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Systematic Review Article

Nutritional Assessment among Type 2 Diabetes Mellitus Patient in Southeast Asian Countries: A Scoping Review

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ABSTRACT

This scoping review aims to determine the available nutritional assessments for people with Type 2 Diabetes Mellitus (T2DM) in Southeast Asian countries. The methodology used for this research was based on the PRISMA-ScR standards. An extensive electronic search was carried out for papers published between 2012 and 2022 that pertained to studies conducted in Southeast Asian countries and were written in English. The eligibility criteria for this review were T2DM patients aged 20 years and older. The search was carried out using PubMed, Science Direct, Scopus, and Google Scholar databases. Hence, out of 5,445, fourteen articles met the eligibility requirements of the analysis. According to the findings, twelve studies used anthropometry measurements and biochemical tests, followed by eight studies using clinical assessments and four studies using dietary assessments. The research utilized various nutritional assessment methods such as weight, height, Body Mass Index (BMI), waist and hip circumference, body fat percentage, Fasting Blood Glucose (FBG), Glycated Hemoglobin (HbA1c), lipid profiles, Blood Pressure (BP), 3-day and 24-hour dietary recall. This review examined how the available nutritional assessments for T2DM are frequently carried out in Southeast Asian countries. The review discovered that weight, height, BMI, waist and hip circumference, FBG, HbA1c, BP, and 3-day dietary recall are the most commonly reported nutritional assessment methods.

INTRODUCTION

One of the first diseases and metabolic conditions known to man is diabetes mellitus (DM), which involves excessively elevated blood glucose levels. Type 1 Diabetes Mellitus (T1DM) and Type 2 Diabetes Mellitus (T2DM) are the two main subtypes of Diabetes Mellitus (DM). T1DM and T2DM are primarily brought on by faulty insulin production and action, respectively (Sapra & Bhandari 2021). T1DM presents in children or adolescents, while T2DM is thought to affect middle-aged and older adults who have prolonged hyperglycemia due to poor lifestyle and dietary choices (Sapra & Bhandari 2021).

Type 2 diabetes is becoming more and more commonplace globally, and there are no indications that this trend will slow down. The International Diabetes Federation (IDF) states that those in their 20s to 79s are particularly at risk for developing diabetes in South Asia (SA) and Southeast Asia (SEA). Diabetes roughly affects over 88 million adults in the IDF South-East Asia Region between the ages of 20 and 79. This represents almost 9% of the regional population in this age group (International Diabetes Federation

(IDF) 2021). According to IDF predictions, by 2045, the SEA Region would see a 68% increase in the number of diabetics, reaching 152 million people and a 30% increase in the prevalence of diabetes, to 11.3%. Additionally, with 51.2% of cases remaining undiagnosed, according to the IDF (2021), the SEA Region has the third-highest rate of diabetes worldwide. As such, diabetes continues to rank among the leading causes of major health problems.

A study by Selph *et al.* (2015) discovered that Glycated Hemoglobin (HbA1c) tests and fasting glucose levels are crucial for the early diagnosis of type 2 diabetes. The American Diabetes Association (ADA) states that a diagnosis of diabetes may come from any of the following: a HbA1c reading of at least 6.5%; 7.0 mmol/L or greater fasting plasma glucose (no caloric intake for at least 8 hours); Nonetheless, the ADA advises screening everyone 45 years of age and older, regardless of risk, while the United States Preventive Services Task Force suggests screening overweight people 40 to 70 years of age (Selph *et al.* 2015).

The nutritional assessment is a complex procedure that collects, organizes, and integrates data from the clinical, laboratory, and paraclinical domains in which enables healthcare professionals to systematically evaluate a patient's overall nutritional status, diagnose malnutrition, identify underlying pathologies that cause malnutrition, and prepare necessary interventions; thus, nutritional status has an impact on clinical outcomes (Kesari & Noel 2022). When performing nutritional assessments, it is imperative to remember that there is no one test that is ideal for determining nutritional status. To assess the population's nutritional status, a systematic data collection process is required, and all available data should be analysed. An extensive clinical examination (history and physical examination), anthropometric measurements, diagnostic testing, and dietary assessments should all be part of a comprehensive nutritional assessment, according to the American Society for Parenteral and Enteral Nutrition (ASPEN) (Kesari & Noel 2023).

