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REVIEW ARTICLE

Non-Communicable Diseases Among Orang Asli in Malaysia: A Scoping Review of Prevalence and Associated Factors

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ABSTRACT

Non-communicable diseases (NCDs), including cardiovascular diseases, diabetes, chronic respiratory diseases, and cancer, pose significant public health challenges globally and in Malaysia. The Orang Asli, an indigenous community in Malaysia, faces unique health challenges due to socioeconomic disparities and lifestyle changes. This scoping review synthesizes existing literature on the prevalence and determinants of NCDs among the Orang Asli, aiming to identify research gaps and inform public health strategies. We conducted a systematic search across databases including PubMed, Scopus, Google Scholar, and Web of Science, identifying 15 relevant studies from an initial pool of 573 records, following PRISMA guidelines. The review reveals significant variability in the prevalence of hypertension (3.3% to 57.2%), diabetes mellitus (0.8% to 25%), and dyslipidaemia (1.5% to 41.4%) among the Orang Asli. Other conditions such as gout and asthma were noted with prevalences of 2.7% and 0.4%, respectively. Factors associated with NCD prevalence include older age, female gender, lower education levels, poor dietary habits, physical inactivity, smoking, obesity, genetic predispositions, and the impacts of urbanization and modernization. Addressing the NCD burden requires multifaceted strategies, including culturally sensitive health promotion, improved healthcare access, and the preservation of traditional practices. This review underscores the urgent need for targeted interventions to mitigate the rising NCD burden in this vulnerable

population.

Contribution/Originality: This study provides a comprehensive synthesis of evidence on non-communicable diseases (NCDs) among the Orang Asli, focusing on the role of sociodemographic factors such as age, gender, and education, as well as the impact of urbanization on health outcomes. By identifying key demographic and environmental variations in NCD prevalence, this review offers critical insights for targeted and culturally sensitive public health interventions.

1. Introduction

Cardiovascular disease, diabetes, chronic respiratory diseases, and cancer are some of the most prevalent non-communicable diseases (NCDs) that affect human health worldwide. They are the primary drivers of morbidity, mortality, and increased healthcare expenditures globally (Vos et al. 2020; WHO, 2014). NCDs are also affected the Orang Asli, the indigenous people living in Peninsular Malaysia who are considered marginalized and live at the periphery of Malaysian society and who experience specific and peculiar lifestyle and diet related NCD risk factors (Wong et al., 2018).

The Orang Asli accounting for about 0. 8% of the Malaysia's population, are identified as those people whose father is an indigenous person of Malaysia, who speaks an indigenous language and follows indigenous cultures and traditions (Ministry of Transport Malaysia, 2010; Syed Hussain et al., 2017). Specifically, this group is divided into 18 ethnic subgroups categorized into three main tribes: the Negrito, which comprises the Bateq, Jahai, and Kensiu; the Senoi, which includes the Temiar, Che Wong, and Semai; and the Proto Malay, which includes the Temuan, Kuala, and Jakun (Masron, Masami, & Ismail, 2013).

In addition, Orang Asli is also associated with low socioeconomic status, poor education, and higher incidence of health problems (Khor & Zalilah, 2008). These discrepancies are most profound regarding their geographical distribution across rural and remote regions, with the highest population density in Pahang, mainly originating from the Senoi ethnic group (JAKOA, 2021). Since 1970s, the Malaysia government has attempted to provide education, health facilities and resettlement to improve the living standards of Orang Asli. However, most of them still lead a traditional and nomadic lifestyle, which influences their health perceptions and compliance with disease treatments (Shah et al., 2018).

Moreover, developments and modernization strategies initiated by the Malaysian government, especially through the Department of Orang Asli Development (JAKOA), have changed disease patterns within these communities. The changing lifestyles brought about by the adoption of urban life, especially in areas near townships, bring new forms of illnesses due to sedentary lifestyle and changes in diets (Mahmud et al., 2022; Othman et al., 2012). For that reason, this transition highlights the importance of determining how genetic influences, socio-economic status, and culture influence the prevalence of NCDs among the Orang Asli.

