Obesity and Asthma Risk in Indonesian Adults: Findings from the 2018 Indonesia Basic Health Research

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Abstract

Obesity and asthma are both global public health challenges. Mounting evidence suggests that obesity may increase asthma risk in adults; however, the association by sex remains uncertain. This study examined the association of obesity with asthma risk in Indonesian adult men and women. Data were obtained from the 2018 Indonesia Basic Health Research. The analysis included 299,837 men and 333,218 women aged ≥18 years. Asthma was identified by the self-report of a doctor's diagnosis. Obesity was defined as a body mass index ≥30 kg/m^2. A logistic regression was used for data analysis. Asthma prevalence was 2.7% (2.5% in men and 2.8% in women) and was higher in obese than non-obese adults. The adjusted odds ratio (aOR) of having asthma-related obesity was 1.22, 95% Confidence Interval (CI) = 1.17–1.28 (aOR = 1.25, 95% CI = 1.21–1.34 in women and aOR = 1.14, 95% CI = 1.05–1.25 in men). In conclusion, asthma prevalence is relatively low in Indonesian adults and slightly higher in women than men. Both men and women have a slight increase in the odds of having asthma-related obesity. Longitudinal studies are needed to understand better the causality association of obesity with asthma in adults.

Keywords: adults, asthma, Indonesia, obesity

Introduction

Asthma affects about 262 million people globally,[1] and is among adults' most frequent chronic respiratory diseases.[2] The recent findings from the Global Asthma Network Phase I study, a multi-country population-based survey, reported that asthma prevalence among adults differed significantly within and between countries.[3] Although its global prevalence has decreased,[4] the burden of asthma remains substantial on healthcare systems and the community.[5,6] Findings from a systematic analysis of the 2017 global burden of disease study indicated that asthma was the second most common cause of death among chronic respiratory diseases.[4] In fact, the majority of deaths from asthma occurred in low and lower-middle-income countries.[7,8] In Indonesia, the prevalence of self-reported, doctor-diagnosed asthma had significantly increased from 1.9% in 2007,[9] to 2.4% in 2018.[10] In 2018, asthma prevalence among Indonesian adults ranged from 2.2% to 5.1%.[10] In addition, asthma prevalence in 2018 differed by sex, with a prevalence of 2.3% in men and 2.5% in women.[10]

Obesity has become another global public health concern in adults.[11] In Indonesia, obesity prevalence is higher in females than males, and obesity prevalence in adults has increased over the past two decades.[9,10] Obesity has been associated with many chronic diseases, including asthma.[12] The increase in obesity prevalence has implicated obesity-related diseases and health economics, subsequently burdening the healthcare system.[13] A review of obesity and asthma in adults reported a higher asthma prevalence in obese women and a predominantly positive association in women.[14] In addition, increased odds of having asthma were shown among obese adults in some cross-sectional studies.[15-17] A meta-analysis of Mendelian randomization analysis suggested an increased risk of asthma associated with a higher genetically predicted body mass index (BMI) in European adults; however, individual studies showed mixed results.[18] The role of sex in the obesity-asthma association remains controversial. For example, several studies reported a significant association only in females,[19,20] but another found a similar association between sexes.[21] Other studies found a stronger association in females than males.[22,23] Two population-based Indonesian studies showed positive associations of obesity with asthma in men and working women,[24] and non-working

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women.[25]

Given the increasing prevalence of both obesity and asthma in Indonesia and the prevalence differed by sex,[9,10] it is essential to assess the association between these conditions for preventive measures. Many studies in other countries reported inconclusive results regarding the potential role of sex on the association of obesity with adult asthma[20,22,23]; however, evidence from Indonesia is limited. A better understanding of the sex differences in asthma prevalence in adult populations and its association with obesity can benefit its management. Thus, this study aimed to examine the association of obesity with asthma in Indonesian adults, using national data from the 2018 Indonesia Basic Health Research.

