., Chalise, B., & Pandey, A. R. (2020). Prevalence and determinants of noncommunicable diseases risk factors among reproductive aged women of Nepal: Results from Nepal demographic Health Survey 2016. *PLoS ONE*, *15*(3), 1–13. <https://doi.org/10.1371/journal.pone.0218840>
- Biswas, T., Townsend, N., Islam, M. S., Islam, M. R., Das Gupta, R., Das, S. K., & Mamun, A. Al. (2019). Association between socioeconomic status and prevalence of non-communicable diseases risk factors and comorbidities in Bangladesh: findings from a nationwide cross-sectional survey. *BMJ Open*, *9*(3), e025538. <https://doi.org/10.1136/bmjopen-2018-025538>
- Bonnie, R., Brindis, C., Carrion, G., Courtney, M., Crosnose, Ro., Davis, M., Harris, K. M., Holzer, H., Irwin, C., Luna, B., Murry, V. M., Papacharissi, Z., Schulenberg, J., Sepulveda, M., Viswanath, K., & Walker, L. (2015). Young Adults and Public Health. In *Institute of Medicine and National Research Council of The National Academies*. [https://nap.nationalacademies.org/resource/18869/YAs\\_Public\\_Health\\_Brief.pdf](https://nap.nationalacademies.org/resource/18869/YAs_Public_Health_Brief.pdf)
- Bramhankar, M., Pandey, M., Rana, G. S., Rai, B., Mishra, N. L., & Shukla, A. (2021). An assessment of anthropometric indices and its association with NCDs among the older adults of India: evidence from LASI Wave-1. *BMC Public Health*, *21*(1), 1–13. <https://doi.org/10.1186/s12889-021-11421-4>
- Brennan, L., Klassen, K., Weng, E., Chin, S., Molenaar, A., Reid, M., Truby, H., & McCaffrey, T. A. (2020). A social marketing perspective of young adults' concepts of eating for health: is it a question of morality? *International Journal of Behavioral Nutrition and Physical Activity*, *17*(1), 44. <https://doi.org/10.1186/s12966-020-00946-3>
- Camacho, P. A., Gomez-Arbelaiz, D., Otero, J., González-Gómez, S., Molina, D. I., Sanchez, G., Arcos, E., Narvaez, C., García, H., Pérez, M., Hernandez-Triana, E., Duran, M., Cure, C., Sotomayor, A., Rico, A., Cotes, F., Rangarajan, S., Yusuf, S., & López-Jaramillo, P. (2020). Self-Reported Prevalence of Chronic Non-Communicable Diseases in Relation to Socioeconomic and Educational Factors in Colombia: A Community-Based Study in 11 Departments. *Global Heart*, *15*(1). <https://doi.org/10.5334/gh.792>
- Charalampous, P., Gorasso, V., Plass, D., Pires, S. M., Von Der Lippe, E., Mereke, A., Idavain, J., Kissimova-Skarbek, K., Morgado, J. N., Ngwa, C. H., Noguier, I., Padron-Monedero, A., Santi-Cano, M. J., Sarmiento, R., Devleeschauwer, B., Haagsma, J. A., Ádám, B., Alkerwi, A., Bikbov, B., & Wyper, G. M. A. (2022). Burden of non-communicable disease studies in Europe: a systematic review of data sources and methodological choices. *European Journal of Public Health*, *32*(2), 289–296. <https://doi.org/10.1093/EURPUB/CKAB218>
- De-Wet-Billings, N., & Frade, S. (2022). Non Communicable Disease Comorbidities (NCDs) Among Youth in South Africa: The Causal Contribution of Not Being in School or Work and Other Socioeconomic Characteristics. *Journal of Public Health*, *30*, 1205–1212. <https://doi.org/https://doi.org/10.1007/s10389-020-01398-6>
- Demilew, Y. M., & Firew, B. S. (2019). Factors associated with noncommunicable disease among adults in Mecha district, Ethiopia: A case control study. *PLoS ONE*, *14*(5), 1–13. <https://doi.org/10.1371/journal.pone.0216446>
