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Development of Respirator Fit Test Panel Representing the Population of Malaysia

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Effective respiratory protection depends critically on the proper fit of respirators to users' facial features. Existing fit test panels, such as those developed in the United States, China, and Taiwan, do not accurately represent the craniofacial dimensions of the Malaysian population, thus potentially compromising the protective efficacy of respirators used locally.

This study aimed to

- (1) Evaluate the reliability and accuracy of 2D photogrammetry compared to direct anthropometric measurement;
- (2) Develop a national database of head and facial morphological dimensions; and
- (3) Construct population-specific facial panels for Malaysia using both bivariate and Principal Component Analysis (PCA) approaches.

A cross-sectional survey was conducted using multistage random sampling based on the National Census 2020, encompassing 3,324 participants across Malaysia. Measurements included ten key craniofacial dimensions. Findings showed that 2D photogrammetry had poor reliability for certain parameters, notably bigonial, bizygomatic, and head breadths, indicating limitations for clinical or occupational applications.

The study revealed significant craniofacial variation by sex, ethnicity, and birthplace. Compared to U.S. and Chinese populations, Malaysians exhibited notably wider interpupillary and nasal breadths but smaller bigonial and frontal widths. The resulting Malaysian bivariate and PCA facial panels demonstrated superior coverage—95.0% and 95.6%, respectively—compared to foreign panels.

This is the first nationally representative study on Malaysian facial anthropometry and has important implications for local respirator manufacturing, occupational safety, and public health preparedness, particularly in airborne infectious disease control.

Keywords: Facial Anthropometry, Respirator Fit Test Panel, Malaysia, 2d Photogrammetry, Personal Protective Equipment (PPE) and Principal Component Analysis