While these trends are rarely captured by national surveys, university researchers have documented the epidemiological transition of the Orang Asli, revealing a transformation in the health environment (Mahmud et al., 2022; Othman et al., 2012). Given the

hypothesis that urbanization is associated with an increase of NCDs, mean that there is need to critically review available data in order to accurately assess their health status. (Angkurawaranon et al., 2014). Urbanization-related changes in sedentary lifestyles, diets, healthcare-seeking behavior and disease perception have led to concerns of a rising NCDs burden among the Orang Asli.
Therefore, this scoping review aims to identify the information available on NCDs among the Orang Asli, specifically about their prevalence and associated factors.

2. Materials and Methods

This scoping review was conducted in line with the frameworks provided by Arksey and O'Malley and further refined by the Joanna Briggs Institute (Arksey & O'Malley, 2005; Peters et al., 2017). The study protocol conformed to the PRISMA-ScR checklist for reporting systematic reviews with scoping review (Tricco et al., 2018). All the data used in this review are available from public domain.

2.1. Search Strategies

To ensure that all the relevant studies that could be included in this scoping review were captured, an extensive search approach was used. The electronic databases such as PubMed, Scopus, Google Scholar, and Web of Science were used to search for the eligible studies from the last ten years up to December 15, 2023. The following search strategy combined keywords and Medical Subject Headings (MeSH) terms:

i. "NCD's" [Title/Abstract] OR Non-communicable disease [Title/Abstract] OR "Cardiovascular" [Title/Abstract] OR "Hypertension" [Title/Abstract] OR "Diabetes" [Title/Abstract] OR "Blood Sugar" [MeSH Terms] AND
ii. "Orang Asli" [MeSH Terms] OR "Indigenous" [MeSH Terms] OR "Aborigine" [MeSH Terms] AND "Malaysia" [MeSH Terms].

2.2. Inclusion and Exclusion Criteria

The type of studies included in the review aimed at assessing the prevalence, associated factors, and epidemiological characteristics of NCDs among Orang Asli in Peninsular Malaysia. The inclusion criteria were full-text articles published in Malay or English language only, which were published from January 1, 2013, to December 15, 2023. The exclusion criteria involved the studies that were not relevant to NCDs among the Orang Asli, the studies conducted outside of Peninsular Malaysia, and the articles published in languages other than Malay or English.

