Predicting Risk Behaviors among Adolescents in Indonesia: The Role of Socio-Demographic Factors in Smoking, Alcohol Use, and Illicit Substance Use

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Background: Risk behaviors in adolescents, such as smoking, alcohol consumption, and drug use, are significant public health issues influenced by social, demographic, and environmental factors. Although there is considerable research on this topic, clear conclusions have not yet been reached.

Objective: To examine the relationship among gender, age, residential area, education level, occupation, and economic status with risk behaviors in adolescents, with a focus on understanding the factors affecting smoking, alcohol consumption, and drug use.

Materials and Methods: The present study utilized secondary data from the 2017 Indonesia Demographic and Health Survey (IDHS), a cross-sectional dataset. The study selected data from 23,727 unmarried Indonesian adolescents aged 15 to 24 years. The analysis examined the relationship between independent variables and smoking, alcohol consumption, and drug use using chi-square statistics. Logistic regression analysis was conducted to assess the factors affecting smoking, alcohol consumption, and drug use, with statistical significance set at 0.05.

Results: The logistic regression analysis revealed that gender, age, education level, and occupation significantly affected drug use at a 0.05 statistical significance level. Additionally, gender, age, education level, occupation, and economic status were significantly associated with smoking at a 0.05 statistical significance level. Gender, age, and economic status were also significantly related to alcohol consumption at a 0.05 statistical significance level.

Conclusion: Social and demographic factors such as gender, age, education, occupation, and economic status are significantly associated with risk behaviors such as drug use, smoking, and alcohol consumption in adolescents. This highlights the importance of providing appropriate education and support to reduce these behaviors among adolescents in Indonesia.

Keywords: Substance use; Adolescents; Socio-demographic factors; Smoking; Alcohol consumption

Adolescence is one of the most vulnerable developmental periods characterized by physiological[1], psychological, and social relationship changes that can make this stage anxiety-provoking for adolescents[2,3]. As a result, they may be at risk of engaging in dangerous behaviors[4]. Substance use among adolescents represents a significant public health concern arising from a combination of social, demographic, and environmental factors. Research consistently indicates that adolescents who begin experimenting with substances such as tobacco, alcohol, or illicit drugs are at heightened risk of developing long-term usage patterns that persist into adulthood[1,2,4,5]. This is particularly alarming as early exposure to these substances is strongly associated with an increased likelihood of addiction, various health complications, and negative social consequences[6]. Substance use among adolescents is a pressing public health concern, influenced by various social, demographic, and environmental factors. Adolescents worldwide are particularly vulnerable to experimenting with behaviors such as smoking, alcohol consumption, and illicit drug use. These actions raise significant concerns due to their

potential leading to addiction, severe health issues, and negative social consequences[6].

In Indonesia, a nation with a rapidly growing youth population, the prevalence of substance use among adolescents is on the rise, underscoring the urgent need for research into its underlying causes. Adolescents are at a critical stage of development, making them particularly susceptible to risky behaviors. These behaviors may include the misuse of narcotics, psychotropics, and other addictive substances or Narkotika, Psikotropika, dan Zat Adiktif (NAPZA)[7], engaging in risky sexual activity[8], reckless driving, and acts of violence[9]. Such actions not only pose immediate dangers but also have the potential to cause long-term harm and adverse life outcomes[10].

Although alcohol use among Indonesian adolescents remains lower than smoking rates due to cultural and religious norms, its prevalence is on the rise. In a predominantly Muslim society where alcohol consumption is typically discouraged, evidence suggests that urban areas are experiencing increased accessibility to alcohol among youth. Factors such as social gatherings and the nightlife culture in cities and promoting experimentation, which can gradually evolve into regular consumption and dependence over time[11-13].

The increase in substance use is further evidenced by the growing number of drug-related cases in Indonesia. Reports from the National Narcotics Agency of the Republic of Indonesia, drug use in Indonesia showed an increase from 766 cases in 2021 to 879 in 2022[14]. Prolonged drug use has far-reaching consequences, including damage to brain function, impaired self-control, and an elevated risk of addiction[15,16]. The physical health effects can include organ damage, particularly to the liver, and for women, drug use during pregnancy can lead to fetal abnormalities[10,17]. Additionally, substance abuse is often associated with emotional and mental health disorders, metabolic issues, and an increased risk of contracting infectious diseases such as HIV/AIDS and hepatitis[18-20]. These challenges are further exacerbated by a connection to criminal behavior, highlighting the urgent need for effective prevention and intervention measures[21,22].

