Background

Cardiovascular diseases (CVDs), mainly ischaemic heart disease (IHD) and stroke are the foremost causes of worldwide mortality and are signi cant contributors to disability [1]. In Malaysia, the burden of mortality and morbidity associated with CVD has been on the rise for the past three decades [2]. It was the number one cause of death and contributed approximately 21.65% and 23.79% of all ten principal causes of death in 2018 [3].

e signi cant risk factors for CVD identi ed in Malaysia are hypertension, diabetes, high cholesterol levels, and obesity [2–4]. An increased incidence of and mortality from CVD has an indirect relationship with modi able risk factors [3].

e increasing incidence of CVD can be ascribed to the rapid phenomenon of urbanisation, sedentary behaviour adoption, and alterations in dietary habits [5]. CVD-related mortality can be reduced by predicting CVD risk and subsequently reducing CVD risk factors. As part of CVD prevention and control e orts, a reliable risk predictor for identifying high-risk populations is needed.

is approach facilitates the possibility of estimating and monitoring the distribution of CVD risk at the population level, with the goal of informing recommendations for CVD treatment policies [6]. To predict the risk of CVD over a 10-year period, numerous risk prediction models have been developed. e 2019 WHO CVD prediction chart, Framingham, INTERHEART, SCORE, GLOBORISK, and the Pooled Cohort Equation are among the current CVD risk calculators that have been evaluated in various populations [7]. We utilised the 2019 WHO CVD prediction chart for our analysis. is tool leverages comprehensive contemporary estimates of cardiovascular disease incidence and risk factor values to adapt (i.e., recalibrate) the risk models for diverse populations using a simpler and more generalisable approach [8]. Furthermore, the recalibration methodology allows for rapid updates to the CVD models, ensuring ex-

capillary blood glucose levels above 7.0 mmol/L or a random blood glucose equal or above 11.1 mmol/L or if the respondent was told by medical personnel to have high glucose [11]. Physical inactivity was assessed using the International Physical Activity Questionnaire (IPAQ) [4]. According to the IPAQ, individuals who do not meet the criteria for Categories 2 or 3 are considered "insu - ciently active". Category 2, or "su ciently active," includes individuals who meet any of the following three criteria: engaging in vigorous activity for at least 20 minutes per day on three or more days per week; engaging in moderate-intensity activity or walking for at least 30 minutes per day on ve or more days per week; and participating in any combination of walking, moderate-intensity, or vigorous-intensity activities that accumulate at least 600 Metabolic Equivalent of Task (MET)-minutes per week [4]. Meanwhile, Category 3, or "Health Enhancing Physical Activity(HEPA) active" (a more active category), includes individuals who engage in vigorous-intensity activity for a minimum of 1500 MET-minutes per week on at least three days, and participate in any combination of walking, moderate-intensity, or vigorous-intensity activities that accumulate at least 3000 MET-minutes per week [4]. Marital status was categorised into two: married and not married [12, 13]. Meanwhile, education levels were categorised into four groups: non-formal education, primary education, secondary education, and tertiary education [14, 15]. For occupational status, categories were de ned as employed and unemployed [16].

Factors associated with 10-year risk for CVD among adults in Malaysia

e factors associated with the 10-year risk of CVD, as determined by a logistic regression model, are detailed in Table 4. e crude logistic regression analysis was rst conducted to screen potential variables for inclusion in the adjusted model. Following the results of the crude logistic analysis, all variables were found to be associated with CVD risk and those variables which also deemed important due to biological plausibility were included in the model for the adjusted logistic model. ese variables included occupational status, education levels, obesity status, and physical inactivity.

Multicollinearity checks revealed no issues. However, the interaction term between obesity status and physical inactivity showed evidence of association with CVD risk. erefore, we present our nal model, adjusted for marital status, occupational status, education levels, obesity status, physical inactivity, and the interaction term between obesity status and physical inactivity.

Our nal model suggests that unemployed individuals may be more likely to develop CVD within the next ten years compared to employed individuals (aOR = 1.88, 95% CI = 1.47 − 2.40). Similarly, individuals with non-formal education and primary education were 2.36 times (95% CI

both factors together. erefore, our nal model will consider this interaction e ect to provide a more accurate understanding of CVD risk in the population.