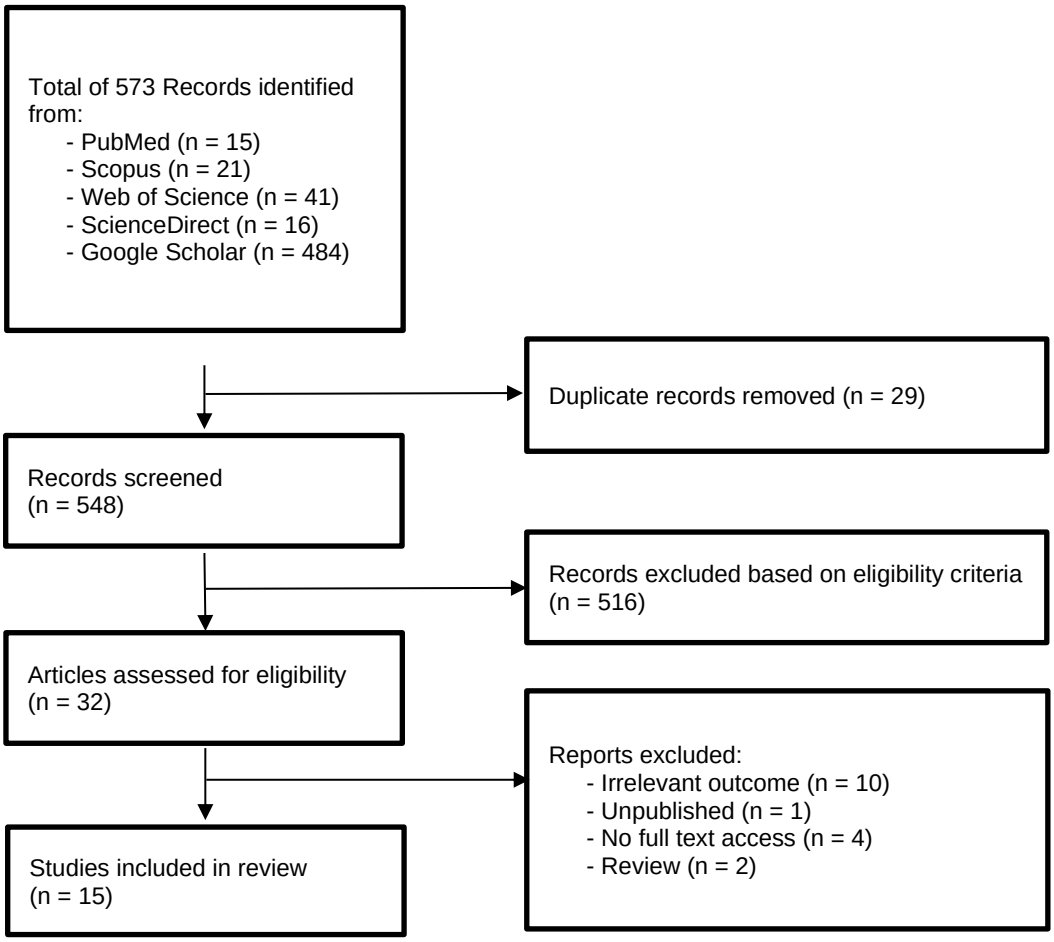
2.3. Selection Process

Study selection was done by two reviewers who scanned the titles and abstracts of the identified records against the predetermined inclusion criteria. Any studies that have titles containing specific keywords were undergo screening. The abstracts were reviewed to categorize the studies as either relevant, not relevant, or potentially relevant. Any conflict was handled through the discussion or consultation with the third reviewer. After careful filtering, articles that were found to be duplicates were excluded from the study. If there is any confusion or if additional clarification is required, the corresponding authors will be emailed for the selection of their articles for review.

A systematic search across multiple databases yielded a total of 573 records, distributed as follows: 15 articles were published in PubMed, 21 in Scopus, 41 in Web of Science, 16 in Science Direct, and 484 in Google Scholar. Out of 573 records initially identified, 29 were duplicates, leaving a pool of 548 records for the first stage of screening. During this process, 516 records were excluded for being outside the scope of the study, leaving 32 articles for eligibility review. Of these, 17 articles were excluded based on the predefined inclusion and exclusion criteria, such as irrelevant outcomes or lack of full-text access. This process resulted in 15 studies being included in the final synthesis.

The study selection process and results are depicted in a flow diagram based on the PRISMA guideline (Figure 1).

Figure 1: PRISMA flow diagram for scoping review



2.4. Data Extraction and Synthesis

The following systematic approach was used in the extraction of data from the selected studies: To structure the information obtained, a standardised form was created with the following fields of study characteristics (for instance, design of the study, the year of publication), sample characteristics, prevalence rates of NCDs, factors determining these diseases, and interventions or public health strategies mentioned in the study. To enhance the validity and reliability of this process, two independent researchers performed this task. Disagreements were discussed and solved informally. In case of any difficulties, a third reviewer was asked for a decision.

Subsequently, the data extracted from the studies were narratively synthesized to present the results. This involved identifying and compiling concise information about NCDs affecting the Orang Asli population. Thematic analysis was employed to synthesize the findings and establish a narrative from the literature, aiming to identify patterns, trends, and emerging themes. The synthesis aimed to provide a comprehensive overview of the prevalence, contributing factors, and epidemiology of NCDs as they affect the Orang Asli.

