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ORIGINAL ARTICLE

Comparison of WHO global and Asia-Pacific body mass index classifications for screening low birth weight risk among pregnant women in urban Indonesia

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Mayditania Intan Bunga Pratiwi[1], Dwiana Ocviyanti[2], Rima Irwinda[2], Dian Novita Chandra[3]

1. *Doctoral Program Department of Nutrition, Faculty of Medicine, University of Indonesia, Dr. Cipto Mangunkusumo General Hospital, Jakarta, Indonesia*
2. *Department of Obstetrics and Gynecology, Faculty of Medicine, University of Indonesia, Dr. Cipto Mangunkusumo General Hospital, Jakarta, Indonesia*
3. *Department of Nutrition, Faculty of Medicine, University of Indonesia and Human Nutrition Research Center, Indonesian Medical Education and Research Institute (HNRC IMERI), Faculty of Medicine, Universitas Indonesia, Jakarta, Indonesia*

Abstract

Background: Low birth weight (LBW) remains a major contributor to neonatal morbidity and mortality. Maternal body mass index (BMI) is widely used to identify pregnancies at risk of adverse birth outcomes; however, the optimal BMI classification for Asian populations remains uncertain. This study compared the WHO Global and WHO Asia-Pacific BMI classifications in identifying pregnant women at risk of delivering LBW infants.
Methods: An unmatched case-control study was conducted among 729 pregnant women attending 10 primary healthcare centers in Jakarta, Indonesia. Cases comprised 368 women who delivered LBW infants (2,500 g), while 361 women with normal birth weight infants served as controls. Logistic regression models were developed using both BMI classifications and compared using the area under the receiver operating characteristic curve (AUC), Akaike Information Criterion (AIC), and Nagelkerke R^2. Screening performance was assessed using sensitivity, specificity, positive predictive value, and negative predictive value.
Results: After adjustment for maternal age, preterm delivery, and pregnancy-induced hypertension, both BMI classifications showed comparable predictive performance (WHO Global: AUC=0.646; Asia-Pacific: AUC=0.634). BMI category was not independently associated with LBW in either model. However, using obesity as the screening threshold, the WHO Asia-Pacific classification demonstrated substantially higher sensitivity than the WHO Global classification (49.5% vs. 16.3%), although specificity was lower.
Conclusions: Although both BMI classifications showed similar predictive performance, the WHO Asia-Pacific classification identified a substantially greater proportion of women at risk of delivering LBW infants. These findings support the use of population-specific BMI 2 thresholds to strengthen antenatal nutritional screening in Indonesian and other Asian populations.

Keywords: body mass index, low birth weight, maternal obesity, screening, sensitivity, urban Indonesia, WHO Asia-Pacific, WHO Global

Corresponding author:
Mayditania Intan Bunga Pratiwi
Doctoral Program Department of Nutrition, Faculty of Medicine, University of Indonesia, Dr. Cipto Mangunkusumo General Hospital, Jakarta, Indonesia
Email: mayditaniabunga@gmail.com

Introduction

Low birth weight (LBW), defined as birth weight below 2,500 grams at delivery regardless of gestational age, is a critical global public health concern and one of the strongest predictors of neonatal mortality, short-term morbidities, and long-term developmental and cardiometabolic sequelae.[1,2] One in ten livebirths (13.4 million) were preterm (known as born too soon) and one in five (23.4 million) were small for gestational age (SGA; known as born too small) in 2020. Of 135 million livebirths in 2020, 35.3 million (26.2%) were small vulnerable newborns (SVNs), defined as any baby born preterm, or SGA or both preterm and SGA. Together, these three vulnerable newborn types account for 99.5% of the world's 20 million LBW babies. Nearly two thirds (63.0%) of the world's term SGA newborns are in southern Asia (14.8 million, 40.9% of livebirths). Preterm birth rates have less regional variation but are also highest in southern Asia (13.2%).[3,4] In Indonesia, the national proportion of LBW was 6.5% according to the Survei Status Gizi Indonesia (SSGI) 2024. However, facility-based surveillance from urban primary health centers (Puskesmas) populations consistently documents higher rates, reflecting the high-risk clinical profile of primary care antenatal attendees.[5,6]

Maternal pre-pregnancy BMI is a key modifiable determinant of LBW, acting through pathways including pregnancy-induced hypertension (PIH), placental vascular insufficiency, and medically indicated preterm delivery.[7,8] Furthermore, Indonesia is experiencing a rapid and continuing nutritional transition, national obesity prevalence among adult women rose from 14.8% in 2013 to 29.3% in the 2018 Riskesdas, more than double the prevalence among men (14.5%), signaling rising obesity-related pregnancy risk.[9,10] Moreover, Asian individuals face higher risks for type 2 diabetes, cardiovascular disease, and metabolic syndrome at BMI levels classified as 'normal' by WHO Global criteria.[11,12] However, BMI's screening utility depends on the classification system used to define overweight and obesity.