The diagnosis methods, intervention thresholds, management goals, and instruments utilised to attain them—collectively, the "four T's"—must be reasonable, practical, and consistent with dietary and lifestyle choices. Because of this, many Southeast Asian countries have established their own national guidelines, such as Clinical Practice Guidelines (CPGs), that are appropriate for their particular circumstances (Kalra *et al.* 2017). However, as far as we are aware, no review article has ever been published that addresses nutritional assessments for T2DM patients in Southeast Asian countries. Health practitioners need to be better informed about the current methods used in nutritional assessments among T2DM patients if they want to ensure and improve the management of the condition. This scoping review sought to examine the most recent studies on the available nutritional assessment of T2DM patients in Southeast Asian countries.

METHODS

The associated publications were reviewed using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses Extension for Scoping Reviews (PRISMA-ScR) criteria as a guide (Tricco *et al.* 2018). The original research papers that were published between 2012 and 2022 were the subject of the current scoping review, which included the following steps: (1) identifying the research question; (2) identifying search strategies; (3) study selection; (4) data charting; and (5) collating, summarizing, and reporting the results (Tricco *et al.* 2018).

Identifying the research question

This scoping review's objective was to determine the available nutritional assessments (anthropometry, biochemical, clinical and dietary) of T2DM patients in Southeast Asian countries. The research question was; What are the available nutritional assessments conducted among T2DM patients in Southeast Asian countries?

Identifying search strategies

The "Preferred Reporting Items for Systematic Reviews and Meta-Analyses Extension for Scoping Reviews (PRISMA-ScR)" approach served as the foundation for the design of this scoping review (Tricco *et al.* 2018). Four separate electronic databases—PubMed, Science Direct, Scopus, and Google Scholar—were accessed in order to do a comprehensive search utilising dependable resources to locate the original English-language research papers published between 2012 and 2022.

There are three stages to the document this selection procedure. In the first phase, keywords

for the search were determined. Nutritional, dietary, nutrition, assessment, evaluation, status, type 2 diabetes mellitus, patients, adults, and Southeast Asian countries such as Brunei, Myanmar, Cambodia, Timor-Leste, Indonesia, Laos, Malaysia, the Philippines, Singapore, Thailand, and Vietnam were among the terminology utilized by the database. Millions of combinations of important search terms were used by the search techniques, including: (i) (nutritional OR dietary OR nutrition) AND (assessment OR evaluation OR status) AND; (ii) (type 2 diabetes mellitus) AND (patients OR adults) AND; (iii) (Southeast Asian countries OR Brunei OR Myanmar OR Cambodia OR Timor-Leste OR Indonesia OR Laos OR Malaysia OR Philippines OR Singapore OR Thailand OR Vietnam).

Study selection

For Phase 2, the screening phase, the selection criteria were established by the researchers whom were working in pairs. The data gathered by the researchers was compared, and any differences between the reviewers were discussed, to guarantee consistency in study selection. The nutritional assessment for T2DM patients served as the primary selection criterion for this scoping review to identify relevant articles. Articles that satisfied the inclusion criteria were deemed admissible for this review. First, to ensure the acquisition of relevant, recent data, the inclusion criteria for this review were English-language original research papers published between 2012 and 2022. From then on, T2DM patients became the study's inclusion criteria for participants and at least 20 years old, whereas the exclusion criteria were children and teenagers (aged under 20 years old) and people with T1DM and GDM. Finally, this review only included the Southeast Asian countries; Brunei, Myanmar, Cambodia, Timor-Leste, Indonesia, Laos, Malaysia, the Philippines, Singapore, Thailand, and Vietnam (SarDesai 2018).

During Phase 3, the articles that did not fit the requirements for inclusion criteria were removed through the eligibility process whereby, papers that were systematic, literature-based, or other review papers were excluded. To determine if the content was appropriate for the review, a thorough screening process was used to the titles and abstracts of the chosen papers. Using the inclusion and exclusion criteria, the researchers (working in pairs) excluded irrelevant papers that did not address the research topics. Excluded were abstracts and titles that had no bearing on the study's objectives.

Data charting

Using the eligible titles and abstracts as a guide, the researchers downloaded the soft copies of the full articles from the databases. The articles were reviewed to find out if the whole article addressed the objective and research question. Version 2.80.1 of the Mendeley software was used for data administration. A Microsoft Excel spreadsheet was then used to record the information that had been taken out of the complete articles. One researcher independently performed the data graphing, and another (working in pairs) confirmed it. A table comprising the following details was created by extracting and charting the general and specific data from the chosen studies: author(s), year of publication, country, sample characteristics (sample size, study design, population, and age), and nutritional assessment (anthropometry, biochemical, clinical, and dietary).