3. Result

3.1. Prevalence of NCDs among Orang Asli

Table 1 shows the reported prevalence of hypertension, diabetes mellitus, dyslipidaemia and other NCDs among the Orang Asli as documented in the studies under review. The prevalence of hypertension varied significantly, ranging from 3.3% in the Semai tribe (Shalihin et al., 2019) to 57.2% in the Negrito tribe (Mokhsin et al., 2018). For diabetes mellitus, the prevalence ranged from 0.8% in the Temiar tribe (Nizaruddin et al., 2022) to 25.0% among the Jakun tribe (Wong et al., 2018). Dyslipidaemia showed considerable variability, with prevalence ranging from 1.5% in the Temiar tribe (Nizaruddin et al., 2022) to 41.4% among Orang Asli in Perak (Ahmad et al., 2018). Other non-communicable diseases included gout and asthma, with Nizaruddin et al. (2022) reporting prevalences of 2.7% and 0.4%, respectively, among the Temiar tribe.

3.2. Factors associated with NCDs among Orang Asli

Table 2 presents a synthesis of the main findings from studies reviewed in relation to risk factors for NCDs among Orang Asli. The reviewed studies identified several key factors associated with the prevalence of non-communicable diseases (NCDs) among the Orang Asli. These factors include education level, socioeconomic status, dietary habits, age, gender, lifestyle factors, obesity, genetic predisposition, and the effects of urbanization and modernization.

3.3. Key Findings

Age emerged as a significant predictor of NCD prevalence among the Orang Asli. For instance, Wong et al. (2018) established that older age was significantly associated with hypertension (OR = 3.171, $p = 0.0056$) and diabetes mellitus (OR = 2.345, $p = 0.021$), with lower education levels also predicted hypertension among the Jakun Orang Asli (adjusted OR = 13.379, $p < 0.05$). Similarly, Sugathan et al. (2021) found that age was a significant factor for metabolic syndrome (MetS), with higher prevalence observed in individuals above 45 years ($p < 0.05$) among rural indigenous populations. Ahmad et al. (2018) highlighted that the clustering of cardiovascular risk factors, including obesity (37% of Orang Asli and 41.6% of rural Malays, $p = 0.013$), hypertension, and dyslipidemia, was more prevalent among older Orang Asli (age above 45 years old). Chua et al. (2017) also noted that older age significantly increased the risk of hypertension among the Jah Hut tribe (OR = 2.917, $p = 0.004$).

Table 1: Prevalence of Non-Communicable Diseases (NCDs) Among Orang Asli in Various Studies

Author(s) (Year)	Primary Objective	Study Design	Orang Asli Sub-tribe	Sample Size	Hypertension (%)	Diabetes Mellitus (%)	Dyslipidaemia (%)	Others (%)
Wong et al. (2018)	To identify the prevalence of hypertension, diabetes mellitus, and dyslipidemia among the Jakun Orang Asli population and examine the association with risk factors	Cross-sectional	Jakun	72	41.7	25	High TC: 6.9	NA
Ithnin et al. (2020)	To evaluate the prevalence, knowledge, attitude, and practices of non-communicable diseases (NCDs) among adult Orang Asli and Malay ethnicity in Negeri Sembilan, Malaysia	Cross-sectional	Temuan	325	14.8	4.3	High TC: 5.2	NA
Nizaruddin et al. (2022)	To identify the prevalence of NCD, determine the appropriate medications used for NCD, and compare the physician prescribing pattern	Cross-sectional	Temiar	259	18.5	0.8	High TC: 1.5	Gout:2.7 Asthma: 0.4
Sugathan et al. (2021)	To assess knowledge, attitude, and practices of non-communicable diseases (NCDs) among adult Semelai Orang Asli in Central Pahang, Malaysia	Cross-sectional	Semelai	251	20.7	9.6	High TC: 8.8	NA
Ahmad et al. (2018)	To determine the prevalence and clustering of CVD risk factors in adult, non-diabetic, rural Malays and Orang Asli in Perak, Malaysia	Cross-sectional	NA	133	19.5	3	High TC: 41.4 High TG: 31.8 High LDL-C: 38.3 Low HDL-C: 48.9	NA
Chua et al. (2017)	To assess the ability of obesity indices to predict hypertension among indigenous adults of Peninsular Malaysia	Cross-sectional	Jah Hut	482	25.5	NA	NA	NA
Mohamud & Suraiami (2010)	To determine the current status of diabetes, impaired fasting glucose (IFG),	Cohort	Temuan	119	NA	8.4	High TG: 9.8 Low HDL-C: 44.6	NA