Method

Data were derived from the 2018 Indonesia Basic Health Research,[10] a national survey with multi-purposes to evaluate Indonesian health status. The 2018 Indonesia Basic Health Research was a cross-sectional survey conducted in 34 provinces, 416 districts, and 98 cities in Indonesia. Data were collected in March 2018 by the Indonesian Ministry of Health. To assess the asthma situation, the 2018 Indonesia Basic Health Research interviewed a representative sample of 1,017,290 individuals of all ages consisting of 510,714 males and 506,576 females.

In this study, the inclusion criteria included individuals aged ≥18 years with information on doctor-diagnosed asthma. A data set request proposal was submitted to the Data Management Laboratory, the Indonesian Ministry of Health, to obtain data set according to the inclusion criteria and proposed variables. Of the 641,951 individuals who met the inclusion criteria, 8,896 were excluded due to missing data on BMI and other covariates. The final analytic sample included 633,055 adults, of which 299,837 were men and 333,218 were women.

The National Institute of Health Research and Development Ethics Committee, the Indonesian Ministry of Health, approved the 2018 Indonesia Basic Health Research with the letter LB.02.01/3/KE.024/2018. Written informed consent was obtained from participants by interviewers of the National Institute of Health Research and Development of the Indonesian Ministry of Health.

Asthma was determined through a question, "Have you ever been diagnosed with asthma by a doctor?". Asthma prevalence was calculated by dividing the number of adults with asthma by the total number of corresponding individuals. Anthropometrics data were obtained by measuring height and weight. The BMI was estimated by dividing body weight (kg) by height (m^2). Obesity was determined as a BMI≥30 kg/m^2 according to World Health Organization's (WHO) classification.[26]

Information on covariates (age, residential area, marital status, education level, smoking status, physical activity, and history of hypertension and diabetes) was obtained from the 2018 Indonesia Basic Health Research questionnaire responses. Age was grouped into 18–44 years, 45–64 years, or ≥65 years. The residential area was classified as rural or urban areas. Marital status was categorized into single, married, or divorced. Education level was grouped into primary if the highest education was middle school, secondary if the highest education was high school, or higher education if the highest education was university. Information on smoking status was ascertained by asking individuals whether they had smoked daily in the past month. Smoking status was then categorized as never, former, or current smoking. Physical activity was categorized into active if individuals performed moderate physical activities for ≥150 minutes/week or vigorous physical activities for ≥75 minutes/week, or less active if individuals did not meet the WHO recommendation.[27] Self-report of a doctor's diagnosis was used to define hypertension and diabetes.

Data analyses were independently done for both sexes. Data were presented in mean ± standard deviation for continuous variables and proportion for categorical variables. Microsoft Office Excel 365 for the web was used to draw a figure on the distribution of obesity according to asthma status. Variables significantly associated with asthma at a p-value of less than 0.05 in bivariate analysis were selected as covariates in multivariate analysis. Multivariate analyses were performed using a logistic regression test to examine the association of obesity with asthma in adults. In multivariate analysis, adjustment was made for age, residential area, marital status, education level, smoking status, physical activity, and records of hypertension and diabetes mellitus. The odd ratios (OR) and 95% confidence intervals (CIs) were presented. Statistical significance was declared if a two-sided p-value was less than 0.05.

Results

Asthma prevalence in adults was 2.7%, with a mean age of 42.9 years. Over half of the adults were women, living in rural areas, married, less active, never smokers, and attained primary education. The adults' mean BMI was 23.9 kg/m^2, and 12.6% of adults were obese. Adults with a records of hypertension and diabetes were 48.8% and 2.3%, respectively (Table 1). Asthma prevalence was higher in women (2.8%) than in men (2.5%). The mean age of men and women was 43.0 and 42.8 years, respectively. More than half of the men and women lived in rural areas, were married, and had primary education. In men, the proportions of current smokers, less active, and records of hypertension were relatively high, but the proportions of obesity and diabetes were relatively low. Most