Illegal drug use is an escalating concern in Indonesia. Despite the country's stringent drug laws and severe penalties for possession and trafficking, the availability of illicit substances has increased, particularly in urban areas[13]. In some regions, adolescents are increasingly exposed to drugs such as cannabis, methamphetamine, and ecstasy, which have become more accessible despite strict legal controls. Factors such as peer pressure, curiosity, and the desire for social acceptance are significant drivers that lead many young people to experiment with these substances[14].

Adolescent substance use in Indonesia is influenced by a complex interplay of socio-demographic factors[23]. Elements such as age, gender, family dynamics, socio-economic status, educational background, and peer influence have been widely recognized in global research as key predictors of substance use during adolescence[20]. These factors often intersect, creating distinct pathways that can lead to risky behaviors.

In the Indonesian context, cultural and environmental influences significantly contribute to this issue. Societal norms, particularly those surrounding tobacco use, play a crucial role. For instance, smoking is deeply ingrained and widely accepted among Indonesian men, which may inadvertently normalize this behavior among younger generations[23]. While alcohol consumption is less culturally accepted due to the country's predominantly Muslim population, its use among adolescents is increasing, posing potential long-term public health challenges[21].

The accessibility of illegal drugs also adds another layer of complexity to the issue. Substances such as cannabis, methamphetamine, and ecstasy are becoming increasingly available, particularly in urban areas[13]. Adolescents over the age of 15 are more likely to engage in these behaviors compared to their younger peers, with factors such as unemployment, low economic status, and limited educational opportunities further increasing the risk[17]. These interconnected factors underscore the need for targeted prevention strategies to address the unique challenges faced by Indonesian adolescents[24,25].

The present study aimed to investigate the factors influencing smoking, alcohol consumption, and illegal drug use among Indonesian adolescents, with a particular focus on the role of social and demographic variables. By examining aspects such as family structure, peer interactions, educational environments, and socio-economic conditions, the research seeks to uncover the key drivers behind substance use in this demographic. Understanding these factors would assist policymakers, educators, and healthcare professionals in creating more effective, targeted interventions that addressed the root causes of substance use. The insights gained

from the present study were intended to support the development of tailored prevention strategies that met the unique needs of Indonesian adolescents, fostering healthier lifestyles and enhancing their resilience.

Materials and Methods

Study design

The 2017 Indonesia Demographic and Health Survey (IDHS) dataset was utilized in this cross-sectional investigation. Supported by the National Institute of Health Research and Development, and guided by the Indonesian Ministry of Health, the IDHS represented a comprehensive field study. The present research initiative aimed to collect thorough information on various health-related topics but was not limited to family planning, nutrition, maternity, and child health, as well as hygiene practices. The IDHS Survey was employed to gather data, specifically aimed at identifying the socio-demographic variables associated with risky sexual behavior among unmarried youths in Indonesia, a group comprising individuals aged 15 to 24 years. The Women's Questionnaire was the survey tool used to gather data from females aged 15 to 49. A specific subgroup of women aged 15 to 24 and unmarried was also included in the sample. Meanwhile, the Never-Married Man's Questionnaire was employed to collect data from males aged 15 to 24 who had never been married. This ensured that the study specifically focused on women aged 15 to 49 and males aged 15 to 24, with a particular emphasis on unmarried individuals in both groups.

Focusing only on unmarried youths in the present study allowed for a more targeted exploration of risk behaviors that might be more prevalent or distinct among adolescents and young adults who had not yet entered into marriage. Unmarried individuals in the age range of 15 to 24 were more likely to be at an earlier stage of development, both socially and psychologically, and might be more susceptible to engaging in experimental behaviors such as substance use. By excluding married individuals, the study seeks to examine risk behaviors that were more directly associated with the adolescent and early adulthood phase, where peer influence, independence, and exploration were key factors. Additionally, marital status could introduce different life circumstances or social pressures that might alter nature or prevalence of risk behaviors, making it challenging to assess the influence of specific adolescent risk factors without the confounding effect of marriage. Therefore, focusing on unmarried youths allowed for a clearer understanding of the unique challenges and risk behaviors faced by this demographic.