	and metabolic syndrome (MetS) among the OA living in four rural resettlement areas.							
Phipps et al. (2015)	To describe the cardio-metabolic risk factors of seven indigenous communities in Malaysia	Cross-sectional	Seletar, Jakun, Mahmeri, Semai, Jehai, Mendriq, Batek	636	29.6	4.6	High TG: 23.9 Low HDL-C: 45.8	NA
Yeo et al. (2019)	To address the anthropometrics and cardio-metabolic health of a resettled Temiar community in Perak	Cross-sectional	Temiar	72	23.2	2.9	NA	NA
Yeo et al. (2022)	To determined the association between the human microbiota and cardiometabolic health of Orang Asli communities	Cross-sectional	Temuan, Temiar, Jehai	102	21.5	6.9	High TC/HDL: 26.5 High LDL/HDL:24.8	NA
Law et al. (2020)	To investigate the predictors of overweight and obesity and its association with blood pressure and quality of life among Senoi OA women.	Cross-sectional	Senoi	355	20.9	NA	NA	NA
Shalihin et al. (2019)	To identify the prevalence of non-communicable diseases among the adult population of Orang Asli in the remote area of Pahang	Cross-sectional	Semai	30	3.3	NA	NA	NA
Ali et al. (2016)	To investigate the prevalence of metabolic syndrome among the Orang Asli aborigines and compare it with the nearby Malay rural community in Perak, Malaysia	Cross-sectional	Senoi	135	34.8	4.4	High TG: 22.2 Low HDL-C: 86.7	NA
Aghakhanian et al. (2019)	To investigate the occurrence of metabolic syndrome (MetS) and	Cross-sectional	Proto-malay,	629	21.3	20	High TG: 19.1 Low HDL-C: 17.6	NA

	cardiovascular disease (CVD) risk in Orang Asli		Senoi, Negrito					
Mokhsin et al. (2018)	To determine the prevalence of metabolic syndrome (MS) among the Negrito and ascertain the status of coronary risk biomarkers.	Cross-sectional	Negrito	150	57.2	1.5	NA	NA

* Abbreviations: TC (Total Cholesterol), TG (Triglycerides), LDL-C (Low-Density Lipoprotein Cholesterol), HDL-C (High-Density Lipoprotein Cholesterol), OA (Orang Asli), NCD (Non-Communicable Disease), NA (Not Available).

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Table 2: Summary of Key Findings from Reviewed Studies on Factors Associated with NCDs among Orang Asli

