DIABETES RISK SCREENING TOOLS FOR PREDIABETES: A COMPREHENSIVE SCOPING REVIEW OF EVIDENCE AND IMPLEMENTATION

© Paleeratana Wongrith[1,2]*, Suphika Dangkrajang[1], Truong Thanh Nam[3]

[1]Thammasart University, Bangkok, Thailand
[2]Walailak University, Nakhon Si Thammarat, Thailand
[3]Can Tho University of Medicine and Pharmacy, Can Tho, Vietnam

BACKGROUND/OBJECTIVES: Diabetes risk screening tools are essential for identifying individuals with prediabetes and preventing the progression to diabetes. However, systematic reviews focusing on such tools, particularly for prediabetes screening, are scarce. This scoping review examines the characteristics, development methods, and effectiveness of diabetes risk assessment tools in identifying prediabetes and predicting its progression to diabetes.
MATERIALS AND METHODS: A scoping review was conducted following the Joanna Briggs Institute methodology. Searches were performed in PubMed, ScienceDirect, and Google Scholar, complemented by citation tracking. Eligible studies included asymptomatic adults with prediabetes. Studies were excluded if they lacked relevant data, were not in English, or had no validation measures. Data were extracted independently by two reviewers and synthesized narratively, focusing on study design, risk model features, performance statistics, and quality assessments.
RESULTS: Fourteen studies met the inclusion criteria, covering 26 risk models. Sensitivity and specificity were used in 9 risk screening tools, with Hazard Ratios and C-Statistics assessing diabetes progression in six. Common risk factors included age, BMI, family history of diabetes, and hypertension. Non-invasive tools and predictive models showed promise, with most studies assessed as having a low risk of bias using QUADAS-2. High-sensitivity tools utilizing FBG, HbA1c, and OGTT cutoffs demonstrated effectiveness but require balancing cost and feasibility for broader implementation.
CONCLUSION: A range of different screening tools has been tested that could identify people with prediabetes or a high risk of developing type 2 diabetes. However, where sufficient evidence was available to compare tools across studies the performance of these tools was inconsistent. Several tools have only been investigated in single studies, with uncertainty around their wider generalisability. Clinicians or researchers wishing to screen people for prediabetes or a high risk of developing type 2 diabetes using any of these tools should be aware of their potential limitations.

KEYWORDS: a scoping review; a risk screening tool; prediabetes; adults.

ИНСТРУМЕНТЫ СКРИНИНГА САХАРНОГО ДИАБЕТА ДЛЯ ВЫЯВЛЕНИЯ ПРЕДИАБЕТА: КОМПЛЕКСНЫЙ ОБЗОРНЫЙ АНАЛИЗ ДАННЫХ И ПРАКТИКИ ВНЕДРЕНИЯ

© Палиратана Вонгрит[1,2]*, Супика Дангкраджанг[1], Чыонг Тхань Нам[3]

[1]Университет Таммасат, Бангкок, Таиланд
[2]Университет Валайлак, Накхонситхаммарат, Таиланд
[3]Медико-фармацевтический университет Кантхо, Кантхо, Вьетнам

ОБОСНОВАНИЕ/ЦЕЛЬ. Инструменты скрининга риска сахарного диабета (СД) имеют решающее значение для выявления лиц с предиабетом и предотвращения его прогрессирования в СД. Однако систематических обзоров, посвященных таким инструментам, особенно для скрининга предиабета, недостаточно. В данном обзорном анализе рассматриваются характеристики, методы разработки и эффективность инструментов оценки риска СД для выявления предиабета и прогнозирования его перехода в СД.
МАТЕРИАЛЫ И МЕТОДЫ. Обзорный анализ проводился в соответствии с методологией Института Джоанны Бриггс. Поиск проводился в базах данных PubMed, ScienceDirect и Google Scholar с дополнительным отслеживанием цитирований. В исследование включались работы, посвященные взрослым с бессимптомным течением предиабета. Исследования исключались, если в них отсутствовали релевантные данные, они были опубликованы не на английском языке или не содержали мер валидации. Данные извлекались независимо двумя рецензентами и обобщались в описательной форме с акцентом на дизайн исследования, характеристики моделей риска, статистические показатели эффективности и оценку качества.
РЕЗУЛЬТАТЫ. Четырнадцать исследований соответствовали критериям включения; в них рассматривалось 26 моделей риска. В 11 моделях использовалась логистическая регрессия, а для оценки прогрессирования СД в шести моделях применялись отношение рисков (Hazard Ratios) и С-статистика. К общим факторам риска относились возраст, ИМТ (индекс массы тела), семейный анамнез СД и гипертония. Неинвазивные инструменты и прогностические

Received: 14.03.2025. Accepted: 11.08.2025.

модели показали свою перспективность, при этом большинство исследований были оценены как имеющие низкий риск систематической ошибки с использованием инструмента QUADAS-2. Высокочувствительные инструменты, использующие пороговые значения глюкозы в плазме натощак, гликированного гемоглобина и перорального глюкозотолерантного теста, продемонстрировали свою эффективность, однако их широкое внедрение требует сбалансированного подхода к затратам и практической реализации.