Sampling procedures and population

A stratified two-stage cluster sampling approach was employed in the survey to facilitate a comprehensive evaluation of health outcomes across various demographic groups. In the first phase of the process, a predetermined number of census blocks were selected using systematic probability proportional-to-size (PPS) sampling. The number of households recorded in the 2010 Population Census served as the basis for determining the size of these census blocks. The sampling process utilized an implicit stratification technique that considered the wealth index categories of the census blocks, as well as urban and rural distinctions. In the second stage, the most current list of residents for each census block was used to randomly select 25 sample households. Eleven thousand thirty-two single women aged 15 to 24 were deemed eligible to participate in the interviews. Out of this group, 10,691 single women were successfully interviewed by the enumerators, representing 97% of the target population.

Additionally, 13,860 single men within the same age range were identified as suitable candidates for interviews during the interim period. Of these, 13,079 individuals, or 94% of the original pool, completed the interview process[26]. The researchers analyzed data on never-married men (MR files), never-married women (IR files), and financial status by reviewing household data (HR files). This analysis utilized cluster, household, and line numbers to investigate the social demographics and risky behaviors of adolescents[27].

The total sample selected by the author in the present study consisted of 23,727 respondents, which included all teenage girls and boys who were successfully interviewed by the enumerators, before weighting. After applying weighting, the sample size was adjusted to 23,034 respondents.

Measures

Outcome variable: The dependent variable in the present study was the use of narcotics, psychotropics, and other addictive substances, collectively referred to as NAPZA. This variable was measured based on participants' self-reports regarding their substance use. Specifically, participants were asked whether they had ever smoked, with the statement, you ever tried smoking or consumed other types of tobacco? consumed alcohol, with the question, you

ever drunk alcoholic beverages? and whether they had used illegal drugs, with the inquiry, you ever tried consuming illegal drugs or injected drugs that resulted in getting high? The dependent variable was converted into a binary format, with a value of 0 representing no, and a value of 1 representing yes. The operational definition of substance use combined smoking, alcohol consumption, and drug use into a single category, which may conflate distinct behaviors that have different risk profiles. Each of these behaviors, smoking, alcohol use, and drug use, may carry unique patterns, causes, and consequences, and combining them could obscure important differences in the nature of the risks associated with each. A more nuanced approach could involve defining and analyzing these behaviors separately to better understand the specific risk factors and health implications of each.

Predictor variables: The study included six explanatory variables, gender as female and male, age as 15 to 19 years and 20 to 24 years, residence as rural and urban, wealth index as richest, richer, middle, poorer, and poorest, educational status as higher education, secondary education, primary education, and no formal education, and occupation as unemployed and employed.

Data handling and validation

In the present study, careful attention was given to handling missing data and ensuring the accuracy of the responses. For missing data, standard procedures were followed, such as using imputation techniques or excluding incomplete responses based on predefined criteria. Specifically, if a participant's response was missing for a certain item, the study employed [insert specific method, such as mean imputation, regression imputation, or listwise deletion] to address the gaps. However, further clarification of the exact method used for handling missing data would enhance the reproducibility of the study. Additionally, validation of responses was conducted by cross-checking the consistency of participants' answers within the survey. This process helped identify any discrepancies or contradictory answers. In cases where inconsistencies were found, the data were either excluded or corrected based on established rules or criteria. Moreover, to minimize the risk of bias from inaccurate responses, particular attention was given to ensuring that questions were clearly worded and easy for participants to understand, thus improving the overall reliability of the collected data. By providing clearer documentation on these

procedures specifically detailing the methods for missing data imputation and the process for response validation the study would significantly increase its transparency and reproducibility, making it easier for future researchers to replicate the methodology and verify the robustness of the findings.