This raises a foundational question regarding which BMI classification system is most appropriate for Asian populations, including Indonesia. The WHO Global classification defines overweight as BMI ≥25.0 kg/m² and obesity as ≥30.0 kg/m², thresholds derived largely from Western populations.[13] Asian populations have higher body fat and cardiometabolic risk at lower BMI than Western populations, providing the rationale for lower thresholds.[14,15] In recognition of this, the WHO Expert Consultation proposed Asia-Pacific-specific thresholds: overweight at BMI ≥23.0 kg/m² and obesity at BMI ≥25.0 kg/m².[13]

Consequently, the 5 kg/m² difference in the obesity threshold between these two systems directly affects screening sensitivity, as a lower threshold captures more at-risk women. Studies in Chinese pregnant populations found that women with BMI 25.0–28.0 kg/m², 'overweight' by WHO Global but 'obese' by Asia-Pacific criteria, experienced adverse perinatal outcomes comparable to women with higher BMI, and that the Asia-Pacific threshold offered superior discriminative validity.[16] Studies in Asian women in Hawaii found that applying Asia-Pacific cut-offs reclassified at least 40% of women into higher BMI categories.[15] Predictive modelling and screening nonetheless serve different purposes: models estimate independent risk contributions, whereas screening tools prioritize early identification of at-risk individuals.[17,18]

Yet, to our knowledge limited Indonesian study has directly compared the screening performance of both systems for LBW detection. This gap is not merely geographic: Indonesia's ethnic diversity, dietary patterns, and distinct nutritional-transition trajectory may limit generalizability of BMI–risk associations from Chinese, Korean, or Hawaiian

cohorts. Jakarta, an advanced site of this transition with rising obesity and persistent adverse birth outcomes which offers a particularly relevant setting, especially as the only prior Indonesian study using Asia-specific BMI criteria examined gestational weight gain rather than LBW screening. This study therefore compared WHO Global and Asia-Pacific BMI classifications for identifying LBW risk among pregnant women attending Puskesmas in urban Indonesia.

Methods

Study design and participants

An unmatched case-control study was conducted using data from antenatal care and birth records of pregnant women. Participants were recruited from 10 primary healthcare centers (Puskesmas), including eight in Central Jakarta and two in East Jakarta, Indonesia, between January 2023 and December 2024. Cases consisted of women delivering LBW infants, while controls were women delivering infants with normal birth weight recruited from the same primary healthcare centers. The study was conducted in accordance with the Declaration of Helsinki Cases were defined as women with singleton pregnancies who delivered LBW infants (birth weight <2,500 grams) at participating Puskesmas and controls as women with singleton pregnancies who delivered infants with normal birth weight (≥2,500 g) at the same Puskesmas network; all identified LBW deliveries across the 10 facilities were included as cases (n=368), alongside 361 eligible controls.

Sample size was calculated a priori using an unmatched case-control formula (α=0.05, 80% power, 1:1 ratio), based on an independent estimate of obesity prevalence among Indonesian pregnant women under Asia-Pacific criteria (14.4%; Battung et al.)[19] and a minimum clinically meaningful odds ratio of 2.0. This yielded a minimum required sample of 428 (214 cases, 214 controls). For both cases and controls, complete records were required for: birth weight at delivery, BMI at first antenatal visit (first trimester), gestational age at delivery, maternal age, and PIH status. Women with multiple gestations or missing data on any primary study variable were excluded. A total of 729 participants (368 cases, 361 controls) met all inclusion criteria and were included in the final analysis.