Discussion

In the present study, utilising a sample from a population that is representative of the entire nation, it was determined that most adults, speci cally 72.6%, exhibit a low cardiovascular disease (CVD) risk level, de ned as a level less than 10%. According to a study published in the Lancet in 2019, the majority of nations in Southeast Asia exhibit a CVD risk level less than 10% [8]. e prevalence of individuals with minimal CVD risk is comparatively

the adjusted model with the interaction term indicates that physical inactivity signi cantly modi es the impact of obesity on CVD risk. is observation is supported by a study showing that individuals who are obese and engage in limited physical activity have a higher risk of CVD than those who maintain normal weight and engage in high levels of physical exercise [31]. In public health campaigns, it is crucial to prioritise the promotion of physical activity among people while also emphasising the importance of managing body weight [31].

ere is a pressing necessity to promptly execute e - cacious interventions for the targeted population (particularly individuals who are unemployed, those with non-formal and primary education, physically inactive and obese) to mitigate the avoidable burden of cardiovascular diseases in Malaysia. is urgency arises from the projected estimation that approximately 677,533 individuals will be at a high or very high risk of experiencing CVD events within a decade. A comprehensive approach encompassing the identi cation and mitigation of several risk factors, the promotion of healthy lifestyles, and the enhancement of healthcare systems is necessary. Public health campaigns, a ordable screening programmes, and promotion of physical exercise are e ective measures that governments can employ to decrease cardiovascular risk. Policy measures should be implemented to promote nutritional education, impose limitations on the advertising of unhealthy food, and facilitate the integration of care. Implementing workplace wellness programmes and speci cally targeting interventions towards high-risk populations, such as the unemployed and individuals with lower levels of education, are also of utmost importance.

NCDs have been recognised as the leading factor responsible for 72% of premature mortality cases in Malaysia, with CVD emerging as the dominant contributor to this outcome [32]. According to the Organisation for Economic Cooperation and Development (OECD), premature mortality has severe repercussions for economies, healthcare systems, and families, leading to extensive implications for productivity, equity, and social well-being. is statement emphasises the pressing need for comprehensive initiatives aimed at reducing economic losses, guaranteeing healthcare accessibility, and fostering societal resilience, as highlighted by the World Health Organisation in 2017.

Strengths and limitations

To the best of our knowledge, this study represents an inaugural endeavour in Malaysia to employ the 2019 WHO CVD risk prediction model for the purpose of estimating CVD risk. e present study also utilised a substantial dataset derived from the NHMS 2019, which is a representative sample of the adult population in Malaysia. When assessing our ndings, it is crucial to consider the constraints associated with this analytical approach. Models pertaining to the 10-year risk of CVD have been recalibrated by incorporating data from the GBD project, with the aim of ensuring accurate representation of LMICs. Nevertheless, the GBD data lack nation-speci c disease risk estimates [6]. Hence, it is probable that the estimation obtained from the chart for each region would be relevant to the largest country within that region or the country from which most of the data are sourced. According to Islam et al. (2020), risk prediction charts provide approximate assessments of CVD risk for persons who do not have a prior history of CHD, stroke, or other atherosclerotic diseases. In addition, the current study was a cross-sectional study; thus, the ndings need to be con rmed with a cohort study.

Conclusions

Approximately 5% or 680,000 adults in Malaysia are at high or very high risk of experiencing CVD events, respectively. Individuals who are unemployed, had lower education status, those obese with physically inactive are at higher risk and therefore should be targeted for public health interventions. Reducing cardiovascular risk necessitates a holistic approach involving multiple organisations to identify risk factors, promote healthy lifestyles, and improve healthcare systems. Key strategies include public health campaigns, a ordable screenings, exercise promotion, nutritional education, advertising restrictions on unhealthy foods, integrated care, workplace wellness programmes, and targeted interventions for high-risk groups.

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with a literate person acting as a witness. The survey protocol was approved by the Medical Research and Ethics Committee (MREC), Ministry of Health Malaysia (NMRR-18-3085-44207(IIR)).

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

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