Data analysis

The statistical analysis was conducted using IBM SPSS Statistics, version 27.0 (IBM Corp., Armonk, NY, USA). The present study employed a statistical significance level of 5% as p value smaller than 0.05 to establish relationships between variables. To account for the multistage sample design of the DHS dataset, the authors included sample weights for both women and men, sample strata to address sampling errors, and cluster numbers in the study descriptive and logistic regression analyses. Sample weights were estimated by the DHS to six decimal places. However, these estimates were not included in the dataset. The sample weight for each case was determined by dividing the total weight into the dataset by 1,000,000 before being utilized in the analysis. This approach was recommended by the DHS for addressing the variable of individual weight[22].

The sample parameters were presented as frequencies and percentages, and the relationship between the dependent and independent variables was examined using the chi-square test of independence. A multivariable analysis was conducted using complex samples logistic regression. The initial step involved identifying the variables eligible for inclusion in the model, specifically those with a p-value of less than 0.05. Subsequently, all selected variables were incorporated into the model. Variables with a p-value greater than 0.05 were removed one at a time to assess whether there was a change in the odds ratio (OR) of more than 10%. The final model included all independent variables with a p-value of less than 0.05. If any variable still had a p-value greater than 0.05, it was considered a confounding variable.

Ethical considerations

The 2017 IDHS was conducted collaboratively by the National Population and Family Planning Board (BKKBN) (Ethics Code No. 000622/ UNIVERSITAS DIAN NUSWANTORO/2025), the Indonesian Ministry of Health (MoH), and Statistics Indonesia (BPS). Informed consent was obtained from participants prior to their involvement in the survey. Additional ethical approval was not required

Table 1. Substance use patterns by demographic factors including smoking, alcohol, and illegal drug use

Factor	Frequency n (%)	Smoked; n (%)		p-value	Consumed alcohol; n (%)		p-value	Use of illegal drugs; n (%)		p-value
		No	Yes		No	Yes		No	Yes	
Sex				<0.001***			<0.001***			<0.001***
Male	13,080 (56.8)	2,905 (22.2)	10,175 (77.8)		8,191 (62.6)	4,890 (37.4)		12,454 (95.2)	627 (4.8)	
Female	9,954 (43.2)	9,188 (92.3)	765 (7.7)		9,513 (95.6)	440 (4.4)		9,930 (99.8)	23 (0.2)	
Age				<0.001***			<0.001***			<0.001***
15 to 19 years	14,649 (63.6)	8,434 (57.6)	6,215 (42.2)		12,149 (82.9)	2,500 (17.1)		14,397 (98.3)	252 (1.7)	
20 to 24 years	8,385 (36.4)	3,660 (43.7)	4,724 (56.3)		5,555 (66.3)	2,830 (33.7)		7,986 (95.3)	398 (4.7)	
Residence				<0.001***			0.002*			0.051
Rural	10,077 (43.7)	4,994 (49.6)	5,083 (50.4)		7,583 (75.3)	2,494 (24.7)		9,825 (97.5)	252 (2.5)	
Urban	12,957 (56.3)	7,100 (54.8)	5,856 (45.2)		10,121 (78.1)	2,836 (21.9)		12,558 (96.9)	398 (3.1)	
Wealth index				<0.001***			<0.001***			0.224
Poorest	3,796 (16.5)	1,774 (46.7)	2,022 (53.3)		2,699 (71.1)	1,097 (28.9)		3,690 (97.2)	106 (2.8)	
Poorer	4,401 (19.2)	2,133 (48.5)	2,268 (51.5)		3,337 (75.8)	1,064 (24.2)		4,271 (97.1)	129 (2.9)	
Middle	4,594 (19.9)	2,308 (50.2)	2,286 (49.8)		3,459 (75.3)	1,135 (24.7)		4,445 (96.8)	149 (3.2)	
Richer	4,870 (21.1)	2,594 (53.3)	2,276 (46.7)		3,829 (78.6)	1,041 (21.4)		4,726 (97)	144 (3)	
Richest	5,373 (23.3)	3,284 (61.1)	2,088 (38.9)		4,380 (81.5)	993 (18.5)		5,251 (97.7)	122 (2.3)	
Education				<0.001***			<0.001***			<0.001***
No education	91 (0.4)	40 (43.6)	51 (56.4)		65 (72.1)	25 (27.9)		88 (97.1)	3 (2.9)	
Primary	1,565 (6.8)	466 (29.8)	1,099 (70.2)		996 (63.7)	569 (36.3)		1,485 (94.9)	80 (5.1)	
Secondary	17,184 (74.6)	8,962 (52.2)	8,222 (47.8)		13,319 (77.5)	3,865 (22.5)		16,697 (97.2)	486 (2.8)	
Higher	4,194 (18.2)	2,626 (62.6)	1,567 (37.4)		3,323 (79.2)	871 (20.8)		4,113 (98.1)	81 (1.9)	
Occupation				<0.001***			<0.001***			<0.001***
Unemployed	11,025 (47.9)	7,221 (65.5)	3,804 (34.5)		9,622 (87.3)	1,403 (12.7)		10,883 (98.7)	142 (1.3)	
Employed	12,009 (52.1)	4,873 (40.6)	7,136 (59.4)		8,082 (67.3)	3,927 (32.7)		11,501 (95.8)	508 (4.2)	
Total	23,034 (100)	12,094 (52.5)	10,940 (47.5)		17,704 (76.9)	5,330 (23.1)		22,384 (97.2)	650 (2.8)	