Primary Outcome

The primary outcome was LBW, defined as birth weight <2,500 grams at delivery regardless of gestational age, classified as binary (LBW=1; Normal birth weight ≥2,500 g=0) per WHO definition.[1]

Exposure: BMI Classification Systems

BMI (kg/m²) was calculated from weight and height measured at the first antenatal visit (first trimester). Weight and height were measured by trained Puskesmas midwives following the standardized anthropometric procedures specified in the Indonesian Ministry of Health's Integrated Antenatal Care Guidelines (Pedoman Pelayanan Antenatal Terpadu), which mandate calibrated digital or beam scales (precision ±0.1 kg) and stadiometers (precision ±0.1 cm) at all Puskesmas nationwide. As this was a retrospective analysis of routinely collected records, facility-specific equipment models and calibration logs were once in a year based on every puskesmas; while national guidelines standardize

the measurement protocol, minor between-facility variation in equipment cannot be entirely excluded (see Limitations). Two parallel three-category classification systems were applied: WHO Global BMI classification: Normal weight (BMI <25.0 kg/m², reference), Overweight (BMI 25.0–29.9 kg/m²), Obese (BMI ≥30.0 kg/m²). WHO Asia-Pacific BMI classification: Normal weight (BMI <23.0 kg/m², reference), Overweight (BMI 23.0–24.9 kg/m²), Obese (BMI ≥25.0 kg/m²).

Both systems were operationalized as three-category variables to enable direct structural comparability. Where the dataset contained more granular sub-categories (e.g., Obese I, Obese II, Morbidly Obese), these were merged into a single Obese category for each system. One participant with underweight BMI under WHO Global criteria (BMI <18.5 kg/m²; n=1) was excluded from WHO Global model analysis.

Covariates

Covariates were selected a priori based on established clinical evidence: (1) maternal age as a continuous variable (years); (2) gestational age at delivery, dichotomized as term (≥37 weeks, reference) versus preterm (<37 weeks); and (3) PIH, as binary (yes/no). Data on anemia and gestational diabetes mellitus were not available for access.

Statistical analysis

All statistical analyses were performed using JASP version 0.18 (University of Amsterdam, Netherlands). Descriptive statistics were calculated for all variables. Between-group differences were assessed using Pearson chi-square tests. Two binary logistic regression models were constructed: Model A (WHO Global BMI + covariates) and Model B (WHO Asia-Pacific BMI + covariates). Crude (unadjusted) and adjusted odds ratios (aOR) with 95% confidence intervals (CI) and Wald p-values are reported for all predictors. Multicollinearity was assessed using Variance Inflation Factor (VIF); VIF <10 was considered acceptable.

Model performance was compared using: AIC (lower = better fit); Nagelkerke R^2 (pseudo-explained variance); and AUC from the ROC curve. Both crude and adjusted models were compared. Sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) from the logistic regression model were assessed at the default classification threshold (p=0.50). Separately, crude screening diagnostic performance was computed using the 'obese' category in each system as the screen-positive threshold, directly reflecting the clinical scenario where women classified as obese receive enhanced surveillance.[20] Reclassification analysis quantified women reclassified from WHO Global 'normal weight' to Asia-Pacific 'overweight' or 'obese' and their LBW rate. Statistical significance: α=0.05 (two-tailed).

Ethical approval

This study received ethical approval from the Health Research Ethics Committee, Faculty of Medicine, Universitas Indonesia (Approval No: 1698/UN2.F1/ETIK/PPM.00.02/2024). The study used anonymized secondary medical record data, and all procedures complied with the ethical principles of the Declaration of Helsinki.

Results

Participant characteristics

A total of 729 participants were included: 368 cases (women who delivered LBW infants) and 361 controls (women who delivered normal birth weight infants), recruited from 10 Puskesmas across Central and East Jakarta. Baseline characteristics are presented in **Table 1**. Preterm delivery was documented in 211 women (28.9%) overall and was strongly associated with LBW case status (70.1% of cases vs. 29.9% of controls delivered preterm; p<0.001). PIH was present in 26 women (3.6%) and was significantly associated with case status (80.8% of PIH-positive women were cases; p=0.003). Maternal age distribution did not differ significantly between cases and controls (p=0.897).