Collating, summarising, and reporting the results

Table 1 summarizes and tabulates the extracted data results. Some limitations of the studies were highlighted to provide useful recommendations for future references on nutritional assessment in T2DM patients.

RESULTS AND DISCUSSION

Study selection

The total number of titles and abstracts found in the databases search were 5,445; in which PubMed (221), Science Direct (1,819), Scopus (57), and Google Scholar (3,348). The duplicate articles were managed using the Mendeley software through recording, monitoring, sorting, and checking the studies, resulting in a total of 255 sets of duplicates being eliminated from the list. After eliminating duplicates, a total of 5,190 abstracts were included in the initial screening phase. However, 5,146 abstracts were discarded due to various reasons. These exclusions were based on criteria such as the removal of articles published in 2011 and earlier (410), non-English articles (213), titles and abstracts unrelated to the review (2,770), and non-Southeast Asian countries (370). Among the 5,146 abstracts,

the publications that were published as reviews which were part of systematic, literature, and scoping reviews were also excluded (1,383). From the 5,146 abstracts, only 44 potentially relevant publications were chosen for eligibility checking by reading their full text. After the full texts of these 44 papers were evaluated for eligibility, fourteen publications were included in the final data collection. A flowchart of the study selection procedure is shown in Figure 1.

Study characteristics

The review papers' study characteristics were summarized in Table 1. Location, study design, sample size, population, age, and nutritional assessment (anthropometry, biochemical, clinical, and dietary) were the categories used to group the abstracted data. Seven studies from Indonesia, three from Malaysia, three from Singapore, and one from Thailand were covered in the papers. Most research designs were cross-sectional and quasi-experimental, followed by prospective observational, retrospective, cohort, clinical trial, and randomized controlled trial studies. T2DM patients made up the entire study group, and they ranged in age from young adults in their early 20s to elderly adults.

Nutritional assessments of T2DM patients

An overview of the nutritional assessments used in the chosen research is shown in Table 1. Among the fourteen reviewed articles, twelve used anthropometry measurement, twelve used biochemical tests, eight used clinical, and four used dietary intakes as their parameters (Table 1). Most of the studies measured the individuals' height, weight, and BMI for anthropometry. However, several studies also measured body fat percentage, hip circumference, and waist circumference. Regarding biochemical testing, the studies assessed revealed (twelve articles) that the tests typically performed among the subjects were HbA1c, Fasting Blood Glucose (FBG), and lipid profile tests for determining the individuals' glycaemic control and cholesterol levels.

In eight of fourteen reviewed articles pertaining to clinical assessments, the blood pressure of the subjects was measured during the assessment. Four articles revealed that the subjects' dietary intake was assessed throughout the assessment process using the 3-day dietary recall (2 weekdays and 1 weekend) and 24-hour dietary recall.

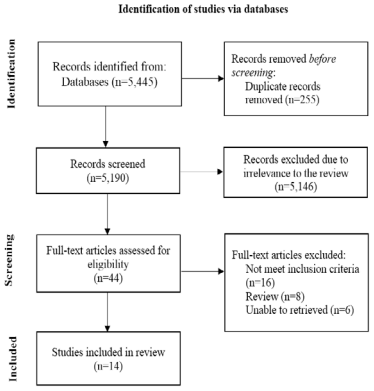

Figure 1. PRISMA-ScR method flowchart

Anthropometry

The anthropometry measurements were reported in twelve of the fourteen analysed studies, six of which were from Indonesia, two from Malaysia, three from Singapore, and one from Thailand (Table 1). The assessments took into account the following factors: height, weight, Body Mass Index (BMI), hip and waist measurements, and body fat percentage.

According to research conducted in Malaysia, 62% of the participants were either obese or overweight, and most of them displayed indications of abdominal obesity, and women had a substantially higher mean BMI than males ($p<0.05$) (Firouzi *et al.* 2015). Another study from Indonesia (Andriani & Maria 2022) reported the majority of patients had poor nutritional status (56.6%), whereas a study from Thailand (Thewjitcharoen *et al.* 2018b) reported the majority (80.2%) met the WHO-recommended BMI cut-offs for Asians, indicating they were overweight or obese. Besides that, according to Thewjitcharoen *et al.* (2018b) and Andriani & Maria (2022), the following were the BMI categories: (a) underweight: 18.5 kg/m^2; (b) normal: 18.5–22.9 kg/m^2; (c) pre-obese: 23–27.4 kg/m^2; and (d) obese: 27.5 kg/m^2. The normalization of BMI in obese T2DM patients due to weight loss may also have a good impact on glycaemic management, which is among the goals that DM patients ought to strive towards (Harbuwono *et al.* 2021).