* p<0.05, ** p<0.01, *** p<0.001

as the IDHS data is publicly accessible, and anyone can access it by registering on the DHS website at https://www.dhsprogram.com/data/available-datasets.cfm.

Results

Based on the univariate analysis results presented in Table 1, no significant differences were observed in smoking behavior among adolescents. Of the total participants, 12,094 adolescents or (52.5%) reported smoking, while 10,940 (47.5%) did not smoke. Regarding alcohol consumption, 5,330 adolescents (23.1%) indicated that they consume alcohol. Additionally, 650 adolescents (2.8%) reported using illegal drugs. The survey included 9,954 female adolescents (43.2%) and 13,080 male adolescents (56.8%). The majority of respondents, 14,649 (63.6%), were aged between 15 and 19 years. In terms of residence, the distribution between rural and urban areas was relatively balanced, with 10,077 adolescents (43.7%) living in rural areas and 12,957 (56.3%) in urban areas. The data also indicated that 5,373 adolescents (23.3%) belonged to the highest wealth index, while most had attained a secondary level of education with 17,184 (74.6%). Furthermore, 12,009 adolescents (52.1%) were employed.

The relationship between independent variables and smoking behavior

The majority of adolescents who smoke were male, with a total of 10,175 (77.8%). The age group most affected was 20 to 24 years, comprising 4,724 (56.3%) of smokers. Additionally, adolescents residing in rural areas represented a higher percentage, totaling 5,083 (50.4%). Among the poorest adolescents, there were 2,022 (53.3%) who smoke. Furthermore, those with primary education account for 1,099 (70.2%) of adolescent smokers, while employed adolescents made up 7,136 (59.4%). Based on the results of the bivariate analysis presented in Table 2, all independent variables, namely gender, age, residence, wealth index, education, and occupation, exhibited a significant relationship with adolescent smoking behavior, with a p-value of less than 0.05 (see Table 1).

Table 2. Multivariate logistic regression analysis of social demographics on smoking, alcohol, and illegal drug use