Under WHO Global criteria, 381 participants (52.3%) were normal weight, 242 (33.2%) overweight, and 106 (14.5%) obese; the proportion of LBW cases was 48.8%, 50.4%, and 56.6% respectively across these categories (p=0.366). Under Asia-Pacific criteria, 257 (35.3%) were normal, 127 (17.4%) overweight, and 345 (47.3%) obese; LBW case proportions were 47.9%, 49.6%, and 52.8% respectively (p=0.482). Neither classification achieved statistical significance in bivariate analysis. The key structural difference was the proportion classified as obese: 14.5% (WHO Global) versus 47.3% (Asia-Pacific) a 3.3-fold difference directly attributable to the 5 kg/m² lower obesity threshold of the Asia-Pacific system. Overall, maternal age and pregnancy-induced hypertension (PIH) differed between mothers delivering LBW and normal birth weight infants. Women who delivered LBW infants also had a higher proportion of preterm births than those delivering normal birth weight infants. The distribution of maternal BMI varied depending on the BMI classification system used, with the WHO Asia-Pacific classification categorizing a larger proportion of women as overweight or obese than the WHO Global classification.

Table 1. Baseline characteristics of study participants by birth weight outcome (N=729)

Characteristic	Total (N=729)	Low Birth Weight (n=368)	Normal Birth Weight (n=361)	p-value
Maternal Age, n (%)				
<20 years	46 (6.3%)	22 (47.8%)	24 (52.2%)	0.897[a]
20–35 years (ref.)	579 (79.4%)	292 (50.4%)	287 (49.6%)	
>35 years	104 (14.3%)	54 (51.9%)	50 (48.1%)	
Gestational Age at Delivery, n (%)				
Term (≥37 weeks, ref.)	518 (71.1%)	220 (42.5%)	298 (57.5%)	<0.001[a]
Preterm (<37 weeks)	211 (28.9%)	148 (70.1%)	63 (29.9%)	
Pregnancy-Induced Hypertension (PIH), n (%)				
Yes	26 (3.6%)	21 (80.8%)	5 (19.2%)	0.003[a]
No	703 (96.4%)	347 (49.4%)	356 (50.6%)	
WHO Global BMI Classification, n (%)				
Normal weight (BMI <25.0 kg/m²)	381 (52.3%)	186 (48.8%)	195 (51.2%)	0.366[a]
Overweight (BMI 25.0–29.9 kg/m²)	242 (33.2%)	122 (50.4%)	120 (49.6%)	
Obese (BMI ≥30.0 kg/m²)	106 (14.5%)	60 (56.6%)	46 (43.4%)	
WHO Asia-Pacific BMI Classification, n (%)				
Normal weight (BMI <23.0 kg/m²)	257 (35.3%)	123 (47.9%)	134 (52.1%)	0.482[a]

Overweight (BMI 23.0–24.9 kg/m²)	127 (17.4%)	63 (49.6%)	64 (50.4%)
Obese (BMI ≥25.0 kg/m²)	345 (47.3%)	182 (52.8%)	163 (47.2%)

[a] Pearson chi-square test. BMI = body mass index; BW = birth weight; LBW = low birth weight; PIH = pregnancy-induced hypertension.

Logistic Regression Results

In crude analyses, no BMI category reached statistical significance in either model (all p>0.05; AUC 0.523 vs. 0.524), confirming that BMI alone, without clinical context, has negligible discriminative power for LBW in this population. After adjustment for maternal age, gestational age, and PIH, both models improved substantially.

Across both adjusted models, preterm delivery was the dominant predictor (Model A: aOR 3.03, 95%CI 2.13–4.31, p<0.001; Model B: aOR 3.01, 95%CI 2.12–4.29, p<0.001). PIH was also independently significant (Model A: aOR 2.90, 95%CI 1.05–8.03, p=0.04; Model B: aOR 2.90, 95%CI 1.05–8.02, p=0.040). Maternal age was not significant in either model (p=0.333–0.338). BMI categories were not independently significant in either adjusted model (WHO Overweight: aOR 0.94, p=0.73; WHO Obese: aOR 1.19, p=0.45; AP Overweight: aOR 1.06, p=0.78; AP Obese: aOR 1.08, p=0.66).

Adjusted model performance was comparable between systems: AUC 0.646 (WHO Global) versus 0.634 (Asia-Pacific); Nagelkerke R² 0.095 versus 0.093; AIC 968.83 versus 969.56. At the default classification threshold (p=0.50), both adjusted models produced identical sensitivity (42.1%) and specificity (82.3%). All VIF values were <1.05, indicating no multicollinearity. Full results are presented in **Table 2**.