- Dhawan, D., & Sharma, S. (2020). Abdominal Obesity, Adipokines and Non-communicable Diseases. *The Journal of Steroid Biochemistry and Molecular Biology*, *203*, 105737. <https://doi.org/10.1016/j.jsbmb.2020.105737>
- Effendi, D. E., Nugroho, A. P., Handayani, S., Novita, R., Purwoko, S., & Agustina, Z. A. (2022). Tobacco Consumption Among Young Population in Rural Indonesia: Prevalence and Associated Factors. *Open Access Macedonian Journal of Medical Sciences*, *10*(E), 1178–1183. <https://doi.org/10.3889/oamjms.2022.10011>
- Hauerslev, M., & Allen, L. (2018). Young people and noncommunicable diseases - vulnerable to disease, vital for change. *International Journal of Noncommunicable Disease*, *3*, 45–48. <https://doi.org/10.4103/jncd.jncd>
- Hinton, T. C., Adams, Z. H., Baker, R. P., Hope, K. A., Paton, J. F. R., Hart, E. C., & Nightingale, A. K. (2020). Investigation and treatment of high blood pressure in young people: too much medicine or appropriate risk reduction? *Hypertension*, *75*(1), 16–22. <https://doi.org/10.1161/HYPERTENSIONAHA.119.13820>
- Htet, A. S., Bjertness, M. B., Sherpa, L. Y., Kjøllesdal, M. K., Oo, W. M., Meyer, H. E., Stigum, H., & Bjertness, E. (2016). Urban-rural differences in the prevalence of non-communicable diseases risk factors among 25-74 years old citizens in Yangon Region, Myanmar: A cross sectional study. *BMC Public Health*, *16*(1), 1–12. <https://doi.org/10.1186/s12889-016-3882-3>
- Hui, L. (2017). Assessment of the role of ageing and non-ageing factors in death from non-communicable diseases based on a cumulative frequency model. *Scientific Reports 2017 7:1*, *7*(1), 1–7. <https://doi.org/10.1038/s41598-017-08539-0>
- Hurllock, E. B. (1999). *Developmental Psychology: A life Span Approach* (5th ed.). McGraw-Hill.
- Joshi, V., Joshi, N. K., Suthar, P., & Jain, Y. K. (2021). Non-communicable diseases risk factors among government school teachers in Jodhpur, Rajasthan. *International Journal of Public Health Science*, *10*(4), 920–926. <https://doi.org/10.11591/IJPHS.V10I4.20895>
- Jung, S. O., Son, Y. H., & Choi, E. (2022). E-health literacy in older adults: an evolutionary concept analysis. *BMC Medical Informatics and Decision Making*, *22*(1), 28. <https://doi.org/10.1186/s12911-022-01761-5>
- Kaur, H., & Aeri, B. T. (2019). Protective impact of Fruits and

- vegetable intake on cardiovascular risk factors-a review. *Journal of Clinical and Diagnostic Research*, 13(5), 6–9. <https://doi.org/10.7860/jcdr/2019/41330.12884>
- Kayaroganam, R., Sarkar, S., Satheesh, S., Tamilmani, S., Sivanantham, P., & Kar, S. S. (2022). Profile of noncommunicable Disease Risk Factors Among Nurses in a Tertiary Care Hospital in South India. *Asian Nursing Research*, August, 1–8. <https://doi.org/10.1016/j.anr.2022.07.001>
- Kementerian Kesehatan Republik Indonesia. (2019). *Laporan Nasional Risesdas 2018*. Penerbit Balitbangkes.
- Khorrami, Z., Rezapour, M., Etemad, K., Yarahmadi, S., Khodakarim, S., Mahdavi Hezaveh, A., Kameli, M., & Khanjani, N. (2020). The patterns of Non-communicable disease Multimorbidity in Iran: A Multilevel Analysis. *Scientific Reports 2020 10:1*, 10(1), 1–11. <https://doi.org/10.1038/s41598-020-59668-y>
- Kwon, S. H., Myong, J.-P., Kim, H.-A., & Kim, K. Y. (2020). Association between morbidity of non-communicable disease and employment status: a comparison between Korea and the United States. *BMC Public Health*, 20(1), 763. <https://doi.org/10.1186/s12889-020-08883-3>
- Letme, B. (1995). *Development in adulthood* (2nd ed.). McGraw-Hill.