A noteworthy discovery was made by Firouzi *et al.* (2015) in their investigation: women had a smaller mean waist circumference than men. For men, a waist circumference of 90 cm was optimal, and for women, it was 80 cm

Table 1. Nutritional assessment methods of type 2 diabetes mellitus patients in Southeast Asian countries

Author and year	Parameters and location	Study design and sample size	Population and age	Nutritional assessments			
				Anthropometry	Biochemical	Clinical	Dietary
Artha *et al.* 2019	Anthropometry, biochemical Indonesia	Retrospective study 140 patients	T2DM 30–65 years old	Weight, height, BMI	HBA1c, lipid profile; LDL-C, HDL-C, TG, and TC	-	-
Adrian & Maria 2022	Anthropometry, dietary Indonesia	Cross-sectional study 260 patients	T2DM ≥20 years old	Weight, height, BMI	-	-	1x24 hours dietary recall
Dalan *et al.* 2013	Anthropometry, biochemical Singapore	Cross sectional study 575 patients	T2DM 25–75 years old	Weight, height, BMI	FSG, HbA1c, serum creatinine levels	-	-
Fatmah 2020	Anthropometry, biochemical, clinical, dietary Indonesia	Quasi-experimental study 70 patients	T2DM 35–75 years old	Weight, height, waist and hip circumference, BFP	FBS, lipid profile; LDL, HDL, TG, and TC	Blood pressure	3-day dietary recall
Firouzi *et al.* 2015	Anthropometry, biochemical, clinical, dietary Malaysia	Clinical trial 104 patients	T2DM Mean age = 56.7±9.94 years old	Weight, height, BMI, waist circumference	FSG, HbA1c, plasma lipid components; TG, TC, and HDL	Blood pressure	3-day dietary recall
Harbuwono *et al.* 2021	Anthropometry, biochemical, clinical Indonesia	Prospective observational study 37 patients	T2DM 40–70 years old	Weight, height, BMI, waist circumference	FBG, HbA1c, lipid profiles; LDL, HDL, TG, and TC	Blood pressure	-
Hening *et al.* 2019	Biochemical, clinical Indonesia	Prospective quasi-experimental study 81 patients	T2DM ≥20 years old	-	HbA1c, FBG, PPBG, lipid profiles; LDL, HDL, TG, and TC	Blood pressure	-
Lam *et al.* 2015	Anthropometry, biochemical, clinical Singapore	Cross sectional study 1,891 patients	T2DM 21–74 years old	Weight, height, BMI, waist and hip circumferences, BAI, WHR, WHtR	FBG, lipid profiles; TC, HDL-C and TG	Blood pressure	-
Lim *et al.* 2015	Anthropometry Singapore	Cohort study 13,278 patients	T2DM	Weight, height, BMI, waist and hip circumference	-	-	-
Rusdiana *et al.* 2020	Anthropometry, biochemical, clinical Indonesia	Quasi-experimental study 40 patients	T2DM >40 years old	Weight, height, BMI, waist circumference	FBS and HbA1c	Blood pressure	-

Continue from Table 1

Author and year	Parameters and location	Study design and sample size	Population and age	Nutritional assessments			
				Anthropometry	Biochemical	Clinical	Dietary
Savira & Amelia 2018	Anthropometry, biochemical, clinical Indonesia	Quasi-experimental study 80 patients	T2DM >40 years old	Weight, height, BMI, waist circumference	FBS and HbA1c	Blood pressure	-
Sazlina *et al.* 2015	Anthropometry, biochemical, clinical Malaysia	Cross-sectional study 21,336 patients	T2DM ≥60 years old (range 60–104 years old)	Weight, height, BMI, waist circumference	HbA1c, fasting plasma lipids	Blood pressure	-
Thambiah *et al.* 2016	Biochemical Malaysia	Cross-sectional, retrospective study 214 patients	T2DM ≥20 years old	-	Lipid profiles; LDL, HDL, TG, and TC	-	-
Thewjitcharoen *et al.* 2018b	Anthropometry, biochemical, dietary Thailand	Cross sectional study 304 patients	T2DM 25–85 years old	Weight, height, and BMI	HbA1c, lipid profiles, and serum creatinine	-	3-day dietary recall