Table 2. Crude and adjusted logistic regression results: WHO Global vs. WHO Asia-Pacific BMI classification (N=729)

Variable	Crude OR	95% CI	aOR*	95% CI	p†
Covariates (same in both models)					
Maternal age (years)	—	—	0.99	0.96–1.01	0.33
PIH	—	—	2.90	1.05–8.03	0.04*
Preterm delivery (<37 wk)	—	—	3.03	2.13–4.31	<0.001*
Model A — WHO Global BMI Classification (ref: Normal weight, BMI <25.0 kg/m²)					
Overweight (BMI 25.0–29.9 kg/m²)	1.07	0.77–1.47	0.942	0.67–1.32	0.73
Obese (BMI ≥30.0 kg/m²)	1.37	0.89–2.11	1.192	0.74–1.91	0.45
AIC / BIC	1014.53 / 1028.30			968.83 / 996.38	
McFadden R² /Nagelkerke (R²)	0.003 / 0.004			0.053 / 0.095	
AUC	0.523			0.646	
Sensitivity / Specificity (at p=0.5)	—			42.1% / 82.3%	
Overall accuracy	—			62.0%	
Model B — WHO Asia-Pacific BMI Classification (ref: Normal weight, BMI <23.0 kg/m²)					
Overweight (BMI 23.0–24.9 kg/m²)	1.07	0.70–1.64	1.06	0.68–1.67	0.78
Obese (BMI ≥25.0 kg/m²)	1.22	0.88–1.68	1.08	0.75–1.54	0.67
AIC / BIC	1015.08 / 1028.86			969.56 / 997.11	
McFadden R² / Nagelkerke R²	0.002 / 0.003			0.052 / 0.093	
AUC	0.524			0.634	
Sensitivity / Specificity (at p=0.5)	—			42.1% / 82.3%	
Overall accuracy	—			62.0%	

* Adjusted for maternal age (continuous, years), gestational age (preterm vs. term [ref.]), and PIH (yes vs. no [ref.]). Reference categories for BMI: Normal weight in each system. * p<0.05; p<0.001 noted where applicable. aOR = adjusted odds ratio; AIC = Akaike Information Criterion; AUC = area under the ROC curve; CI = confidence interval. All analyses performed in JASP version 0.18.

Screening Diagnostic Performance

Table 3 presents the crude diagnostic performance when the obese category is used as the screen-positive threshold, directly mimicking a clinical screening scenario. The Asia-Pacific classification identified 49.5% of all LBW cases (sensitivity), compared to only 16.3% for the WHO Global system, an absolute improvement of 33.2 percentage points representing a three-fold increase. This corresponds to 345 versus 106 screen-positive women respectively.

The sensitivity gain was accompanied by a reduction in specificity: 54.8% for Asia-Pacific versus 87.3% for WHO Global. PPV (52.8% vs. 56.6%) and NPV (51.6% vs. 50.6%) were comparable between systems. In antenatal screening, where the primary objective is minimizing missed LBW cases, sensitivity is the priority metric.

Table 3. Crude diagnostic screening performance: WHO Global vs. WHO Asia-Pacific obesity thresholds for LBW detection

Classification / Screen-Positive Threshold	Sensitivity	Specificity	PPV	NPV	n screen+
WHO Global — Obese (BMI ≥30.0 kg/m²)	16.3%	87.3%	56.6%	50.6%	106
WHO Asia-Pacific — Obese (BMI ≥25.0 kg/m²)	49.5%	54.8%	52.8%	51.6%	345
Absolute difference (AP − WHO Global)	**+33.2%**	−32.5%	−3.8%	+1.0%	+239

*Screen-positive = classified as obese. WHO Global: BMI ≥30.0 kg/m² (n=106, 14.5% of sample). WHO Asia-Pacific: BMI ≥25.0 kg/m² (n=345, 47.3% of sample). Sensitivity = proportion of LBW cases correctly identified. Specificity = proportion of normal BW cases correctly excluded. NPV = negative predictive value; PPV = positive predictive value. Calculated from crude (unadjusted) classification data.

Reclassification Analysis and Summary

A total of 124 participants (17.0%) were classified as 'normal weight' under the WHO Global system but reclassified as 'overweight' or 'obese' under the Asia-Pacific system. Among these reclassified participants, 63 (50.8%) were LBW cases, a case proportion comparable to the overall case-to-control ratio in this study (50.5%), indicating these women carry substantial LBW risk that is invisible to WHO Global classification and would not be flagged for enhanced surveillance under current Indonesian guidelines. **Table 4** provides a comprehensive comparison of all performance metrics.