Study	Factors Associated with NCD	Detailed Findings and Statistical Analysis
Wong et al. (2018)	Education Level, Obesity, Female Gender, Protective Lifestyle Factors	Education was found to be a significant determinant of hypertension risk, with those having lower education levels displaying an adjusted odds ratio (OR) of 13.379 for developing hypertension ($p < 0.05$). Obesity was directly linked to an increased risk of diabetes mellitus with an OR of 7.384 ($p = 0.002$). Females were more prone to dyslipidemia, highlighting gender as a risk factor. Additionally, protective factors such as younger age, active lifestyle, and non-smoking status were associated with reduced NCD risk.
Sugathan et al. (2021)	Age, Gender	Older age significantly correlated with a higher incidence of metabolic syndrome, particularly in individuals above 45 years ($p < 0.05$). The study also found a marked gender disparity, with metabolic syndrome being significantly more prevalent in women (49.54%) than in men (36.76%), suggesting that gender influences NCD prevalence.
Ahmad et al. (2018)	Obesity, Age, Cardiovascular Risk Factors	This study highlighted the prevalence of key cardiovascular risk factors such as obesity, hypertension, and dyslipidemia among older Orang Asli. Notably, obesity was present in 37% of Orang Asli and 41.6% of rural Malays ($p = 0.013$), underscoring the significant role of age and obesity in cardiovascular health.
Chua et al. (2017)	Age	The study highlighted that older age significantly increased the risk of hypertension, with an odds ratio (OR) of 2.917 ($p = 0.004$).
Phipps et al. (2015)	Urbanization	Findings from this study showed that urbanized sub-tribes had higher rates of obesity (31.6%), hypertension (39.2%), and diabetes (9.1%) compared to their rural counterparts, highlighting the health challenges posed by urban living conditions.
Yeo et al. (2019)	Urbanization, Gender	The study observed that semi-urbanized Temiar communities faced higher cardiometabolic risks, with significant rates of pre-diabetes (44.9%) and abdominal obesity (52.8%, $p < 0.001$). Additionally, men exhibited a higher prevalence of pre-diabetes and insulin resistance than women, suggesting that urbanization and gender both play crucial roles in shaping health outcomes.
Mokhsin et al.	Gender Differences	Obesity and hypertension were found to be

(2018)		significantly more prevalent in women than in men among the Negritos, with obesity rates in women at 70.59% (p = 0.031) and higher rates of hypertension in women (p = 0.029), pointing to significant gender-related health disparities.
Aghakhanian et al. (2019)	Genetic Predisposition	The study revealed that metabolic syndrome prevalence varied significantly among sub-tribes, attributed to genetic factors. Notably, MetS prevalence was highest in the Proto-Malay (39.56%) and Negrito (26.35%) sub-tribes, with women being more affected than men (p < 0.001), underscoring the influence of genetic predispositions on NCD risks.

Gender differences were also prominent in the prevalence of NCDs. Mokhsin et al. (2018) noted that obesity was significantly higher among women (70.59%, p = 0.031) and hypertension was significantly higher among women compared to men among the Negritos (p = 0.029). Sugathan et al. (2021) also reported a gender disparity with MetS being more prevalent among female respondents (49.54%) than male respondents (36.76%, p = 0.002). Conversely, Yeo et al. (2019) found that the prevalence of pre-diabetes was higher in men (53.1%, p = 0.002) compared to women among the Temiar tribe.

Lifestyle factors, such as physical activity, dietary habits, and smoking, were strongly correlated with NCD risk factors. According to Wong et al. (2018), physical inactivity (OR: 0.173, p: 0.023) and smoking (OR: 0.258, p: 0.045) were significant risk factors for hypertension among the Jakun tribe. Ithnin et al. (2020) noted that male respondents had higher incidences of smoking at 31.7% (p = 0.024) than their female counterparts, contributing to higher NCD risks. Nizaruddin et al. (2022) reported that obesity (adjusted OR = 7.384, p = 0.002) and lower job energy levels (OR = 0.087, p = 0.003) were associated with higher odds of diabetes mellitus among the Temiar. Ali et al. (2016) found that dietary patterns significantly influenced the prevalence of MetS among the Senoi tribe, with higher rates of dyslipidemia observed in those with poor dietary habits (OR = 1.847, p = 0.026). Law et al. (2020) found that higher physical activity levels, particularly related to domestic activities (β = -0.335, p < 0.001), were associated with better blood pressure control and quality of life among Senoi Orang Asli women.

Obesity and overweight were often viewed as one of significant risk factors for various NCDs such as diabetes mellitus and hypertension. According to Wong et al. (2018), it was noted that obesity was an independent risk factor for diabetes mellitus among the Jakun tribe. Ahmad et al. (2018) reported that obesity indices such as waist circumference (WC) and Body Mass Index (BMI) were significantly positive related to cardiovascular risk factors among the rural Malays and Orang Asli**.** Law et al. (2020) noted that higher BMI was significantly associated with increased systolic blood pressure (SBP: β = 0.185, p = 0.001) and diastolic blood pressure (DBP: β = 0.259, p < 0.001) among Senoi women. Shalihin et al. (2019) found a high prevalence of overweight/obesity (36.6%) and its association with abnormal blood sugar levels (53.3%) among the Semai people in Kampung Ulu Tual.

