PANAKEIA 2 (2) 2025

PANAKEIA JOURNAL OF EPIDEMIOLOGY

https://e-journals2.unmul.ac.id/

Non-Communicable Disease Risk Factors Across Age Groups in Urban Indonesia: A STEPS-Based Study

Muh. Amri Arfandi[1]✉, Muhamad Zakki Saefurrohim[1], Arlina Azka[1], Irfansyah Baharuddin Pakki[1], Siswanto[1], Risva[1], Akhmad Azmiardi[1]

[1]Epidemiology, Faculty of Public Health, Mulawarman University, Samarinda, Indonesia

Article Info

Article History:
Submitted 15-12-2025
Revised 17-12-2025
Accepted 19-12-2025

Kata Kunci: Penyakit tidak menular; remaja; dewasa muda; faktor risiko; STEPS

Keywords: *Non-communicable diseases; adolescents; young adults; risk factors; STEPS*

Abstrak

Penyakit tidak menular (PTM) merupakan masalah kesehatan masyarakat utama, dengan faktor risiko yang semakin banyak diamati pada populasi yang lebih muda. Untuk mendeskripsikan dan membandingkan faktor risiko PTM perilaku dan biologis di antara remaja (15–19 tahun), dewasa muda (20–24 tahun), dan dewasa (25–59 tahun) di Samarinda, Indonesia. Studi cross-sectional dilakukan pada 242 responden menggunakan kuesioner WHO STEPS, mencakup faktor perilaku (tembakau, alkohol, aktivitas fisik, diet) dan faktor biologis (IMT, tekanan darah, glukosa darah, kolesterol). Merokok paling tinggi pada dewasa muda (22,2%) dibandingkan remaja (9,3%) dan dewasa (17,7%). Remaja melaporkan penggunaan alkohol yang relatif lebih tinggi (12,4%). Dewasa muda menunjukkan perilaku sedentari lebih banyak (40%). Konsumsi buah tidak memadai di semua kelompok. Prevalensi kelebihan berat badan/obesitas meningkat seiring usia: remaja (19,4%), dewasa muda (24,4%), dewasa (54,4%). Dewasa menunjukkan hipertensi lebih tinggi (44,1%) dan kolesterol tinggi (35,3%). Risiko perilaku muncul selama masa remaja, sementara risiko biologis terakumulasi seiring usia. Pencegahan dini yang menargetkan anak muda melalui edukasi berbasis komunitas dan pemantauan kesehatan sangat penting.

Abstract

Non-communicable diseases (NCDs) are a major public health concern, with risk factors increasingly observed among younger populations. To describe and compare behavioral and biological NCD risk factors among adolescents (15–19 years), young adults (20–24 years), and adults (25–59 years) in Samarinda, Indonesia. A cross-sectional study was conducted among 242 respondents using the WHO STEPS questionnaire, covering behavioral factors (tobacco, alcohol, physical activity, diet) and biological factors (BMI, blood pressure, blood glucose, cholesterol). Smoking was highest among young adults (22.2%) versus adolescents (9.3%) and adults (17.7%). Adolescents reported relatively higher alcohol use (12.4%). Young adults showed more sedentary behavior (40%). Fruit consumption was inadequate across all groups. Overweight/obesity prevalence increased with age: adolescents (19.4%), young adults (24.4%), adults (54.4%). Adults showed higher hypertension (44.1%) and high cholesterol (35.3%). Behavioral risks emerge during adolescence, while biological risks accumulate with age. Early prevention targeting youth through community-based education and health monitoring is essential.

Alamat korespondensi:
Jl. Sambaliung, Gn. Kelua, Kec. Samarinda Utara,
Kota Samarinda, Kalimantan Timur 75119

eISSN : 3089 – 7262

INTRODUCTION

Non-communicable diseases (NCDs) represent one of the most pressing global health challenges of the 21st century, accounting for approximately 74% of all deaths worldwide (Biswas et al., 2022). In Indonesia, NCDs have emerged as the leading cause of mortality and morbidity, contributing to significant economic burden and reduced quality of life among affected populations (Schröders et al., 2017). The traditional perception of NCDs as diseases of older adults has been challenged by mounting evidence demonstrating that risk factors for these conditions frequently emerge during adolescence and young adulthood, with potentially serious consequences extending into later life (Patton et al., 2016).