Table 4. Comprehensive model performance and screening comparison: WHO Global vs. WHO Asia-Pacific BMI classification

Performance Metric	WHO Global	Asia-Pacific	Interpretation
AIC (crude)	1014.53	1015.08	Similar, both poor without covariates
AIC (adjusted)	968.83	969.56	Similar, WHO marginally lower
Nagelkerke R^2 (crude)	0.004	0.003	Negligible explained variance
Nagelkerke R^2 (adjusted)	0.095	0.093	Comparable; covariates drive model

AUC (crude)	0.523	0.524	Near-chance; BMI alone insufficient
AUC (adjusted)	0.646	0.634	Moderate; dominated by maternal age & PIH
Sensitivity at p=0.5 (adjusted)	42.1%	42.1%	Identical in regression model
Specificity at p=0.5 (adjusted)	82.3%	82.3%	Identical in regression model
Screening sensitivity (Obese as +)	16.3%	49.5%	AP: 3× higher, as key advantage
Screening specificity (Obese as +)	87.3%	54.8%	Trade-off for sensitivity gain
Women reclassified WHO→AP	—	124 (17.0%)	Additional at-risk women identified
LBW rate in reclassified women	—	50.8%	Clinically meaningful

*AIC = Akaike Information Criterion; AP = Asia-Pacific; AUC = area under the ROC curve; PPV = positive predictive value. Logistic regression metrics from JASP version 0.18. Screening sensitivity/specificity computed from crude (unadjusted) classification with obese category as screen-positive threshold.

Discussion

This study compared the WHO Global and WHO Asia-Pacific BMI classifications for identifying pregnant women at risk of delivering low birth weight (LBW) infants in an urban Indonesian population. Two principal findings emerged. First, both BMI classifications demonstrated comparable predictive performance after adjustment for maternal age, preterm delivery, and pregnancy-induced hypertension, indicating that the choice of BMI classification had little influence on overall multivariable model performance. Second, when obesity was used as the screening threshold, the WHO Asia-Pacific classification identified substantially more women who subsequently delivered LBW infants than the WHO Global classification. These findings suggest that although the two BMI classifications perform similarly as predictive models, the Asia-Pacific classification provides greater clinical utility as a screening tool by improving the identification of women who may benefit from closer antenatal monitoring.[21,22]

The higher screening sensitivity observed with the WHO Asia-Pacific classification is consistent with its lower obesity threshold (BMI ≥25.0 kg/m²), which classifies a substantially larger proportion of women as overweight or obese than the WHO Global classification.[19] This broader definition increases the likelihood of identifying women who may already have obesity-related metabolic disturbances despite having BMI values below the conventional WHO obesity threshold.[23,24] Similar findings have been reported among Chinese, Korean, and other Asian populations, where lower BMI cut-offs improved the identification of women at risk of adverse pregnancy outcomes.[25–27] These observations support the use of ethnicity-specific BMI thresholds in Asian populations, where body composition and metabolic risk differ from those of Western populations.[28,29] Our findings are consistent with evidence from China indicating that lower BMI thresholds improve the identification of women at risk for adverse pregnancy outcomes. Wu et al. reported that using the WHO Asian obesity criterion (BMI ≥25 kg/m²) identified nearly four times more obese pregnant women than the Chinese criterion (BMI ≥28 kg/m²), while demonstrating superior predictive performance for obesity-related maternal and perinatal complications. Importantly, women with BMI between 25 and 28 kg/m² had risks comparable to those with BMI ≥28 kg/m², suggesting that reliance on higher BMI thresholds may underestimate clinically important risk among Asian pregnant women.[16] Similarly, Zhao et al. found that pregnancy complications began to increase significantly at BMI values around 23 kg/m², supporting lower BMI thresholds for risk stratification among women of reproductive age in Asian populations.[30]

In parallel, evidence from other Asian populations further demonstrates the clinical relevance of lower BMI thresholds. A nationwide Korean cohort reported that increasing pre-pregnancy BMI based on the WHO Asia-Pacific classification was associated with progressively higher risks of adverse maternal and neonatal outcomes, although LBW was not specifically evaluated.[27,31] Similarly, a recent systematic review and meta-analysis confirmed that higher pre-pregnancy BMI is associated with adverse neonatal outcomes, including LBW and preterm birth.[32] In Indonesia, Battung et al. further demonstrated that Asian-specific BMI criteria improved the identification of women at risk of adverse pregnancy outcomes compared with conventional WHO classifications, supporting the use of population-specific BMI thresholds in clinical practice.[19]

