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# A systematic review of the prevalence and phenotypic characteristics of hemoglobin Malay in Southeast Asia

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**Abstract** BACKGROUND: Hemoglobin (Hb) Malay is a beta-globin variant associated with a beta(+)(+)-thalassemia phenotype, resulting from a point mutation at codon 19 of the beta-globin gene. Data on its prevalence and phenotypic characteristics remain fragmented. AIMS: This study aimed to determine the prevalence of Hb Malay and describe its phenotypic spectrum across different regions. METHODS: A systematic literature search was conducted using Medline (PubMed), CINAHL (EBSCOhost), and ScienceDirect. Relevant studies published from database inception to 2024 were screened according to predefined eligibility criteria. Meta-analysis was performed using Review Manager (RevMan) version 5.4. Pooled prevalence estimates were calculated, and outcomes were reported with corresponding 95% confidence intervals. RESULTS: Twenty-two studies involving 19,956 participants were included. Due to substantial heterogeneity among studies ( $I^2 = 86\%$ ,  $P < 0.001$ ), a random-effects model was applied. The overall pooled prevalence of Hb Malay was 3.53%. The highest prevalence was observed in Indonesia (12.18%), followed by Thailand (3.43%), Malaysia (3.02%), and Singapore (0.75%). CONCLUSION: This study represents the first comprehensive meta-analysis of Hb Malay prevalence and phenotypic characteristics over 30 years (1990-2024). Although Hb Malay is a relatively rare Hb variant largely confined to Southeast Asia, its clinical relevance is significant, particularly when coinherited with other beta-thalassemia mutations, which may modify disease severity and increase transfusion requirements. These findings provide valuable evidence to inform regional thalassemia screening strategies and support targeted genetic counselling programmes.

**Keywords** Author Keywords: Hemoglobin Malay; prevalence; Southeast Asia; beta++-thalassemia  
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