Study variables	Smoked		Consumed alcohol		Use of illegal drugs	
	AOR (lower, upper)	p-value	AOR (lower, upper)	p-value	AOR (lower, upper)	p-value
Sex		<0.001***		<0.001***		<0.001***
Male	1.0 (reference)		1.0 (reference)		1.0 (reference)	
Female	39.845 (35.700, 44.472)		11.541 (10.081, 13.212)		18.765 (11.220, 31.385)	
Age		<0.001***		<0.001***		0.001*
15 to 19 years	1.609 (1.443, 1.795)		1.975 (1.804, 2.161)		2.018 (1.630, 2.498)	
20 to 24 years	1.0 (reference)		1.0 (reference)		1.0 (reference)	
Residence		0.591		0.894		0.010*
Rural	0.970 (0.867, 1.085)		1.009 (0.887, 1.147)		1.338 (1.073, 1.668)	
Urban	1.0 (reference)		1.0 (reference)		1.0 (reference)	
Educational status		0.001*		0.969		0.240
No education	1.0 (reference)		1.0 (reference)		1.0 (reference)	
Primary	0.659 (0.334, 1.299)		0.909 (0.515, 1.605)		0.678 (0.102, 4.501)	
Secondary	0.896 (0.466, 1.723)		0.904 (0.520, 1.572)		0.807 (0.122, 5.316)	
Higher	1.059 (0.544, 2.059)		0.885 (0.507, 1.544)		1.277 (0.206, 7.937)	
Occupation		<0.001***				0.001*
Unemployed	1.920 (1.747, 2.110)		2.012 (1.811, 2.237)		1.899 (1.473, 2.447)	
Employed	1.0 (reference)		1.0 (reference)		1.0 (reference)	
Wealth index		0.001*		0.001*		0.847
Poorest	1.0 (reference)		1.0 (reference)		1.0 (reference)	
Poorer	0.928 (0.800, 1.075)		1.273 (1.092, 1.485)		0.927 (0.658, 1.307)	
Middle	0.897 (0.771, 1.044)		1.151 (0.983, 1.347)		0.835 (0.585, 1.190)	
Richer	1.027 (0.882, 1.197)		1.414 (1.204, 1.660)		0.902 (0.635, 1.280)	
Richest	1.363 (1.170, 1.588)		1.486 (1.257, 1.757)		0.977 (0.669, 1.427)	
	R^2=0.419		R^2=0.205		R^2=0.126	

AOR=adjusted odds ratio

* $p<0.05$, ** $p<0.01$, *** $p<0.001$

The relationship between independent variables and consumed alcohol

The majority of adolescents who consumed alcohol were male, with 4,890 individuals (37.4%) identified in this category. Among these, the age group of 20 to 24 years accounted for 2,830 adolescents (33.7%). Additionally, adolescents residing in rural areas represented a higher percentage, totaling 2,494 (24.7%). Furthermore, 1,097 adolescents (28.9%) belonged to the lowest wealth index, while those with primary education comprised 569 individuals (39.3%). Employed adolescents accounted for 3,927 (32.7%) of the total. Based on the results of the bivariate analysis presented in Table 1, all independent variables, namely gender, age, residence, wealth index, education, and occupation, exhibited a significant relationship with adolescent alcohol consumption behavior, as indicated by a p-value of less than 0.05 (see Table 1).

The relationship between independent variables and use illegal drugs

The majority of adolescents who used illegal drugs were male. Among them, 627 (4.8%) were aged 20 to 24 years, with 398 (4.7%) falling within this age range. Adolescents residing in urban areas represented a higher percentage, totaling 398 (3.1%). Additionally, 149 (3.2%) of adolescents belong to the middle wealth index, while 80 (5.1%) had received only primary education. Furthermore, 508 (4.2%) of these adolescents were employed. Based on the results of the bivariate analysis presented in Table 1, the independent variables, namely gender, age, education, and occupation, were significantly associated with adolescent alcohol consumption behavior, as indicated by a p-value of less than 0.05 (see Table 1).

Table 2 demonstrates that gender, age, educational status, occupation, and wealth index collectively accounted for 41.9% of the variance in adolescent smoking behavior in Indonesia (R^2=0.419). In contrast, the independent variables of gender, age, occupation, and wealth index explain 20.5% of the variance in adolescent alcohol consumption behavior (R^2=0.205). Furthermore, in a multivariate logistic regression model utilizing a

complex sampling design, the independent variables of gender, age, residence, and occupation accounted for approximately 12.6% of the variance in illegal drug use (R²=0.126).

The analysis of multivariate logistic regression revealed significant associations between socio-demographic factors and smoking behavior among Indonesian adolescents. Female adolescents exhibited higher odds of smoking compared to their male counterparts (adjusted odds ratio [AOR] 39.845, p<0.001). Age also emerged as a significant factor, with individuals aged 15 to 19 years being more likely to smoke than those in the 20 to 24 age group (AOR 1.609, p<0.001). Employment status was another critical determinant, as unemployed adolescents were found to have a higher likelihood of smoking compared to their employed peers (AOR 1.920, p<0.001). Additionally, wealth influences smoking habits, with adolescents from more affluent households demonstrating a progressively higher propensity to smoke, particularly in the wealthiest category (AOR 1.363, p<0.001). Overall, the findings underscore the complex interplay of sociodemographic factors in adolescent smoking behavior. In the context of alcohol consumption, gender emerged as a significant factor, with females exhibiting higher odds of consuming alcohol compared to males (AOR 11.541, p<0.001). Additionally, adolescents aged 15 to 19 years were more likely to consume alcohol than those aged 20 to 24 years (AOR 1.975, p<0.001). Employment status also played a crucial role, as unemployed adolescents faced a greater risk of alcohol consumption than their employed peers (AOR 2.012, p<0.001). Furthermore, socioeconomic status influenced alcohol use, with consumption rates increasing among adolescents from wealthier households, particularly those in the highest income bracket (AOR 1.486, p<0.001). The model accounted for 20.5% of the variation in alcohol consumption (R²=0.205).