BAI: Body Adiposity Index; BFP: Body Fat Percentage; FBG: Fasting Blood Glucose; FBS: Fasting Blood Sugar; FSG: Fasting Serum Glucose; HbA1c: Glycated Hemoglobin; HDL-C: High Density Lipoprotein; LDL-C: Low Density Lipoprotein; WHtR: Waist-to-Height Ratio; PPBG: Postprandial Blood Glucose; T2DM: Type 2 Diabetes Mellitus; TC: Total Cholesterol; TG: Triglyceride Levels; WHR: Waist-to-Hip Ratio

(Sazlina *et al.* 2015), and studies have shown that Asian people, particularly South Asians, are more susceptible to abdominal obesity because they are not regularly engaged in physical exercise (Firouzi *et al.* 2015). According to comparable data from diabetes patients in Kelantan, most diabetes patients do not engage in regular physical exercise (Firouzi *et al.* 2015). As the subjects of these studies were primarily overweight, obese, and had abdominal obesity, two studies from Indonesia (Fatmah 2020) and Singapore (Lam *et al.* 2015) reported that body fat percentage and Body Adiposity Index (BAI), respectively, were also included in the T2DM patients' assessments.

Monitoring metabolic indicators, such as body weight and body fat, is essential for the therapeutic care of patients with diabetes due to these patients frequently have hypertension, obesity, and dyslipidemia (Savira & Amelia 2018). BMI is the anthropometric indicator for which most research has been conducted. The conflicting results between obesity and overweight regarding T2DM-related mortality risk may be explained by the use of BMI alone, a broad indication of obesity that does not distinguish between fat and lean mass or depict body fat distribution (Lim *et al.* 2015). Lam *et al.* (2015) have come to similar findings and speculated that measures of central adiposity are good indicators of visceral adiposity and, as a result, are more closely associated with diabetes than BMI, which more accurately represents body volume and mass. In light of this research, it would be preferable to also use a mix of measurements, such as one that contains both a general and a central adiposity measure (Lam *et al.* 2015).

Furthermore, Lam *et al.* (2015) also stated that the BAI assessment may be useful in determining overall adiposity, although it is not expected to surpass BMI which demonstrates that the BAI operates similarly to BMI. As a result, the BAI has no added value once BMI has been taken into consideration (Lam *et al.* 2015). This is in line with the fact that while BAI makes an effort to estimate Body Fat Percentage (%BF), it does not account for how adiposity is distributed throughout the body. As a result, it would serve as an all-encompassing adiposity measure, similar to BMI. Therefore, Lam *et al.* (2015) asserted that there is no evidence to suggest that the BAI would be a better general measure of adiposity than the BMI; rather, it would

serve the same purpose. Moreover, validation studies consistently show that the BAI tends to overestimate or underestimate adiposity at the extremes of BF (Lam *et al.* 2015).

However, according to a study from Singapore by Lam *et al.* (2015), BMI is unable to distinguish between lean mass and fat mass; as a result, changes in body adiposity with a given BMI across age, gender, and ethnicity confine it. Furthermore, some data suggests visceral adiposity, rather than total adiposity, is more directly associated with the metabolic side effects of obesity (Lam *et al.* 2015). This is a key fault in the BMI since it fails to account for body fat distribution. As a result, several adiposity metrics that take into consideration the distribution of body fat, such as Waist Circumference (WC), Waist-to-Hip Ratio (WHR), and Waist-to-Height Ratio (WHtR), have been devised and examined. In an adult population, a combination of BMI and WHtR may have the most therapeutic benefit, despite the apparent equality of the relationships between BMI, WC, WHtR, and diabetes (Lam *et al.* 2015).

Biochemical

The biochemical tests used were lipid profiles, Glycated Hemoglobin (HbA1c), and Fasting Blood Glucose (FBG), according to the articles we reviewed. Twelve out of the fourteen articles were evaluated, and six papers from Indonesia, three from Malaysia, two from Singapore, and one from Thailand were among them (Table 1).