- Malecki, S. L., Van Mil, S., Graffi, J., Breetvelt, E., Corral, M., Boot, E., Chow, E. W. C., Sanches, M., Verma, A. A., & Bassett, A. S. (2020). A genetic model for multimorbidity in young adults. *Genetics in Medicine*, 22(1), 132–141. <https://doi.org/10.1038/s41436-019-0603-1>
- Marthias, T., Anindya, K., Ng, N., McPake, B., Atun, R., Arfyananto, H., Hulse, E. S. G., Zhao, Y., Jusril, H., Pan, T., Ishida, M., & Lee, J. T. (2021). Impact of non-communicable disease multimorbidity on health service use, catastrophic health expenditure and productivity loss in Indonesia: A population-based panel data analysis study. *BMJ Open*, 11(2), 1–13. <https://doi.org/10.1136/bmjopen-2020-041870>
- Mishra, V. K., Srivastava, S., Muhammad, T., & Murthy, P. V. (2022). Relationship between tobacco use, alcohol consumption and non-communicable diseases among women in India: evidence from National Family Health Survey-2015-16. *BMC Public Health*, 22(1), 1–12. <https://doi.org/10.1186/s12889-022-13191-z>
- Motuma, A., Regassa, L. D., Gobena, T., Roba, K. T., Berhane, Y., & Worku, A. (2022). Almost all working adults have at least one risk factor for non-communicable diseases: Survey of working adults in Eastern Ethiopia. *PLOS ONE*, 17(2), e0264698. <https://doi.org/10.1371/JOURNAL.PONE.0264698>
- Mridha, M., Hasan, M., Khan, S., Hossain, M., & Sutradhar, I. (2019). Women are more vulnerable to non-communicable diseases in rural and urban Bangladesh. *Current Developments in Nutrition*, 3(Supplement\_1). <https://doi.org/10.1093/cdn/nzz039.p18-082-19>
- Olawuyi, A. T., & Adeoye, I. A. (2018). The prevalence and associated factors of non-communicable disease risk factors among civil servants in Ibadan, Nigeria. *PLOS ONE*, 13(9), e0203587. <https://doi.org/10.1371/journal.pone.0203587>
- Pan American Health Organization. (2022). *Non-communicable diseases and gender*. Pan American Health Organization. <https://www.paho.org/hq/dmdocuments/2011/gdr-ncd-gender-factsheet-final.pdf>
- Peters, R., Ee, N., Peters, J., Beckett, N., Booth, A., Rockwood, K., & Anstey, K. J. (2019). Common risk factors for major noncommunicable disease, a systematic overview of reviews and commentary: the implied potential for targeted riskreduction. *Therapeutic Advances in Chronic Disease*, 10. <https://doi.org/10.1177/2040622319880392>
- Rasul, F. B., Kalmus, O., Sarker, M., Adib, H. I., Hossain, M. S., Hasan, M. Z., Brenner, S., Nazneen, S., Islam, M. N., & De Allegri, M. (2019). Determinants of health seeking behavior for chronic non-communicable diseases and related out-of-pocket expenditure: results from a cross-sectional survey in northern Bangladesh. *Journal of Health, Population and Nutrition*, 38(1), 48. <https://doi.org/10.1186/s41043-019-0195-z>
- Segawa, H. K., Uematsu, H., Dorji, N., Wangdi, U., Dorjee, C., Yangchen, P., Kunisawa, S., Sakamoto, R., & Imanaka, Y. (2021). Gender with marital status, cultural differences, and vulnerability to hypertension: Findings from the national survey for noncommunicable disease risk factors and mental health using WHO STEPS in Bhutan. *PLOS ONE*, 16(8), e0256811. <https://doi.org/10.1371/JOURNAL.PONE.0256811>
- Setyonaluri, D., & Aninditya, F. (2019). *Transisi Demografi dan Epidemiologi: Permintaan Pelayanan Kesehatan di Indonesia*. In Badan Perencanaan dan Pembangunan Nasional.
- Wang, D. D., Li, Y., Bhupathiraju, S. N., Rosner, B. A., Sun, Q., Giovannucci, E. L., Rimm, E. B., Manson, J. A. E., Willett, W. C., Stampfer, M. J., & Hu, F. B. (2021). Fruit and vegetable intake and mortality. *Circulation*, 143(17), 1642–1654. <https://doi.org/10.1161/CIRCULATIONAHA.120.048996>
- Wekesah, F. M., Nyanjau, L., Kibachio, J., Mutua, M. K., Mohamed, S. F., Grobbee, D. E., Klipstein-Grobusch, K., Ngaruiya, C., Haregu, T. N., Asiki, G., & Kyobutungi, C. K. (2018). Individual and household level factors associated with presence of multiple non-communicable disease risk factors in Kenyan adults. *BMC Public Health*, 18 (Suppl 3). <https://doi.org/10.1186/s12889-018-6055-8>
- World Health Organization. (2018). *Global Status Report on Alcohol and Health 2018*. WHO.
- World Health Organization. (2021). *Noncommunicable diseases*. <https://www.who.int/news-room/fact-sheets/detail/noncommunicable-diseases>
- Zatońska, K., Psikus, P., Basiak-Rasala, A., Stepnicka, Z., Gaweł-Dabrowska, D., Wołyniec, M., Gibka, J., Szuba, A., & Poltyn-Zaradna, K. (2021). Obesity and Chosen Non-Communicable Diseases in PURE Poland Cohort Study. *International Journal of Environmental Research and Public Health*, 18(5), 1–10. <https://doi.org/10.3390/IJERPH18052701>