Adolescence, defined by the World Health Organization as the period between 10 and 19 years of age, represents a critical developmental window during which many health-related behaviors are established (WHO, 2024). Approximately 70% of premature deaths among adults stem from health-related behaviors that originate during childhood and adolescence (UNICEF, 2024). The transition from adolescence through young adulthood into mature adulthood is characterized by increasing autonomy, shifting social contexts, and evolving lifestyle patterns that collectively shape long-term health trajectories (Biswas et al., 2022). Understanding how NCD risk factors manifest and evolve across these developmental stages is essential for designing targeted interventions that can effectively prevent disease onset and progression.

The Asia-Pacific region, which accounts for nearly 60% of the world's young population aged 15–24 years, has experienced rapid socioeconomic transitions accompanied by dramatic shifts in lifestyle patterns (Liu et al., 2022). Indonesia, as the fourth most populous country globally and the largest economy in Southeast Asia, exemplifies these transitions. Rapid urbanization, increased mechanization, widespread adoption of digital technologies, and shifts in dietary patterns have collectively contributed to an obesogenic environment that facilitates the development and maintenance of unhealthy behaviors (Schröders et al., 2017). Data from the Indonesian Ministry of Health indicate rising prevalence of multiple NCD risk factors, yet comprehensive understanding of how these risks differ across age groups remains limited, particularly at the local level (Chadijah et al., 2023).

Physical inactivity has been identified as the third leading cause of death globally, with Asia-Pacific countries showing particularly concerning trends (Strain et al., 2024). Evidence suggests that more than 80% of adolescents worldwide are insufficiently physically active to safeguard their health (Guthold et al., 2020). Simultaneously, sedentary behavior—characterized by prolonged periods of low-energy expenditure activities such as screen time—has increased

dramatically across all age groups, with screen-based activities now constituting the primary form of sedentary behavior in many Asian populations (Annear et al., 2022). These behavioral patterns, combined with dietary shifts toward increased consumption of processed foods and sugar-sweetened beverages, create a potent combination of risk factors that predispose individuals to obesity, diabetes, cardiovascular diseases, and other NCDs (Tham et al., 2023).

The WHO STEPwise approach to NCD risk factor surveillance (STEPS) provides a standardized, evidence-based framework for collecting, analyzing, and disseminating data on key NCD risk factors (WHO, 2024). The STEPS methodology encompasses three sequential levels of risk factor assessment: behavioral risk factors (Step 1), physical measurements (Step 2), and biochemical measurements (Step 3). This comprehensive approach enables systematic comparison of NCD risk factor profiles both within and across populations, facilitating evidence-based policy development and program planning (Riley et al., 2016). Multiple countries in Southeast Asia, including Malaysia, Thailand, and Indonesia, have adopted the STEPS approach to inform their national NCD prevention and control strategies (Ghani et al., 2024).

Despite growing recognition of the importance of addressing NCDs among younger populations, most existing surveillance systems and prevention programs in Indonesia primarily target adults (Chadijah et al., 2023). The Indonesian Ministry of Health's current action plan for the directorate for prevention and disease control includes only one NCD target that encompasses adolescents: early detection screening for NCD risks among people aged 15 and above. This limited focus on younger age groups represents a significant gap in national NCD prevention efforts, as interventions implemented during adolescence and young adulthood offer the greatest potential for preventing the establishment of unhealthy behavioral patterns and mitigating the lifetime accumulation of biological risk factors (Patton et al., 2016).

Samarinda, the capital city of East Kalimantan province, presents a unique context for examining NCD risk factors across age groups. As a rapidly developing urban center experiencing significant socioeconomic transformation, Samarinda exemplifies the challenges faced by many Indonesian cities in balancing economic development with population health protection. The city's diverse population, ranging from traditional communities to urbanized professionals, provides an opportunity to examine how NCD risk factors manifest across different age groups within a dynamic urban environment.

This study aims to describe and compare behavioral and biological NCD risk factors among three distinct age groups—older adolescents (15–19 years), young adults (20–24 years), and adults (25–59 years). By examining how risk factor profiles differ across developmental stages, this research seeks to identify critical windows for

intervention and inform the development of age-appropriate prevention strategies. The findings from this study will contribute to the growing evidence base on NCD epidemiology among younger populations in Indonesia and provide actionable insights for public health practitioners, policymakers, and healthcare providers working to address the rising burden of NCDs in urban Indonesian settings.

METHOD

This descriptive cross-sectional study was conducted in Samarinda, East Kalimantan, Indonesia, between August-September 2025. The study employed a household-based approach to capture community-level patterns of NCD risk factors across different age groups. A total of 242 respondents were included in the final analysis, distributed across the three age groups older adolescents (15–19 years), young adults (20–24 years), and adults (25–59 years) residing in Samarinda. A convenience sampling method was utilized in this study due to the lack of a reliable sampling frame and uncertainty regarding the precise population size of the target age groups in Samarinda. Eligible respondents were recruited from accessible households based on their availability and willingness to participate.