The assessment of biochemical profiles was done, according to Savira and Amelia (2018), to ascertain the participants' level of diabetes management. A measure of blood glucose control during the previous three months was HbA1c, and at the time FBG demonstrated the significance of diabetes control. According to research by Firouzi *et al.* (2015), the individuals' average FBG and HbA1c were higher than what the treatment was supposed to achieve. HbA1c and fasting glycemia were only optimum in 28% and 20% of the individuals, respectively. Based on Malaysian diabetic patients' recommended levels, out of these subjects, only 20.2% and 27.9% met the recommended targets for FBG (FBG<7.0 mmol/L) and HbA1c (HbA1c<6.5%), respectively (Firouzi *et al.* 2015).

However, research from Thailand found that, based on having an HbA1C below 7.0%, more half of the individuals who were enrolled had adequate glucose control. This might be because the patients are already receiving a variety of teaching techniques, such as coaching, follow-ups, and motivational interviews, as needed to guarantee adherence and the intended results (Thewjitcharoen *et al.* 2018b). According to a study from Indonesia, obtaining effective glycemic control requires diabetes education, as HbA1c<6.5% was found to be an indicator for the control of T2DM in this study (Rusdiana *et al.* 2020). Since they only knew FBG as a control glycemic for DM, many people were unaware of the control glycemic of the HbA1c result.

The main objective of DM is blood glucose stabilization because DM has a significant negative impact on health due to its high morbidity and death rates. The American Diabetes Association (ADA) recommends glycemic control as one of the most important strategies for the management of type 2 diabetes (T2DM) since HbA1c is the best indication of glycemic level during the past three months (Rusdiana *et al.* 2020).

Nine out of the fourteen publications that were reviewed (four from Indonesia, three from Malaysia, one from Singapore and one from Thailand) also included results from lipid profile tests in their assessments. This is because obesity and dyslipidemia are prevalent in diabetes patients, thus monitoring metabolic indicators such as lipid profiles, FBG, and HbA1c is essential in the clinical treatment of diabetic patients (Savira & Amelia 2018). Total Cholesterol (TC), Low-Density Lipoprotein Cholesterol (LDL-C), High-Density Lipoprotein Cholesterol (HDL-C), and Triglycerides (TG) were all included in the lipid profiles.

According to ADA guidelines, people with diabetes should have periodic serum lipid testing as a screening tool to identify the presence of dyslipidemia (Artha *et al.* 2019). The targets for lipid control were, according to Sazlina *et al.* (2015): (a) LDL-C: 2.6 mmol/L; (b) HDL-C:>1.0 mmol/L for males and >1.3 mmol/L for women; and (c) TG:<1.7 mmol/L. Thambiah *et al.* (2016) discovered that patients with HbA1c≥6.5% had significantly higher TC, TG, non-HDL, and TC/HDL ratios than patients with HbA1c<6.5%. The noteworthy correlation shown between dyslipidemia and glycemic state highlights the potential utility of HbA1c as a dyslipidemia biomarker (Thambiah *et al.* 2016). Thus, HbA1c can be employed as a biomarker in predicting

dyslipidemia among T2DM patients in addition to glycemic management.

Clinical

Eight out of fourteen studies—five from Indonesia, two from Malaysia, and one from Singapore—include Blood Pressure (BP) in their analyses of T2DM (Table 1). Due to diabetes patients frequently have hypertension, monitoring metabolic indicators like BP is crucial for the clinical care of patients with diabetes (Savira & Amelia 2018).

Hypertension was defined as a systolic blood pressure measurement of more than 140 mmHg and a diastolic blood pressure measurement of more than 90 mmHg. Other studies have produced similar results, which are thought to be because BMI better reflects body volume and mass, which is associated with blood viscosity and blood volume and, therefore, more closely related to blood pressure, while measures of central adiposity are good indicators of visceral adiposity and, therefore, more closely associated with diabetes (Lam *et al.* 2015).

A Malaysian investigation discovered a link between high BP and inadequate glycemic management. This finding was consistent with that of another study, which found that those with T2DM who had uncontrolled hypertension had a higher likelihood of having poor glycemic control compared to those with normal blood pressure (Sazlina *et al.* 2015). Although it has been demonstrated that elderly individuals can benefit from lowering their BP, it should be emphasized that they have decreased tolerance; as a result, the treatment must be started gradually (Sazlina *et al.* 2015).

