# UNIVERSITI TEKNOLOGI MARA

# PLASMA POLYCHLORINATED BIPHENYLS DETECTION AMONG ADULTS WITH METABOLIC SYNDROME AND THEIR ASSOCIATION WITH HOUSE CHARACTERISTICS, RESIDENT'S BEHAVIOUR, PERCEIVED INDOOR AIR QUALITY, AND DIETARY CONSUMPTION AT UITM PRIMARY CARE MEDICINE CLINIC

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# ABSTRACT

Polychlorinated biphenyls (PCBs) are Persistent Organic Pollutants (POPs) targeted for elimination by 2028 due to their environmental persistence and health risks. However, there is scarce information on the prevalence of PCBs in human plasma, especially among the Metabolic Syndrome (MetS) population, which is vulnerable to lifestyle and environmental-related health risks. To address this gap, this study examined the prevalence of five highly chlorinated PCB congeners (PCB 153, 180, 194, 206, and 209) in the plasma of adults with MetS and their association with house characteristics, resident behaviour, perceived indoor air quality (PIAQ), and dietary consumption. A cross-sectional study was conducted among 129 MetS patients at the UiTM PCM clinic. Plasma PCB was measured under a national project entitled "Elucidating the Effects of Persistent Organic Pollutant - Polychlorinated Biphenyls Exposure on Atherosclerosis Development Among Adults with and without MetS." House characteristics and residents' behaviour were assessed in terms of the general condition of the house, ventilation methods, cooking practices, and cleaning habits, which consisted of 20 questions that were content validated by an expert panel to ensure accuracy in evaluating PCB exposure factors. The participant's diet was assessed using a 203-item food frequency questionnaire, while PIAQ was based on seven subjective factors, including temperature, odour, and humidity. The association between these factors and plasma PCBs was identified using logistic regression analysis. The study result indicated that at least one PCB congener was detected in 96% of plasma samples, with PCB 206 being the most prevalent. PIAQ significantly predicted all PCB congeners, with perceived hot temperatures associated with PCB 153 (AOR: 2.7167, 95% CI: 1.2705 – 5.8089) and 194 (AOR: 2.3506, 95% CI: 1.1305 – 4.9423) detections. Conversely, perceived cold temperatures show a protective effect against PCB 180 (AOR: 0.2118, 95% CI: 0.0427 – 0.9905) but increase the risk of PCB 209 detection (AOR: 7.7360, 95% CI: 1.2422 – 48.177), indicating the complex relationship between indoor temperature and PCB exposure. Unpleasant odours were associated with higher risks of PCB 194 (AOR: 8.5742, 95% CI: 2.3955 – 30.6899) and 206 (AOR: 3.1129, 95% CI: 1.0220 – 7.5797), indicating that sensory perceptions might indicate environmental contamination. In terms of house characteristics and resident behaviour, building age, fan use, and carpet application were associated with increased PCB detection risks, while weekly mopping reduced them. The study also addresses dietary factors, identifying fish and dairy consumption were associated with a higher risk of PCB 180 and 206 detections (AOR: 1.0880, 95%CI: 1.0064 – 1.0996) and (AOR: 1.0065, 95% CI: 1.0009 – 1.0128), respectively, while fruit and vegetable consumption shows a protective effect (AOR: 0.9982, 95% CI: 0.9968 – 0.999). In conclusion, the threat of PCBs is still prevalent in the population. These findings underscore the need for comprehensive strategies to manage PCB exposure, particularly in vulnerable populations such as those with MetS, by optimising indoor environmental conditions, enhancing ventilation and cleaning practices, and making informed dietary choices.

Keywords: environmental pollutant, ingestion, inhalation, human exposure, body burden

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# CHAPTER ONE
# INTRODUCTION

## 1.1 Research Background

Polychlorinated biphenyls (PCBs) are a group of toxic environmental pollutants categorised as persistent organic pollutants (POPs). The commercial production of PCBs started in 1929, with an estimated total production of around 1.5 million (UNEP, 2020). Owing to their thermal and chemical stability, PCBs have been used in several commercial and industrial settings, including as dielectric fluids for capacitors and transformers, plasticisers, printing inks, carbonless copy paper, adhesives, sealants, paints and lubricants, hydraulic fluids and laminating and impregnating agents (US EPA, 2022a).

Because of their significant adverse effects on human well-being and ecosystems, the manufacturing of PCBs was banned in the United States of America (USA) in 1979 under the U.S. Toxic Substance Control Act. As a result, the Stockholm Convention (SC) was established by the United Nations Environment Programme (UNEP) in May 2001 to eliminate PCB-containing products by 2025 and manage the rest in an environmentally sound manner by 2028. Following this effort, the international ban on PCBs was enacted on 17 May 2004 (UNEP, 2021b).

Elimination of PCB is still a long way to go, as only 3 million tons of PCB products have been eliminated as of 2016 (Figure 1.1). Meanwhile, 83% of PCBs (14 million tons) still exist in the environment, indicating that the exposure risk has not yet ended (UNEP, 2021a). Of these, only 30% of the countries are on track to reaching their goals. According to the report on the progress towards the elimination of PCB in February 2019, countries face difficulties in estimating quantitative PCB data due to (1) incomplete national reporting by the parties, (2) limited coverage of the survey, (3) incomplete and inconsistent inventories, (4) lack of analytical methods to identify waste containing PCB, and (5) diverse interpretation of the meaning of "PCB in use" (UNEP, 2019a). PCBs are still slowly and continuously being released by the products manufactured before the ban and dumped as waste into the environment. They are found in the environment matrices and the food chain.