ЗАКЛЮЧЕНИЕ. Протестированы различные инструменты скрининга, способные выявлять людей с предиабетом или высоким риском развития СД2. Однако в исследованиях, где были доступны достаточные доказательства для сравнения инструментов, их эффективность оказалась неоднозначной. Некоторые инструменты были изучены только в единичных исследованиях, и их более широкая применимость остается неясной. Клиницисты или исследователи, планирующие использовать эти инструменты для скрининга пациентов с предиабетом или высоким риском развития СД2, должны учитывать возможные ограничения.

КЛЮЧЕВЫЕ СЛОВА: обзорный анализ; инструмент скрининга риска; предиабет; взрослые.

Полный текст статьи доступен в электронной версии журнала на сайте www.dia-endojournals.ru.
[The full text of the article is available in the electronic version of the journal on the website www.dia-endojournals.ru]

INTRODUCTION

The global rise in type 2 diabetes (T2DM) has profoundly impacted healthcare systems, especially in low- and middle-income countries where over 75% of diabetes cases occur [1].

Prediabetes — a condition marked by blood sugar levels higher than normal but not yet at diabetic levels — is a critical precursor to T2DM, often progressing to full-blown diabetes if left unaddressed [2, 3]. Individuals with prediabetes face heightened risks for complications like nephropathy, neuropathy, and macrovascular diseases [3–5]. Studies show that up to 70% of those with prediabetes eventually develop T2DM, sometimes within five years [2, 6]. The American Diabetes Association (ADA) defines prediabetes using HbA1c levels between 5.7% and 6.4% or fasting plasma glucose levels between 100 and 125 mg/dL [7–11]. However, there is no universal consensus on the HbA1c range that best identifies high-risk individuals, as different recommendations vary across organizations [12, 13]. In the Asia-Pacific region, guidelines advocate for screening and intervention for those aged 35 and older or individuals at high risk, using laboratory tests such as FPG, HbA1c, and the 75-gram OGTT to support early detection and potential prevention of T2DM [14]. Despite these screening protocols, diabetes risk assessment tools differ significantly in sensitivity, specificity, and suitability across diverse populations [9, 15–18].Previous research identifies several key risk factors for prediabetes including sex (female) [19–22], age (45 years or older) [19, 21, 23, 24], Body Mass Index (overweight or obese) [21, 25], waist circumference and family history of diabetes [26], high blood pressure [22], polycystic ovary syndrome in women [27, 28], dyslipidemia [29], psychological factors such as stress or depression [6], lifestyle behaviors like smoking or tobacco use and alcohol consumption [22, 30], poor dietary habits [28, 31–33], and physical inactivity [34]. This scoping review aims to summarise existing research on diabetes risk screening tools systematically, identifying knowledge gaps to support potential shifts toward population-wide screening within community-based programs. Specifically, this review examined the characteristics, development methods, and effectiveness of diabetes risk assessment tools for identifying prediabetes and monitoring progression to diabetes in at-risk individuals.

MATERIALS AND METHODS

Literature Review Strategy

This review systematically identified and synthesized studies on diabetes risk assessment tools (Fig. 1). The methodology followed PRISMA-ScR guidelines, accessible at http://www.prisma-statement.org/ and https://www.prisma-statement.org/scoping [35] (see PRISMA checklist in the supplementary file). The protocol was reviewed and revised with input from the advisory board of the Community Medicine Division at Thammasat University; a Principal Research fellow from Southampton Health Technology Assessments Centre (SHTAC), School of Healthcare Enterprise and Innovation, University of Southampton, UK; and members of the research team.

Eligibility Criteria:

1) *Inclusion:* Studies on diabetes risk tools for adults with prediabetes or T2DM risks (18+), examining factors affecting tool adoption, implementation, or validation.
2) *Exclusion:* Studies lacking relevant data, focusing on genetic factors, or not classified as original research. Also excluded were studies focusing on children, pregnant individuals, or unrelated conditions.

Search Strategy and Study Selection

A systematic search across PubMed, ScienceDirect, and Google Scholar used Boolean operators, MeSH terms, and synonyms (e.g., "diabetes risk assessment", "prediabetes screening", "adults", "non-invasive tools") (Appendix A, B). The timeframe covered October 2012 to September 30, 2022, and October 1, 2022 to September 2024.

Studies were selected through:

Title & Abstract Screening: Based on predefined criteria.

Full-Text Review: To confirm eligibility.

Data Extraction & Synthesis

Two reviewers independently extracted data using a standardized QUADAS-2 form. Discrepancies were resolved by a third reviewer. Of 843 identified studies, 14 met inclusion criteria (see Figure 1 for the PRISMA flow chart summarising the selection process). These studies included 26 risk models (e.g., THIARISK, CANRISK, FINDRISC, ADA-Risk). Data on AU-ROC, sensitivity, specificity, and validation efforts were summarized in tabular format for comparison.