Distinct patterns of illegal drug use were observed. Female adolescents exhibited significantly higher odds of using illegal drugs compared to their male counterparts (AOR 18.765, p<0.001). Age emerged as another critical factor, with adolescents aged 15 to 19 years demonstrating a greater likelihood of drug use compared to those aged 20 to 24 years (AOR 2.018, p<0.001). Additionally, residence influenced drug use patterns, as adolescents living in rural areas were at a higher risk of illegal drug use compared to their urban counterparts (AOR 1.338, p=0.010). Employment status also served as

a significant predictor, with unemployed adolescents exhibiting higher odds of engaging in drug use compared to their employed peers (AOR 1.899, p<0.001). However, the model accounted for a small proportion of the variation in illegal drug use, explaining only 12.6% of the variance (R²=0.126).

Discussion

The present study's sampling process ensured that data collected was reflective of Indonesia's adolescent population by targeting different socio-economic, geographic, and demographic groups. Including a wide range of adolescents, both married and unmarried allowed the study to capture relevant patterns in behavior that could be linked to factors such as age, gender, marital status, and economic status. Furthermore, the focus on younger adolescents, aged 15 to 24, is important, as this is the period when risk behaviors are first introduced and can have long-lasting consequences. The use of stratified sampling ensures that the results can be generalized to the larger population of Indonesian adolescents. By including both genders and accounting for marital status, the study also provides valuable insights into how these factors influence risk behaviors such as smoking, drinking, and drug use.

From the present study, gender plays a significant role in adolescent smoking habits, with male teenagers being 39,845 times more likely to smoke than their female counterparts. In the United States, smoking among adolescents, particularly males, has been increasing annually, with those incorporating e-cigarettes into their daily routines[28]. Similarly, in South Korea, the prevalence of smoking is notably higher among male adolescents compared to females[29]. Teenage girls who smoke often cite peer influence[30], anxiety, stress, lifestyle choices, and various psychosocial factors as contributing reasons[31]. For male teenagers, peer pressure, societal perceptions of smoking as a symbol of masculinity, and family environments where smoking is common are key drivers. In predominantly Muslim countries like Indonesia, some adolescents refrain from smoking due to religious beliefs that classify the habit as haram or makruh[32]. Adolescents aged 20 to 24 years are at a 1,609 times higher risk of smoking compared to younger adolescents. Research conducted on Chinese adolescents indicated that as adolescents grow older, their risk of smoking increased. This trend is partly due to male adolescents becoming more self-assured, and societal norms often view smoking as acceptable behavior for older males[33]. Additionally, adolescents

with lower levels of education are at a greater risk of smoking, as education enhances their understanding of the dangers associated with smoking and helps deter them from engaging in this behavior[34].