Data were collected using the WHO STEPwise approach to NCD risk factor surveillance (STEPS) questionnaire, which has been validated and widely implemented across multiple countries and cultural contexts (WHO, 2024). The STEPS instrument provides a standardized framework for collecting information on behavioral and biological risk factors through three progressive levels of data collection. Data collection was conducted by trained field enumerators who had received comprehensive training on STEPS methodology, interview techniques and anthropometry. All collected data were entered into a secure electronic database using Kobotoolbox.

Data analysis was performed using STATA version 17.0. The primary analytical approach involved descriptive comparison of risk factor prevalence across age groups. Cross-tabulations were used to examine the distribution of risk factors by age group and sex. Given the descriptive nature of the study, formal statistical testing for differences between groups was not conducted, with emphasis placed on describing patterns and magnitude of differences across age categories.

RESULT AND DISCUSSION

A total of 242 respondents participated in this study, comprising three age groups: older adolescents aged 15-19 years (53.31%), young adults aged 20-24 years (18.60%), and adults aged 25-59 years (28.10%). The majority of participants were female (69.42%). In terms of educational attainment, most respondents (83.06%) had completed basic education (elementary through senior high school), while 16.11% had achieved higher education and 0.83% had no formal schooling. The ethnic composition reflected Samarinda's diversity, with Javanese as the largest

group (37.60%), followed by Bugis (15.70%), Banjar (13.22%), Kutai (8.26%), Dayak (7.02%), and others (18.18%). Regarding occupation, the majority were students (64.88%), followed by unemployed/homemakers (12.40%), private sector employees (11.57%), self-employed individuals (7.85%), and government employees/civil servants (3.31%).

Table 1. Demographic Characteristics of Study Participants

Respondent Characteristic	n	%
Age Group		
Older Adolescents (15-19 years)	129	53.3
Young Adults (20-24 years)	45	18.6
Adults (25-59 years)	68	28.1
Sex		
Female	168	69.42
Male	74	30.58
Education Level		
Not attended school	2	0.83
Basic education (Primary-Highschool)	201	83.06
Higher education (Diploma/Bachelor/Master)	39	16.11
Ethnicity		
Dayak	17	7.02
Banjar	32	13.22
Kutai	20	8.26
Bugis	38	15.7
Jawa	91	37.6
Others	44	18.18
Occupation		
Student (School/University)	157	64.88
Government Employee/Civil Servant	8	3.31
Private sector employee	28	11.57
Self-employed	19	7.85
Unemployed/Homemaker	30	12.4

Patterns of tobacco use varied substantially across age groups, with young adults demonstrating the highest prevalence of current smoking at 22.2%, compared to 9.3% among adolescents and 17.7% among adults. This pattern suggests that smoking initiation and escalation occurs predominantly during the transition from adolescence to young adulthood, with some attenuation in prevalence among older adults potentially reflecting cessation efforts or survivor effects. Alcohol consumption patterns showed a somewhat different trajectory than tobacco use. Although overall alcohol consumption was low across all age groups, adolescents reported the relatively highest prevalence at 12.4%, compared to lower rates in young adults and adults. This finding may reflect experimental alcohol use during adolescence, often occurring

in social contexts such as peer gatherings or family celebrations. Physical activity levels showed generally comparable patterns across age groups, though young adults reported slightly higher levels of sedentary behavior, with 40% engaging in high sedentary time (defined as more than 6 hours per day of sitting or reclining).

Dietary patterns revealed concerning uniformity across age groups, with most respondents reporting consumption of fruits on fewer than four days per week. This finding indicates inadequate fruit intake across the entire age spectrum studied, suggesting that poor dietary habits are established early and persist throughout adulthood. The low frequency of fruit consumption may reflect factors such as limited availability, high cost relative to processed alternatives, lack of knowledge about nutritional recommendations, and taste preferences shaped by ubiquitous marketing of processed foods. Patterns of vegetable consumption and other dietary indicators showed similar trends, though detailed data on specific food groups would provide additional insight into nutritional adequacy. The widespread nature of poor dietary habits across age groups underscores the need for comprehensive nutrition education and environmental interventions to improve access to and consumption of nutritious foods.

Body mass index patterns demonstrated a clear age-related gradient, with the proportion of overweight and obesity substantially greater among adults (54.4%) compared to young adults (24.4%) and adolescents (19.4%). This progressive increase in weight status with age reflects the cumulative effects of energy imbalance over time, influenced by behavioral factors (physical inactivity, dietary patterns) and physiological changes associated with aging.