Genetic factors were also influential in the prevalence of NCDs among Orang Asli. Aghakhanian et al. (2019) suggested that genetic predispositions in certain sub-tribes

may contribute to higher levels of metabolic abnormalities. They found that MetS prevalence was 26.35% in Negrito, 39.56% in Proto-Malay, and 11.26% in Senoi, with women more affected than men (35.25% vs. 21.95%, $p < 0.001$). Mokhsin et al. (2018) also suggested that genetic factors could explain the high prevalence of hypertension (57.2%) among Negritos, indicating a possible genetic resilience to some NCD risk factors.

Urbanization and modernization had significant impacts on the health profiles of Orang Asli communities. Phipps et al. (2015) observed that urbanized sub-tribes had higher prevalences of obesity (31.6%), hypertension (39.2%), and diabetes (9.1%) compared to more traditional, rural sub-tribes. This trend was echoed by Yeo et al. (2019), who found that semi-urbanized Temiar exhibited higher rates of cardiometabolic risks, including pre-diabetes (44.9%) and abdominal obesity (52.8%, $p < 0.001$), compared to their more rural counterparts. Yeo et al. (2022) further detailed the influence of urbanization on the microbiota composition and its association with cardiometabolic health among the Temuan, Temiar, and Jehai tribes, with urbanized communities showing lower microbial diversity and higher prevalence of metabolic disorders ($p < 0.05$).

4. Discussion

This scoping review reveals that NCDS are impacting the Orang Asli people in Malaysia and and there are indeed disparities in health. It is noteworthy that the prevalence of hypertension, diabetes, obesity, and metabolic syndrome are highest among the urbanized sub-tribes (Phipps et al., 2015; Sugathan et al., 2021; Wong et al., 2018; Yeo et al., 2019, 2022). These findings are in line with trends observed across other indigenous populations worldwide, including Australia's Aboriginal people, Native Americans, and Inuit, where risk factors of NCDs continue to emerge (Anderson et al., 2016; Gubhaju et al., 2013; Pressler et al., 2022).

Some of these NCDs important associated factors include age and gender. For example, Wong et al. (2018) and Sugathan et al. (2021) established that older people and female gender had higher NCDs prevalence. This is in concordance with other studies in various population groups in Malaysia, where increased age and female gender are known risk factors for certain NCDs (Bakar et al., 2015).

Furthermore, common modifiable behavioral risk factors such as physical inactivity, unhealthy diet, and smoking significantly contribute to the initial burden of NCDs in the population (Ithnin et al., 2020; Othman et al., 2012). For instance, Wong et al. (2018) established a relationship between physical inactivity and smoking with hypertension among the Jakun Orang Asli in Johor. Such lifestyle factors are also considered globally as key factors affecting the risk of non-communicable diseases (NCDs). The World Health Organization (WHO) identifies tobacco use and physical inactivity as major modifiable risk factors for NCDs, contributing significantly to diseases such as cardiovascular disease, cancer, chronic respiratory disease, and diabetes (WHO, 2014). Reducing these risk factors is crucial for preventing and controlling NCDs worldwide.

Additionally, the secular trend of the NCDs epidemic among the Orang Asli is due to the effects of urbanization and the modernization process. Phipps et al. (2015) conducted a study and concluded that prevalences of obesity, hypertension, and diabetes are higher among the urbanized sub-tribes than those from rural areas. The economic transformation in terms of urbanization brings changes in lifestyles that contribute to

the escalation of NCDs risks, and the results obtained in the current study are in sync with international research (Cheema et al., 2014; Gassasse et al., 2017; Miao & Wu, 2016).