Hening *et al.* (2019) asserted that preventing the onset of diabetes complications like cardiovascular disease requires a thorough reduction in risk variables other than blood glucose, such as BP and lipid control. To sum, BP is a useful indicator for diabetes patients in preventing the onset of cardiovascular disease and other diabetes complications like hypertension. Additionally, because diabetes patients with uncontrolled hypertension typically have poor glycemic control, BP is also linked to poor glycemic control (Hening *et al.* 2019).

Dietary

Four out of the fourteen publications—two from Indonesia, one from Malaysia, and one from Thailand—incorporated dietary assessments in their research (Table 1). Based on the findings, the dietary assessment tools included were the 3-day diet recall, and 24-hour diet recall. According to Fatmah (2020), patients with DM are advised to limit their daily consumption of the seven nutrient groups—carbohydrates, protein, fat, vitamins, minerals, dietary fibre, and water. One of the various tools that may be used to assess eating patterns is the 24-hour dietary recall. Other tools include the Food Frequency Questionnaire (FFQ), diet histories, and dietary records.

The dietary record and 24-hour dietary recall are both entirely open-ended questionnaires that gather a wide range of specific information about the food consumed during a predetermined period. A Thai study (Thewjitcharoen *et al.* 2018b) found no association between total energy and macronutrient intake between patients who achieved appropriate glycaemic control (HbA1C<7.0%) and patients who did not (HbA1C>7.0%). In addition, a Malaysian study revealed that the majority of participants (62%) had abdominal obesity besides being overweight and obese overall. According to a 3-day dietary recall used in this study, the respondents had lower intakes of fibre (10.6±5.8 g), calcium (629±314 mg), and vitamin C (60.6±55.7 mg) which was recommended for people with T2DM (fibre: 20–30 g; calcium: 800–1,000 mg; vitamin C: 70 mg) (Firouzi *et al.* 2015).

A straightforward 24-hour dietary recall carried out by qualified dietitians could, in contrast to 3-day dietary data, provide accurate estimates of food groups such as energy, macronutrient intakes, and fibre, according to Thewjitcharoen (2018a). However, it proved inadequate for estimating data at the individual level. Large cross-sectional surveys usually utilize the 24-hour dietary recall, although prior research from Western populations consistently shows that food intake is underreported in dietary recall (Thewjitcharoen 2018a). Furthermore, concentrating on food-based healthy eating habits rather than employing a single nutrient-based assessment could help predict diabetic patient outcomes more accurately (Andriani & Maria 2022).

Strength and limitations

The comprehensive electronic search conducted for this study utilising Google Scholar, Science Direct, PubMed, and Scopus as four databases and a broad range of search terms to

find as many linked articles as possible is one of this study's strongest points. We were also able to examine the nutritional assessment methods thanks to this scoping review that was already in use among T2DM patients, spot any gaps, and propose possible paths for method improvement

However, there are some limitations to this scoping review. This scoping review, in contrast to a systematic review, does not assess the calibre of the selected papers. Furthermore, unpublished research that has not been made available online may indicate a lack of nutritional assessment data. Due to the small number of studies that satisfied the inclusion and exclusion criteria, variations in sample sizes, participant restrictions, reference standards, and geographic locations, it was challenging to generalise the findings. Another issue with the review is that it only discovered relevant research in four of the eleven Southeast Asian countries which are Indonesia, Malaysia, Singapore, and Thailand.

CONCLUSION

This review examined the available nutritional assessment technique that is used for nutritional assessments of people with T2DM in Southeast Asian countries. According to the research, nutritional assessment techniques were most commonly applied in these areas: anthropometry, biochemical, clinical, and dietary. The parameters that were frequently measured in anthropometric assessments were weight, height, BMI, waist and hip circumference, and body fat percentage. Biochemical assessments mostly utilized were FBG, HbA1c, and lipid profiles to assess the glycaemic value and cholesterol level of the patients. Some studies also took Blood Pressure (BP) for clinical assessments, while the tools usually utilised for dietary assessments are 3-day and 24-hour dietary recalls.

Hence, it is crucial to ensure that the nutritional assessment procedures in those countries are frequently revised to efficiently handle patients with diabetes. Even though the majority of the results used comparable parameters, only one study included BAI in their research. Although it was claimed that the BAI would be equally useful as the BMI as a general predictor of adiposity, however there was no evidence to support its superiority. Therefore, more research is required to confirm the parameter's suitability for T2DM patients.

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DECLARATION OF CONFLICT OF INTERESTS

The authors declare that no conflicts of interest arose during any part of the research process.

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