Table 1. Participants' Characteristics by Sex

Variable	Category	All (n = 633,055)	Male (n = 299,837)	Female (n = 333,218)
		n (%)	n (%)	n (%)
Asthma	No	616,023 (97.3)	292,276 (97.5)	323,747 (97.2)
	Yes	17,032 (2.7)	7,561 (2.5)	9,471 (2.8)
Sex	Male	299,837 (47.4)	-	-
	Female	333,218 (52.6)	-	-
Age, year*		42.9±14.9	43.0±14.9	42.8±14.9
Age group, year	18-44	360,820 (57.0)	168,784 (56.3)	192,036 (57.6)
	45-64	216,183 (34.1)	104,756 (34.9)	111,427 (33.4)
	≥65	56,052 (8.9)	26,297 (8.8)	29,755 (8.9)
Residential area	Rural	359,217 (56.7)	171,051 (57.0)	188,166 (56.5)
	Urban	273,838 (43.3)	128,786 (43.0)	145,052 (43.5)
Marital status	Single	85,501 (13.5)	55,046 (18.4)	30,455 (9.1)
	Married	484,568 (76.5)	230,831 (77.0)	253,737 (76.1)
	Divorced	62,986 (9.9)	13,960 (4.7)	49,026 (14.7)
Education level	Primary	395,244 (62.4)	178,973 (59.7)	216,271 (64.9)
	Secondary	174,492 (27.6)	92,350 (30.8)	82,142 (24.7)
	Higher education	63,319 (10.0)	28,514 (9.5)	34,805 (10.4)
Physical activity	Less active	452,499 (71.5)	168,585 (56.2)	283,914 (85.2)
	Active	180,556 (28.5)	131,252 (43.8)	49,304 (14.8)
Smoking status	Never	397,677 (62.8)	76,680 (25.6)	320,997 (96.3)
	Former	33,057 (5.2)	28,717 (9.6)	4,340 (1.3)
	Current	202,321 (32.0)	194,440 (64.8)	7,881 (2.4)
BMI, kg/m²*		23.9±4.6	23.0±4.0	24.7±4.9
Obesity status	No	553,057 (87.4)	278,626 (92.9)	274,431 (82.4)
	Yes	79,998 (12.6)	21,211 (7.1)	58,787 (17.6)
Hypertension	No	324,371 (51.2)	132,469 (44.2)	191,902 (57.6)
	Yes	308,684 (48.8)	167,368 (55.8)	141,316 (42.4)
Diabetes	No	618,807 (97.7)	294,287 (98.1)	324,520 (97.4)
	Yes	14,248 (2.3)	5,550 (1.9)	8,698 (2.6)

Notes: BMI = Body Mass Index, *Data are presented as means±standard deviation.

women were never smokers and less active. In women, the proportions of obesity and hypertension were high, but the proportion of diabetes was low (Table 1).

Table 2 shows the characteristics of the participants based on their asthma status. Asthma prevalence was higher in rural, married, lower educated, and less active adults. Adults with asthma were likely to be older, had lower rates of hypertension and diabetes, and 23.1% of adults were current smokers. In men, the highest asthma prevalence was among current smokers. In contrast, the highest asthma prevalence in women was among never smokers.

Figure 1 presents the distribution of obesity according to asthma status. The obesity proportion was higher in adults with asthma than those without asthma. In addition, obesity was specifically higher in women with asthma than in men with asthma. Obesity was significantly associated with asthma regardless of sex.

Table 3 presents the OR associated with asthma according to obesity status. Obese adults had 1.23 times higher odds of having asthma than non-obese adults. The odds of having asthma associated with obesity differed between sexes. The odds of having asthma were 1.15 for obese men and 1.26 for obese women. Adjustment for the covariates did not noticeably change the results. The multivariate-adjusted odds of having asthma were higher in obese women than in obese men (aOR (95% CI) = 1.25 (1.21–1.34) vs. 1.14 (1.05–1.25), p-value<0.05).