The finding that nearly one in five adolescents already demonstrates overweight or obesity is particularly alarming, as elevated BMI during adolescence predicts increased risk of adult obesity and associated comorbidities. The more than doubling of overweight/obesity prevalence from adolescence to young adulthood (from 19.4% to 24.4%), followed by another more than doubling to adulthood (54.4%), illustrates the compounding nature of weight gain across the lifespan and highlights the importance of early intervention.

Hypertension prevalence showed marked age-related increases, with adults demonstrating the highest proportion at 44.1%, substantially exceeding rates in younger groups. The presence of elevated blood pressure even among younger age groups, though at lower prevalence, indicates that hypertension is not exclusively a disease of older adults and that screening and prevention efforts should extend to younger populations. Clinical indicators of metabolic dysfunction showed similar age-related patterns, with adults demonstrating higher proportions of elevated blood glucose and high cholesterol (35.3%) compared to younger groups. The presence of metabolic risk factors among younger

age groups, even at lower prevalence, is concerning as it indicates early onset of cardiometabolic disease processes.

Table 2. Comparison Between NCD Risk Factors Between Age Groups

NCD Risk Factors	Older Adolescent (15-19 Years)	Young Adults (20-24 Years)	Adults (25-59 Years)
	n=129 (%)	n=45 (%)	n=68 (%)
Behavior/Lifestyle			
Smoking			
No	117 (90.70%)	35 (77.78%)	56 (82.35%)
Yes	12 (9.30%)	10 (22.22%)	12 (17.65%)
Alcohol			
No	113 (87.60%)	44 (97.78%)	62 (91.18%)
Yes	16 (12.40%)	1 (2.22%)	6 (8.82%)
Physical Activity (Moderate PA Every Day)			
Yes	92 (71.32%)	31 (68.89%)	52 (76.47%)
No	37 (28.68%)	14 (31.11%)	16 (23.53%)
Sports (Leisure Time)			
Yes	57 (44.19%)	22 (48.89%)	28 (41.18%)
No	72 (55.81%)	23 (51.11%)	40 (58.82%)
Sedentary Time			
≤ 6 Hours/Day	82 (63.57%)	27 (60%)	51 (75%)
> 6 Hours/Day	47 (36.43%)	18 (40%)	17 (25%)
Dieary Pattern			
Fruits Consumption (Weekly)			
Always (7 Days)	11 (8.53%)	2 (4.44%)	12 (17.65%)
Often (4-6 Days)	29 (22.48%)	10 (22.22%)	19 (27.94%)
Rarely (1-3 Days)	54 (41.86%)	20 (44.44%)	22 (32.35%)
Never	35 (27.13%)	13 (28.89%)	15 (22.06%)
Vegetables Consumption (Weekly)			
Always (7 Days)	37 (28.68%)	14 (31.11%)	35 (51.47%)
Often (4-6 Days)	35 (27.13%)	15 (33.33%)	18 (26.47%)
Rarely (1-3 Days)	45 (34.88%)	10 (22.22%)	5 (7.35%)
Never	12 (9.30%)	6 (13.33%)	10 (14.71%)
Salt Consumption (Weekly)			
Never	3 (2.33%)	3 (6.67%)	6 (8.82%)
Rarely (1-2 Days)	30 (23.26%)	15 (33.33%)	24 (35.29%)
Sometimes (3-4 days)	47 (36.43%)	8 (17.78%)	18 (26.47%)
Often (5-6 Days)	28 (21.71%)	11 (24.44%)	9 (13.24%)
Always (7 Days)	21 (16.28%)	8 (17.78%)	11 (16.18%)
Clinical Condition			
BMI			
Underweight	32 (24.81%)	10 (22.22%)	1 (1.47%)
Normal	72 (55.81%)	24 (53.33%)	30 (44.12%)

NCD Risk Factors	Older Adolescent (15-19 Years)	Young Adults (20-24 Years)	Adults (25-59 Years)
	n=129 (%)	n=45 (%)	n=68 (%)
Overweight	15 (11.63%)	9 (20%)	23 (33.82%)
Obese	10 (7.75%)	2 (4.44%)	14 (20.59%)
High Blood Pressure (By Health Professional)			
No	111 (86.05%)	41 (91.11%)	38 (55.88%)
Yes	18 (13.95%)	4 (8.89%)	30 (44.12%)
High Blood Glucose (By Health Professional)			
No	121 (93.80%)	44 (97.78%)	62 (91.18%)
Yes	8 (6.20%)	1 (2.22%)	6 (8.82%)
High Cholesterol (By Health Professional)			
No	125 (96.90%)	42 (93.33%)	44 (64.71%)
Yes	4 (3.10%)	3 (6.67%)	24 (35.29%)