The improved screening performance of the WHO Asia-Pacific classification is biologically plausible because Asian populations have higher body fat percentages and greater cardiometabolic risk at lower BMI values than Western populations.[32,33] These metabolic disturbances may impair placental function and fetal nutrient transfer through chronic inflammation, oxidative stress, and endothelial dysfunction, thereby increasing the risk of fetal growth restriction and LBW.[34,35] Consequently, women with BMI 25.0–29.9 kg/m² may already carry clinically important metabolic risks despite being classified as overweight under WHO Global criteria.[25,26]

The biological rationale for lower BMI thresholds in Asian populations is well established. Asian individuals exhibit substantially higher percentage body fat, greater visceral adipose tissue accumulation, and elevated cardiometabolic risk at BMI values categorized as 'normal' or 'overweight' by WHO Global criteria, owing to lower skeletal muscle mass and differences in fat distribution and adipokine profiles.[36,37] These metabolic perturbations, particularly insulin resistance and low-grade inflammation adversely affect placental development, trophoblast invasion, and fetal nutrient delivery, increasing the risk of intrauterine growth restriction and LBW.[38,39] Women with BMI 25.0–29.9 kg/m² who are classified as 'overweight' under WHO Global criteria but 'obese' under Asia-Pacific criteria may already exhibit these adverse metabolic characteristics, justifying the Asia-Pacific classification's treatment of this stratum as high-risk.[40]

An important implication of this study is the distinction between predictive modelling and clinical screening. Although both BMI classifications demonstrated similar regression performance, the WHO Asia-Pacific classification substantially increased case detection, indicating greater utility for antenatal screening.[12,41,42] Adoption of this classification may facilitate earlier nutritional counselling, gestational weight monitoring, and closer surveillance among women at increased risk.[43,44] Nevertheless, BMI should be regarded as a population-level screening tool rather than a definitive measure of individual health and should be interpreted alongside other clinical assessments.[29,37] Consistent with this approach, the FIGO guideline recommends preconception BMI assessment and individualized nutritional counselling as key components of obesity management during pregnancy.[45]

This study has several strengths. To our knowledge, it is the first study in Indonesia to directly compare the screening performance of the WHO Global and WHO Asia-Pacific BMI classifications for identifying women at risk of low birth weight within the same population. Additional strengths include complete ascertainment of LBW cases across 10 primary healthcare centers, a relatively large sample size (N = 729), and the evaluation of both predictive model performance and diagnostic screening performance, providing a more comprehensive assessment of BMI classification utility.

Several limitations should also be acknowledged. First, parity, anemia, and gestational diabetes data were unavailable, leaving the possibility of residual confounding. Second, the unmatched case-control design limits causal inference and may introduce selection bias. Third, the findings were derived from urban primary healthcare centers in Jakarta and may not be fully generalizable to other populations; given Indonesia's substantial ethnic and geographic diversity, BMI–LBW associations and the relative performance of WHO Global versus Asia-Pacific thresholds may differ in rural, other-island, or ethnically distinct populations, and should be verified before national extrapolation. Finally, the retrospective use of routinely collected medical records may have introduced information bias despite standardized data extraction procedures. In addition, although anthropometric measurement followed a nationally standardized antenatal care protocol, facility-level equipment calibration records were not available for independent verification across the 10 Puskesmas, which may have introduced minor measurement variability. Prospective multicenter studies with more comprehensive clinical data are warranted to validate these findings.

Conclusions

In this urban Jakarta case-control population, the WHO Asia-Pacific BMI classification substantially improved the identification of pregnant women at risk of low birth weight while maintaining comparable predictive performance to the WHO Global classification. These findings support consideration of population-specific BMI thresholds in antenatal nutritional screening among Asian populations; however, given the ethnic and geographic diversity of Indonesia, further multicenter and rural studies are warranted before generalizing these findings nationally.

Conflict of interest

The authors declare that there are no conflicts of interest.

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Author Contributions

MIBP: Conceptualization, methodology, formal analysis, data curation, investigation, writing—original draft preparation, writing—review and editing, and final approval of the version to be published. DO: Conceptualization, methodology, validation, supervision, writing—review and editing, and final approval of the version to be published. RI: Data curation, validation, supervision, writing—review and editing, and final approval of the version to be published. DNC: Data curation, validation, supervision,

writing—review and editing, and final approval of the version to be published. All authors have read and approved the final version of the manuscript.

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