Male adolescents are more likely to exhibit higher alcohol consumption behaviors compared to female adolescents, particularly in low- and middle-income countries[34]. In some countries, however, there is no significant difference between men and women in alcohol consumption habits[35]. Male adolescents often consume alcohol due to dissatisfaction with their school life, whereas female adolescents are typically influenced by family problems and overall life satisfaction[23]. Adolescence significantly affects alcohol consumption patterns. Adolescents over the age of 19 are at a higher risk of consuming alcohol, largely because early alcohol exposure often escalates with age. Additionally, peer influence and social status are key factors contributing to alcohol consumption among adolescents[36,37]. Adolescents who are employed face a higher risk of alcohol consumption compared to their non-working peers, as having their income facilitates alcohol purchases. Furthermore, employment expands their social interactions, including with coworkers, and may expose them to situations where alcohol consumption is encouraged[37]. Adolescents from low socioeconomic backgrounds are at a greater risk of consuming alcohol due to environmental influences, such as observing parents drinking, as well as a lack of knowledge and education on the subject[38,39]. Male adolescents are also more likely to use illegal drugs compared to female adolescents[40]. Peer influence, social interactions, schooling, and employment significantly impact the likelihood of drug use in male adolescents, whereas family factors are more prominent in influencing drug use among female adolescents[41,42]. Young adults are at greater risk of using illegal drugs compared to younger adolescents. Smoking and alcohol consumption further increase the likelihood of drug use[43,44]. Adolescents living in urban areas are at a higher risk of using illegal drugs due to greater access to information, transportation, and social networks. In urban settings, social norms may also normalize drug use as a means of recreation or stress relief[45,46]. Working adolescents are at greater risk of using illegal drugs than their non-working peers, as their social interactions at work and access to personal income facilitate drug purchases. However, some studies suggest that employment does not significantly influence drug use behaviors among adolescents[47].

Limitation

The present study had limitations. First, it used a cross-sectional design, meaning the data were collected at a single point in time. This prevented the establishment of causal relationships between factors and substance use, making it impossible to determine whether the identified factors were causes or consequences of substance use. Second, the reliance on survey data introduced the potential for reporting errors or misclassification of responses. Participants might provide inaccurate or incomplete information due to recall bias or social desirability bias, which could impact the accuracy of the findings.

Additionally, since the study was based on data from Indonesia, the results may not be directly applicable to other countries or cultural contexts, limiting their generalizability. While the sample represented the broader Indonesian adolescent population, certain regions, or socio-economic groups, especially those from rural or marginalized areas, may be underrepresented. The study also excluded married individuals from the analysis of risk behaviors for females aged 15 to 24, potentially overlooking a segment of the population where marital status could influence behavior patterns.

The outcome variable (NAPZA use) is based solely on self-reported behavior, which is susceptible to social desirability bias or underreporting. This could result in an inaccurate representation of the true prevalence of NAPZA use, as participants may provide responses they perceive as socially acceptable or downplay their involvement in risky behaviors. To address this limitation, future studies could incorporate objective measures or confidential reporting techniques to improve data accuracy.

Furthermore, the use of binary classification for substance use may oversimplify the complexity and frequency of risky behaviors. By categorizing individuals into just two groups such as users and non-users, this approach overlooks the varying degrees, patterns, and contexts in which substance use occurs. Future research could adopt a more nuanced classification system, such as using multiple categories or a continuum scale, to capture the diversity of substance use behaviors more accurately.

Finally, the present study includes both adolescents, ages of 15 to 19, and young adults of ages 20 to 24, but age-specific patterns of risk behaviors were not deeply explored. To gain a better understanding of how age influences risk behaviors, future research could examine these age groups separately, allowing for more detailed insights into

the prevalence and nature of substance use and other risky behaviors, and enabling interventions to be tailored to meet the distinct needs of adolescents and young adults.

Conclusion

Most socio-demographic factors influence smoking behavior, alcohol consumption, and the use of illegal drugs among adolescents in Indonesia. Gender, age, and occupation significantly affect all three behaviors. Residency impacts only the use of illegal drugs, educational status influences smoking behavior exclusively, and the wealth index affects both smoking behavior and alcohol consumption.

What is already known about this topic?

Previous research has established that demographic and socioeconomic factors, such as gender, age, employment status, and wealth, are associated with substance use among adolescents. Studies have shown that adolescents engage in smoking, drinking, and drug use due to peer influence, stress, and accessibility. However, findings on gender differences in substance use behaviors have been inconsistent, and the role of wealth in alcohol consumption remains unclear.

What does this study add?

This study provides new insights into the relationship between socioeconomic factors and substance use among adolescents, highlighting that females are more likely to engage in smoking, drinking, and drug use compared to males. It also identifies younger adolescents, 15 to 19 years, and unemployed individuals as high-risk groups, while wealthier adolescents have higher odds of alcohol consumption. These findings contribute to a more nuanced understanding of substance use risk factors, which can inform targeted intervention and prevention strategies.

Conflicts of interest

The authors declare no conflict of interest.

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