This study provides important insights into the patterns and distribution of NCD risk factors across three critical developmental periods—adolescence, young adulthood, and mature adulthood—in an urban Indonesian setting. Several key findings emerge from this analysis. First, behavioral risk factors are already present during adolescence, with notable proportions of adolescents engaging in tobacco use, alcohol consumption, physical inactivity, and poor dietary practices. Second, there is a clear age-related gradient in the prevalence of biological risk factors, with substantially higher rates of overweight/obesity, hypertension, and dyslipidemia among adults compared to younger groups. Third, certain risk factors show non-linear age patterns, such as the peak in smoking among young adults and the relatively higher alcohol use among adolescents, suggesting that different risk factors may have distinct developmental trajectories requiring age-specific intervention approaches.

Behavioral Risk Factors Across Age Groups

The patterns of behavioral risk factors observed in this study align with broader regional and global trends while also revealing some locally specific characteristics. The finding that smoking prevalence is highest among young adults (22.2%) reflects a common pattern observed across many Asian populations, where smoking initiation typically occurs during late adolescence and early adulthood, often associated with increased social independence and reduced parental oversight (Biswas et al., 2022). The substantial proportion of adult smokers (17.7%) demonstrates that tobacco use, once established, tends to persist, though the lower prevalence compared to young adults may reflect successful cessation among some adults or cohort effects.

The presence of smoking among adolescents, even at the relatively lower rate of 9.3%, is concerning as early smoking initiation is associated with greater difficulty quitting, higher

lifetime consumption, and increased disease risk (Patton et al., 2016). Indonesia has one of the highest rates of male smoking in the world, and tobacco control efforts have historically been limited by strong industry influence and cultural factors that normalize smoking. The patterns observed in this study underscore the critical importance of preventing smoking initiation during adolescence and supporting cessation among young adults before tobacco dependence becomes firmly established.

The pattern of alcohol consumption, with relatively higher prevalence among adolescents compared to older groups, warrants careful interpretation. While Indonesia is a predominantly Muslim country where alcohol consumption is generally discouraged, experimental alcohol use during adolescence has been documented in various Indonesian populations (Chadijah et al., 2023). The higher reported use among adolescents may reflect several factors, including social experimentation, peer influence, or potentially greater willingness among adolescents to report such behavior compared to adults who may face stronger social sanctions. Regardless of the underlying reasons, any alcohol consumption during adolescence is concerning due to the vulnerability of the developing brain to alcohol's neurotoxic effects and the association between early alcohol initiation and increased risk of alcohol use disorders in adulthood.

Physical activity and sedentary behavior patterns revealed in this study mirror global trends showing increasing sedentarism across all age groups, particularly in urban settings. The finding that 40% of young adults engage in high sedentary time is consistent with evidence from other Asia-Pacific countries showing that this age group faces particular risk due to sedentary occupations, prolonged educational activities, and extensive recreational screen time (Annear et al., 2022; Strain et al., 2024). Physical inactivity and sedentary behavior are now recognized as distinct risk factors, with sedentary behavior carrying independent health risks even among individuals who meet physical activity recommendations.

The uniformly low consumption of fruits across all age groups indicates a systemic dietary problem that is not limited to any particular life stage. This finding reflects broader dietary transitions occurring throughout Indonesia and much of Southeast Asia, characterized by increased consumption of energy-dense, nutrient-poor processed foods and decreased consumption of fruits, vegetables, and traditional dietary staples (Tham et al., 2023). Multiple factors contribute to these dietary shifts, including aggressive marketing of processed foods, the increasing availability and affordability of fast food and convenience foods, time constraints associated with modern lifestyles, and taste preferences shaped by food environments that prioritize palatability over nutritional quality.

Biological Risk Factors and the Lifecourse Perspective

The clear age-related gradient observed in biological risk factors—particularly the more than doubling of overweight/obesity prevalence from

adolescence to young adulthood, and again from young adulthood to adulthood—exemplifies the lifecourse accumulation of health risks. This pattern is consistent with evidence from other populations showing that obesity typically develops progressively over decades, driven by sustained energy imbalance resulting from the behavioral risk factors discussed above (NCD Risk Factor Collaboration, 2024).