Discussion

This study showed that asthma prevalence was relatively low in Indonesian adults and slightly higher in women than men. The prevalence of doctor-diagnosed asthma in this study was 2.5% in men and 2.8% in women. These findings were lower than the respective prevalence of 6.7% and 7.0% among men and women workers in Indonesia, which defined asthma based on symptoms.[24] In addition, several studies have reported that the prevalence of adult asthma differs between men and women.[4,17,22,23,28,29] Results from a national survey of Iranian adults in 2018 reported a variation in asthma prevalence between sexes and asthma definitions. In that study, asthma prevalence was higher in men using the European Community Respiratory Health Survey questionnaire but higher in women when using self-report of doctor-diagnosis.[29] Consistent with the current findings, many studies have shown a higher prevalence among women than men.[4,17,22,23,28] It has been suggested that

**Table 2. Participants' Characteristics by Asthma Status**

Variable	Category	All (n = 633,055)			Male (n = 299,837)			Female (n = 333,218)		
		Asthma	Without Asthma	p-value*	Asthma	Without Asthma	p-value*	Asthma	Without Asthma	p-value*
		n (%)	n (%)		n (%)	n (%)		n (%)	n (%)	
Sex	Male	7,561 (44.4)	292,276 (47.4)	<0.001	-	-	-	-	-	-
	Female	9,471 (55.6)	323,747 (52.6)							
Age, year**		47.0±16.2	42.8±14.8	<0.001	49.8±16.7	42.8±14.8	<0.001	44.7±15.4	42.8±14.9	<0.001
Age group, year	18-44	7,914 (46.5)	352,906 (57.3)		2,911 (38.5)	165,873 (56.8)		5,003 (52.9)	187,033 (57.8)	
	45-64	6,433 (37.8)	209,750 (34.0)	<0.001	3,077 (40.7)	101,679 (34.8)	<0.001	3,356 (35.4)	108,071 (33.4)	<0.001
	65	2,685 (15.8)	53,367 (8.7)		1,573 (20.8)	24,724 (8.5)		1,112 (11.7)	28,643 (8.8)	
Residential area	Rural	9,287 (54.5)	349,930 (56.8)	<0.001	4,305 (56.9)	166,746 (57.1)	0.843	4,982 (52.6)	183,184 (56.6)	<0.001
	Urban	7,745 (45.5)	266,093 (43.2)		3,256 (43.1)	125,530 (42.9)		4,489 (47.4)	140,563 (43.4)	
Marital status	Single	1,738 (10.2)	83,765 (13.6)		976 (12.9)	54,070 (18.5)		760 (8.0)	29,695 (9.2)	
	Married	13,088 (76.8)	471,480 (76.5)	<0.001	5,982 (79.1)	224,849 (76.9)	<0.001	7,106 (75.0)	246,531 (76.2)	<0.001
	Divorced	2,208 (13.0)	60,778 (9.9)		603 (8.0)	13,357 (4.6)		1,605 (16.9)	47,421 (14.6)	
Education level	Primary	11,284 (66.3)	383,960 (62.3)		5,106 (67.5)	173,867 (59.5)		6,178 (65.2)	210,093 (64.9)	
	Secondary	4,010 (23.5)	170,482 (27.7)	<0.001	1,783 (23.6)	90,567 (31.0)	<0.001	2,227 (23.5)	79,915 (24.7)	0.003
	Higher education	1,738 (10.2)	61,581 (10.0)		672 (8.9)	27,842 (9.5)		1,066 (11.3)	33,739 (10.4)	
Physical activity	Less active	13,254 (77.8)	439,245 (71.3)	<0.001	4,965 (65.7)	163,620 (56.0)	<0.001	8,289 (87.5)	275,625 (85.1)	<0.001
	Active	3,778 (22.2)	176,778 (28.7)		2,596 (34.3)	128,656 (44.0)		1,182 (12.5)	48,122 (14.9)	
Smoking status	Never	11,242 (66.0)	386,435 (62.7)		2,278 (30.1)	74,402 (25.5)		8,964 (94.6)	312,033 (96.4)	
	Former	1,848 (10.9)	31,209 (5.1)	<0.001	1,606 (21.2)	27,111 (9.3)	<0.001	242 (2.6)	4,098 (1.3)	<0.001
	Current	3,942 (23.1)	198,397 (32.2)		3,677 (48.6)	190,763 (65.3)		265 (2.8)	7,616 (2.4)	
BMI, kg/m2**		23.8±5.2	23.9±4.6	0.019	22.5±4.4	23.0±4.0	<0.001	24.9±5.5	24.7±4.9	0.004
Hypertension	No	9,683 (56.9)	314,688 (51.1)	<0.001	4,002 (52.9)	128,467 (44.0)	<0.001	5,681 (60.0)	186,221 (57.5)	<0.001
	Yes	7,349 (43.1)	301,335 (48.9)		3,559 (47.1)	163,809 (56.0)		3,790 (40.0)	137,526 (42.5)	
Diabetes mellitus	No	16,347 (96.0)	602,460 (97.8)	<0.001	7,289 (96.4)	286,998 (98.2)	<0.001	9,058 (95.6)	315,462 (97.4)	<0.001
	Yes	685 (4.0)	13,563 (2.2)		272 (3.6)	5,278 (1.8)		413 (4.4)	8,285 (2.6)	