Therefore, addressing the NCDs burden among the Orang Asli will require multiple strategies, including lifestyle modification, enhanced healthcare access, and the conservation of traditional practices. Culturally sensitive health promotion interventions enhanced primary care services, and partnerships with indigenous communities are of utmost importance to curb this emerging NCDs epidemic. These strategies align with global recommendations for integrated healthcare services and culturally appropriate health promotion to manage NCDs effectively (Browne et al., 2016; Harding & Oetzel, 2019).

4.1. Limitations

Although this scoping review provides valuable insights into the prevalence and factors associated with NCDs among the Orang Asli in Malaysia, the insights provided by this scoping review must be interpreted with caution due to several key methodological considerations. First, the studies we reviewed are heterogeneous in nature with respect to their design, sample sizes and methodologies suggesting that caution should be taken when attempting to compare the findings of various forms. Variability in reported prevalence rates and associated factors may relate to characteristics of study population, methods used for measurements as well data collection. In addition, there may be publication bias that studies with significant finding are more likely to get published than those without - possibly exaggerating the level of association between these factors and NCD prevalence

Another limitation of the studies is their geographical variability. The studies considered in this review were done across different geographical, environmental and socioeconomical settings which might not be fully generalisable to all Orang Asli communities within Malaysia. Moreover, most of the studies included were cross-sectional which inhibits to determine that what is cause and effect in prevalence of NCD. More rigorous longitudinal studies are required to explore the temporality and causal pathways related to NCD incidences in Orang Asli.

In addition, many studies utilized self-reported measures for lifestyle factors including physical activity, diet and smoking which are likely to be subject social desirability bias and recall bias. This could affect the validity of the associations reported between these determinants and prevalence. In addition, several of the Orang Asli sub-tribes may not have appeared or be underrepresented in these reviewed studies suggesting that knowledge gaps exist on NCD burden and their contributing factors across all Orang Asli sub-tribes. The sampling characteristics of the current study may not be generalisable, and future research should aim to achieve a wider representation from different Orang Asli populations.

There would be bias in the reported prevalence rates of NCDs as a result of different definitions and diagnostic criteria for each study. Nonetheless, all studies include standardized definitions and diagnostic criteria to allow for comparison. Moreover, the reviewed studies may not completely cover all possible lifestyle and environmental changes experienced by the Orang Asli associated with their rapid urbanization and modernisation. Factors, such as rapid aging population expansion and prolonged

nutrition transitions require continuous monitoring and updated research to better characterise the active forces/pressures responsible for dynamic changes with implications on NCD prevalence.

Overcoming these limitations in future research will improve our knowledge of NCD among the Orang Asli and provide insight for the development of successful, culturally appropriate strategies to reduce this preventable disease burden within a vulnerable population.

5. Conclusions

This scoping review highlights the increasing prevalence of non-communicable diseases (NCDs), such as diabetes, hypertension, and metabolic syndrome, among the Orang Asli in Malaysia. Sociodemographic factors, including age, gender, and education, alongside urbanization and its associated lifestyle changes, play significant roles in shaping health outcomes within this marginalized population. However, variability in study methodologies and limited data on the Orang Asli community hinder a comprehensive understanding of the full NCD burden they face.

These findings underline the urgent need for targeted and culturally sensitive public health interventions to address the unique health challenges of the Orang Asli. Such interventions should prioritize health promotion, prevention, and management strategies tailored to their sociodemographic context. Strengthening healthcare access and addressing disparities in education and awareness are essential steps toward improving health outcomes.

Future research should focus on longitudinal studies to track temporal trends in NCD prevalence and investigate the complex interplay of genetic, environmental, and cultural factors. Additionally, studies on healthcare access, utilization patterns, and the effectiveness of culturally tailored interventions are critical to developing evidence-based and equitable health policies. Addressing these gaps will not only improve our understanding of NCD dynamics among the Orang Asli but also inform targeted solutions for reducing health inequities in this underserved population.

Ethics Approval and Consent to Participate

Not applicable.

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Conflict of Interest

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