The finding that nearly one in five adolescents already demonstrates overweight or obesity is particularly concerning and aligns with global trends showing increasing childhood and adolescent obesity rates, especially in middle-income countries (WHO, 2024). Adolescent obesity is associated with numerous immediate health concerns, including metabolic syndrome, type 2 diabetes, hypertension, and psychosocial difficulties. Perhaps more importantly, adolescent obesity strongly predicts adult obesity, with individuals who are obese during adolescence facing substantially elevated risk of remaining obese throughout adulthood and developing obesity-related complications at younger ages than those who develop obesity in adulthood (Lister et al., 2023).

The pattern of hypertension prevalence, with 44.1% of adults affected, reflects the high burden of cardiovascular risk in Indonesian populations and is consistent with data from national surveys such as the Riskesdas (Schröders et al., 2017). The presence of elevated blood pressure even among younger age groups, though at lower prevalence, indicates that cardiovascular disease processes begin early and accumulate over time. Notably, hypertension is often asymptomatic, and many individuals with elevated blood pressure are unaware of their condition, meaning that the true burden of hypertension and pre-hypertension may be even higher than screening studies detect.

The high prevalence of high cholesterol among adults (35.3%) similarly reflects the cumulative effects of dietary patterns, physical inactivity, and genetic factors on lipid metabolism. Dyslipidemia is a major risk factor for atherosclerotic cardiovascular disease, the leading cause of death in Indonesia and globally. The presence of abnormal lipid levels among younger age groups indicates that interventions to promote healthy lipid profiles should begin early in life, ideally before atherosclerotic changes become established.

Implications for Prevention and Intervention

The findings of this study have several important implications for NCD prevention policy and practice. First, the presence of multiple risk factors during adolescence clearly demonstrates that prevention efforts must begin early, ideally before risk behaviors become established. School-based interventions representing particularly promising platforms for reaching adolescents with health promotion messages and opportunities for physical activity and healthy eating (Biswas et al., 2022). These interventions should be comprehensive, addressing multiple risk factors simultaneously and incorporating

behavioral skills training, environmental modifications, and family engagement.

Second, the peak in certain risk behaviors during young adulthood suggests that this life stage requires targeted attention. Young adults are often overlooked by health systems, falling between pediatric and adult care models and frequently lacking regular healthcare contact. Workplace wellness programs, educational institution-based health services, and digital health interventions may offer promising avenues for reaching young adults with prevention messages and support services. The transition to independence that characterizes young adulthood represents both a vulnerability—as individuals establish health behaviors that may persist throughout life—and an opportunity for intervention during a period when many individuals are establishing new routines and identities.

Third, the high burden of established biological risk factors among adults underscores the importance of screening, early detection, and management of NCDs. Community-based screening programs, such as Indonesia's Posbindu (Pos Pembinaan Terpadu) initiative, can play important roles in identifying individuals with elevated risk and connecting them with appropriate care (Chadijah et al., 2023). However, screening must be accompanied by accessible, affordable, and effective treatment services to ensure that identified cases receive appropriate management.

Fourth, the uniformity of poor dietary patterns across age groups indicates that individual-level interventions alone will be insufficient to address this problem. Population-level interventions targeting the food environment—including fiscal policies such as taxes on sugar-sweetened beverages, regulations on marketing of unhealthy foods to children, food labeling requirements, and efforts to improve availability and affordability of healthy foods—are essential complements to individual-level education and behavior change programs (WHO, 2024). Indonesia has begun to implement some such policies, including regulations restricting advertising of unhealthy foods during children's programming, but more comprehensive approaches are needed.

Fifth, addressing physical inactivity and sedentary behavior requires multi-sectoral action extending beyond the health sector. Urban planning and transportation policies that promote active transportation (walking, cycling), creation and maintenance of parks and recreational facilities, school policies ensuring adequate physical education time, workplace policies promoting movement breaks, and regulations limiting screen time among children all represent potential intervention points (Annear et al., 2022). The WHO Global Action Plan on Physical Activity 2018-2030 provides a comprehensive framework for such multi-sectoral action, but implementation requires sustained political commitment and intersectoral coordination.

Comparison with Other Studies

The findings of this study are broadly consistent with results from other NCD risk factor surveys conducted

in Indonesia and neighboring Southeast Asian countries. Data from the Malaysian National Health and Morbidity Survey 2023, which also utilized the STEPS methodology, revealed similarly high prevalence of overweight/obesity, hypertension, and dyslipidemia among adults, along with concerning rates among younger age groups (Ghani et al., 2024). Studies from Thailand, Vietnam, and the Philippines have documented comparable patterns of age-related increases in biological risk factors and the presence of behavioral risk factors across age groups (Biswas et al., 2022).