Notes: BMI = Body Mass Index, *p-values were calculated by t-test for continuous variables and the Chi-square test for categorical variables, **Data are presented as means±standard deviation.

the mixed results in asthma prevalence may be partially due to differences in diagnostic criteria.[30] A review article on the prevalence of adult asthma with a wide variation of asthma definitions in Asian countries, including Indonesia, showed that the asthma prevalence in adults varied from 0.7% to 11.9%.[31]

This study showed a slight increase in the odds of having asthma in obese adults regardless of sex, and the associations were statistically significant. The increase in the odds of having asthma was higher in obese women compared to obese men. However, the association for men should cautiously be interpreted because the 95% CI of the OR for asthma in obese men reached a null association. Obesity is a significant risk factor for developing asthma, worsening asthma symptoms, and controlling poor asthma.[5,6] Although this study found a slight increase in the odds of having asthma in obese adults, the prevalence of both asthma and obesity is rising.[9,10] Thus, asthma-related obesity may cause an immense burden of chronic disease prevention in the future public healthcare systems.

Obesity has many negative impacts on health,[12] and the risk of asthma associated with obesity may differ by sex.[32] The association of obesity with asthma in men remains unclear.[23,32] In addition, previous studies found
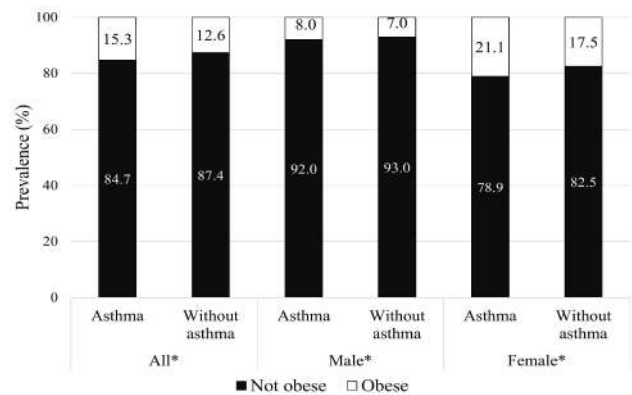
Notes: The association between obesity and asthma was evaluated using Chi-square tests, *p-value<0.05.