The Global School-based Student Health Survey conducted in Indonesia in 2023 found high rates of physical inactivity, inadequate fruit and vegetable consumption, and other risk factors among adolescents, consistent with the patterns observed in this study (WHO, 2023). Regional analyses from the Global Matrix 4.0 Physical Activity Report Card, which assessed physical activity indicators across 15 Asian jurisdictions, found that Indonesia received an "F" grade for overall physical activity among children and adolescents, reflecting the severity of the physical inactivity problem (Liu et al., 2022).

Comparisons with data from high-income Asia-Pacific countries such as Japan, South Korea, and Australia reveal some similarities but also important differences. While these countries also face challenges with physical inactivity and dietary transitions, they generally have lower rates of smoking, more comprehensive NCD screening programs, and better access to preventive and treatment services (Tham et al., 2023). These differences highlight the importance of context-specific approaches to NCD prevention that account for local economic, social, and cultural factors.

Strengths and Limitations

This study has several notable strengths. First, it employed the standardized WHO STEPS methodology, which facilitates comparison with national and international data and ensures systematic assessment of key risk factors. Second, the inclusion of three distinct age groups spanning adolescence through mature adulthood provides valuable insight into how risk factors evolve across the lifecourse. Third, the combination of behavioral self-report data with objective physical and biochemical measurements provides a comprehensive risk factor profile. Fourth, the household-based sampling approach captures community-level patterns that may be missed by facility-based studies.

However, several limitations should be acknowledged. First, the cross-sectional design precludes inference about causality or tracking of individual-level changes over time. Longitudinal studies following individuals from adolescence through adulthood would provide more definitive evidence about risk factor trajectories. Second, the sample size, while adequate for descriptive purposes, limited the ability to conduct detailed stratified analyses or examine risk factor clustering patterns with statistical rigor.

Third, self-reported behavioral data are subject to social desirability bias and recall error, potentially leading to underestimation of socially undesirable behaviors such as smoking and alcohol use. Fourth, the study was conducted in a single urban setting, which may limit generalizability to rural areas or other Indonesian cities with different socioeconomic and cultural contexts. Fifth, the STEPS methodology, while comprehensive, does not capture all potentially relevant risk factors, such as mental health, sleep patterns, or psychosocial stress.

CONCLUSION

The This study reveals concerning patterns of NCD risk factors across age groups in Samarinda, Indonesia, with behavioral risks already present during adolescence and progressive accumulation of biological risk factors from adolescence through adulthood. The presence of multiple risk factors among adolescents and young adults underscores the urgent need for early, sustained, and comprehensive prevention efforts targeting these younger populations. The high burden of established risk factors among adults demonstrates that Indonesia faces a dual challenge of preventing new cases while also providing appropriate screening and management for existing conditions.

Addressing the NCD epidemic in Indonesia will require coordinated action across multiple levels and sectors. At the individual level, health education and behavior change support are essential. At the community level, environmental modifications that make healthy choices easier are needed. At the health system level, expanded screening, early detection, and accessible treatment services are critical. At the policy level, regulatory and fiscal measures addressing tobacco, unhealthy foods, and built environment design are necessary. Success in reducing the burden of NCDs will require sustained political commitment, adequate resource allocation, effective intersectoral coordination, and engagement of multiple stakeholders including government, healthcare providers, schools, workplaces, civil society organizations, and communities themselves.

The transition from adolescence through young adulthood represents a critical window for intervention, when health behaviors are still developing and biological risk has not yet fully accumulated. By investing in prevention during these formative years, Indonesia can reduce the future burden of NCDs, improve population health and wellbeing, enhance productivity and economic development, and move closer to achieving the Sustainable Development Goals and universal health coverage. The evidence from this study provides a foundation for such efforts, highlighting where risks are concentrated and suggesting opportunities for targeted action.