Figure 1. Distribution of Obesity according to Asthma Status

an increase in the odds of having asthma associated with obesity in adults after adjusting for potential confounders; however, results for separate analyses were not shown for men and women.[15,17] Several other studies reported an increased risk of adult asthma associated with obesity only in women and not men.[19,20] Similar to the current findings, a few national-level cross-sectional stud-

Table 3. Odds Ratio (95% Confidence Interval) Associated with Asthma According to Obesity Status

Variable	Category	Unadjusted OR (95% CI)	p-value	Adjusted OR (95% CI)	p-value
All	Non-obese	1.00 (reference)	-	1.00 (reference)	-
	Obese	1.23 (1.21–1.31)	<0.001	1.22 (1.17–1.28)*	<0.001
Male	Non-obese	1.00 (reference)	-	1.00 (reference)	-
	Obese	1.15 (1.06–1.25)	0.001	1.14 (1.05–1.25)**	0.002
Female	Non-obese	1.00 (reference)	-	1.00 (reference)	-
	Obese	1.26 (1.20–1.33)	<0.001	1.25 (1.21–1.34)**	<0.001

Notes: OR = Odds Ratio, CI = Confidence Interval
*Adjusted with sex, age, residence area, marital status, educational attainment, physical activity, smoking status, and history of hypertension and diabetes mellitus.
**Adjusted with age, residence area, marital status, educational attainment, physical activity, smoking status, and history of hypertension and diabetes mellitus.

ies reported a higher increase in the odds of having asthma associated with obesity in women than men.[16,22,23] A meta-analysis of 174,556 adults from 51 nationally representative surveys in which asthma prevalence remains common showed that obese men and women had a similarly high risk for doctor-diagnosed asthma.[33] Results from a prospective study including 523,245 adults found a higher risk of asthma in obese women compared to obese men after an 11-year follow-up.[21] In addition, a retrospective cohort study on more than 5 million adults with a BMI ≥ 23.0 kg/m^{2} showed that the risk of adult asthma gradually increased with increasing BMI, and the increased risk of adult asthma associated with obesity was higher in women than men.[34]

The mechanisms for sex differences in asthma prevalence in adults remain unclear. It has been suggested that sex hormones may cause women a higher asthma risk after puberty.[32] In addition, weight gain may reduce the airway, resulting in airway obstruction in women with smaller airways than men.[35] Another mechanism is probably due to sex differences in the inflammatory response. A higher level of inflammation associated with obesity in obese women than in obese men may explain a higher risk of having asthma for women.[36]

This study had some limitations. First, the causality between obesity and adult asthma could not be determined due to the cross-sectional design. Second, recall bias might occur because the definition of asthma relies on self-reporting a doctor's diagnosis. However, many epidemiologic studies have used this self-report of doctor-diagnosed asthma; thus, it is a standard definition used in asthma studies. Third, the large sample size of this study tended to detect significant associations, and a low asthma prevalence in both sexes precluded further stratification analysis from assessing the association. Nonetheless, a slight increase in the odds of having asthma in obese adults might be considered to prevent comorbidity of the two conditions and alleviate the burden of chronic disease in future public healthcare systems.

Conclusion

This study of Indonesian adults shows that asthma prevalence is relatively low and slightly higher in women. Obesity is associated with asthma in both sexes, and the increase in the odds of having asthma is higher in women than men. Longitudinal studies are needed to understand better the causality association of obesity with asthma in adults.

Abbreviations

BMI: Body Mass Index; WHO: World Health Organization; OR: Odds Ratio; CI: Confidence Interval.

Ethics Approval and Consent to Participate

This study was approved by the Ethics Committee of the National Institute of Health Research and Development, the Ministry of Health of the Republic of Indonesia.

Competing Interest

The author declares that there is no significant competing financial, professional, or personal interest that might have affected the performance or presentation of the work described in this manuscript.

Availability of Data and Materials

The data used in this study are not publicly available. A reasonable request for the dataset can be sent to the corresponding author.

Authors' Contribution

HN was responsible for the entire process, including conceptualization, data analysis, writing, and revising the manuscript.

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