REFERENCES

Annear, M. J., Cushman, G., & Gidlow, B. (2022). The relationship between the school environment and adolescent sedentary behaviour in Southeast Asia. Health Promotion International, 37(4), daac089. https://doi.org/10.1093/heapro/daac089

Biswas, T., Townsend, N., Magalhaes, R. J. S., Islam, M. S., Hasan, M. M., & Mamun, A. (2022). Current progress and future directions in the double burden of malnutrition among adolescents and young adults in Southeast Asia. The Lancet Regional Health - Southeast Asia, 1, 100054. https://doi.org/10.1016/j.lansea.2022.100054

Chadijah, S., Sumampouw, O. J., & Kaunang, W. P. J. (2023). Risk factors of non-communicable diseases among adolescents in Indonesia: A systematic review. Gaceta Sanitaria, 37, 102300. https://doi.org/10.1016/j.gaceta.2023.102300

Ghani, R. A., Ahmad, M. H., Baharudin, A., Ismail, H., & Yusoff, M. F. M. (2024). Prevalence and factors associated with physical inactivity among Malaysian adults: Findings from the National Health and Morbidity Survey 2023. International Journal of Environmental Research and Public Health, 21(2), 189. https://doi.org/10.3390/ijerph21020189

Guthold, R., Stevens, G. A., Riley, L. M., & Bull, F. C. (2020). Global trends in insufficient physical activity among adolescents: A pooled analysis of 298 population-based surveys with 1·6 million participants. The Lancet Child & Adolescent Health, 4(1), 23-35. https://doi.org/10.1016/S2352-4642(19)30323-2

Lister, N. B., Baur, L. A., Felix, J. F., Hill, A. J., Marcus, C., Reinehr, T., Summerbell, C., & Wabitsch, M. (2023). Child and adolescent obesity. Nature Reviews Disease Primers, 9(1), 24. https://doi.org/10.1038/s41572-023-00435-4

Liu, Y., Tang, Y., Cao, Z., Zhai, X., Stodden, D. F., Bovet, P., & Chen, S. T. (2022). Results from the East Kalimantan's 2022 Report Card on physical activity for children and adolescents. Journal of Exercise Science & Fitness, 20(4), 348-353.

NCD Risk Factor Collaboration. (2024). Worldwide trends in underweight and obesity from 1990 to 2022: A pooled analysis of 3663 population-representative studies with 222 million children, adolescents, and adults. The Lancet, 403(10431), 1027-1050. https://doi.org/10.1016/S0140-6736(23)02750-2

Patton, G. C., Sawyer, S. M., Santelli, J. S., Ross, D. A., Afifi, R., Allen, N. B., Arora, M., Azzopardi, P., Baldwin, W., Bonell, C., Kakuma, R., Kennedy, E., Mahon, J., McGovern, T., Mokdad, A. H., Patel, V., Petroni, S., Reavley, N., Taiwo, K., ... Viner, R. M. (2016). Our future: A Lancet commission on adolescent health and wellbeing. The Lancet, 387(10036), 2423-2478.

https://doi.org/10.1016/S0140-6736(16)00579-1

Riley, L., Guthold, R., Cowan, M., Savin, S., Bhatti, L., Armstrong, T., & Bonita, R. (2016). The World Health Organization STEPwise approach to noncommunicable disease risk-factor surveillance: Methods, challenges, and opportunities. American Journal of Public Health, 106(1), 74-78. https://doi.org/10.2105/AJPH.2015.302962

Schröders, J., Wall, S., Kusnanto, H., & Ng, N. (2017). Millennium development goal four and child health inequities in Indonesia: A systematic review of the literature. PLoS ONE, 12(5), e0176663. https://doi.org/10.1371/journal.pone.0176663

Strain, T., Flaxman, S., Guthold, R., Semenova, E., Cowan, M., Riley, L. M., Bull, F. C., & Stevens, G. A. (2024). National, regional, and global trends in insufficient physical activity among adults from 2000 to 2022: A pooled analysis of 507 population-based surveys with 5·7 million participants. The Lancet Global Health, 12(8), e1232-e1243. https://doi.org/10.1016/S2214-109X(24)00150-5

Tham, Y. C., Cheng, C. Y., Zheng, Y., Aung, T., Wong, T. Y., & Tai, E. S. (2023). Metabolic syndrome and obesity in Asia. The Lancet Diabetes & Endocrinology, 11(1), 52-62. https://doi.org/10.1016/S2213-8587(22)00303-1

UNICEF. (2024). Adolescent health and wellbeing. United Nations Children's Fund. https://www.unicef.org/health/adolescent-health-and-wellbeing

World Health Organization. (2023). Global School-based Student Health Survey (GSHS): Indonesia 2023 fact sheet. WHO. https://www.who.int/data/gho/data/themes/topics/topic-details/GHO/gshs

World Health Organization. (2024). Noncommunicable diseases. WHO. https://www.who.int/news-room/fact-sheets/detail/noncommunicable-diseases

World Health Organization. (2024). The WHO STEPwise approach to noncommunicable disease risk factor surveillance (STEPS). WHO. https://www.who.int/teams/noncommunicable-diseases/surveillance/systems-tools/steps