Table 1. Characteristics of the included studies (according to PICOs criteria)

First Authors	Countries	Study Design	Participants (P)	Index Test (I) Name of Tool	Goal Standard / Cut Point (I)	Timing of Study (C)	Setting or Area (C)
Agarwal G (2019) [40]	Philippines	Case-control	Adults ≥40/≤40 yrs with impaired glucose	CANRISK ≥33, FINDRISC ≥15, ADA ≥3, IDRS ≥60, UDD ≥14, Filipino ≥21	FPG≥100 mg/dL (5.6 mmol/L) per ADA	2015–2016	Zamboanga City Health Center (PHAC)
Aekplakorn W (2015) [41]	Thailand	Cross-sectional	Adults 35–65 yrs with 1 or more of 6 common T2DM risk, CVD risk factors	Thai Diabetes Risk Score, 6 risk factors	FPG ≥100 mg/dL (5.6 mmol/L); OGTT ≥140 mg/dL (7.8 mmol/L) per ADA	2013	68 primary care centers across all regions
Bahijri S (2020) [42]	Saudi Arabia	Cross-sectional	Adults 20–81 yrs with impaired glucose and T2DM risk	SADRISC (≥15), FINDRISC	FPG ≥100 mg/dL (5.6 mmol/L); OGTT (50 g, 1h-PG) 140–200 mg/dL; ADA criteria	2016–2017	Public Health Care Centers
Jiang Y (2017) [43]	Canada	Cross-sectional	Adults 30 yrs and over with T2DM risk	CANRISK ≥32	FPG >100 mg/dL (5.6 mmol/L); OGTT ≥140 mg/dL (7.8 mmol/L) per WHO	2013 (2 months)	Inuit communities, Nunavut
Memish ZA (2015) [44]	Saudi Arabia	Cross-sectional	Adults ≥20–45 yrs, non-pregnant	SADRISC	FPG ≥100 mg/dL (5.6 mmol/L); OGTT ≥140 mg/dL (7.8 mmol/L) per ADA	2009	PHCCs Urban & Rural
Rowan CP (2014) [45]	Canada, Toronto	Cross-sectional	Adults ≥18 yrs with high T2DM risk	CANRISK, FINDRISC	HbA1c ≥5.7% (ADA), HbA1c ≥6.0% (CDA), HbA1c ≥6.5%	2013	Community-based
Srugo SA (2020) [46]	Canada	Cross-sectional	Adults 18–39 yrs / Adults ≥40 yrs	CANRISK ≥22	HbA1c ≥5.7% (ADA), HbA1c ≥6.0% (CDA), HbA1c ≥6.5%	2018	Community-based
Vanderwood KK (2015) [47]	USA	Cross-sectional	Adults 40–75 yrs with high T2DM risk	ADA risk test ≥9, CANRISK ≥19	OGTT (2h-PG) ≥140 mg/dL (7.8 mmol/L); ADA criteria	2014	Worksites and community centers
Risøy AJ (2018) [50]	Norway	Longitudinal study	Adults ≥18 yrs with high T2DM risk	FINDRISC, DM-UK	HbA1c ≥5.7% (ADA)	2016 (2 months)	Community pharmacies
Schmidt MI (2019) [51]	Brazil	Longitudinal study	Adults 35–74 yrs (civil servants)	Risk - Self-reported	FPG ≥100 mg/dL (5.6 mmol/L) per ADA	2008–2010	Healthcare centers
Bethel MA (2013) [31]	Asia, Europe, Latin America	NAVIGATOR trial (Cohort, 5 years follow-up)	Adults 45–70 yrs with impaired glucose	Novel Risk Models A-E	FPG ≥100 mg/dL (5.6 mmol/L); OGTT ≥140 mg/dL (7.8 mmol/L)	Not stated	Multinational
Hippisley-Cox J (2017) [48]	England	Prospective Cohort study (3.9 years follow-up)	Adults 25–84 yrs, non-diabetes	QDiabetes models A-C	FPG per ADA; HbA1c ≥5.7%	2016	GP Practices (QResearch)
Kaneko K (2020) [49]	Japan	Cohort study	Adults 40–64 yrs with Mets and impaired glucose and T2DM risk	IFG, MetS combinations	FPG ≥100 mg/dL (5.6 mmol/L)	2008–2018	Health centers
Xu S (2021) [18]	China	Cohort study	Adults with IGT from ACE study	BASIC, EXTENDED, FULL models	FPG ≥100 mg/dL (5.6 mmol/L); 2h-OGTT ≥140 mg/dL (7.8 mmol/L); HbA1c ≥5.7%	Not stated	ACE Study and LUSHOU cohort

Note: FBG: Fasting Blood Glucose; OGTT: Oral Glucose Tolerance Test; HbA1c: Hemoglobin A1c; THAIRISK: Thai Diabetes Risk Score; CDA: Canadian Diabetes Association; CANRISK: Canadian Diabetes Risk Score; FINDRISC: Finnish Diabetes Risk Score; ADA RISK: American Diabetes Association Risk Score; IDRS: Indian Diabetes Risk Score; UDDM: Diabetes Risk Tools for Indonesia; Filipino: Diabetes Risk Tools for the Philippines; SADRISC: Saudi Arabia Diabetes Risk Tool; and UK Diabetes Risk.

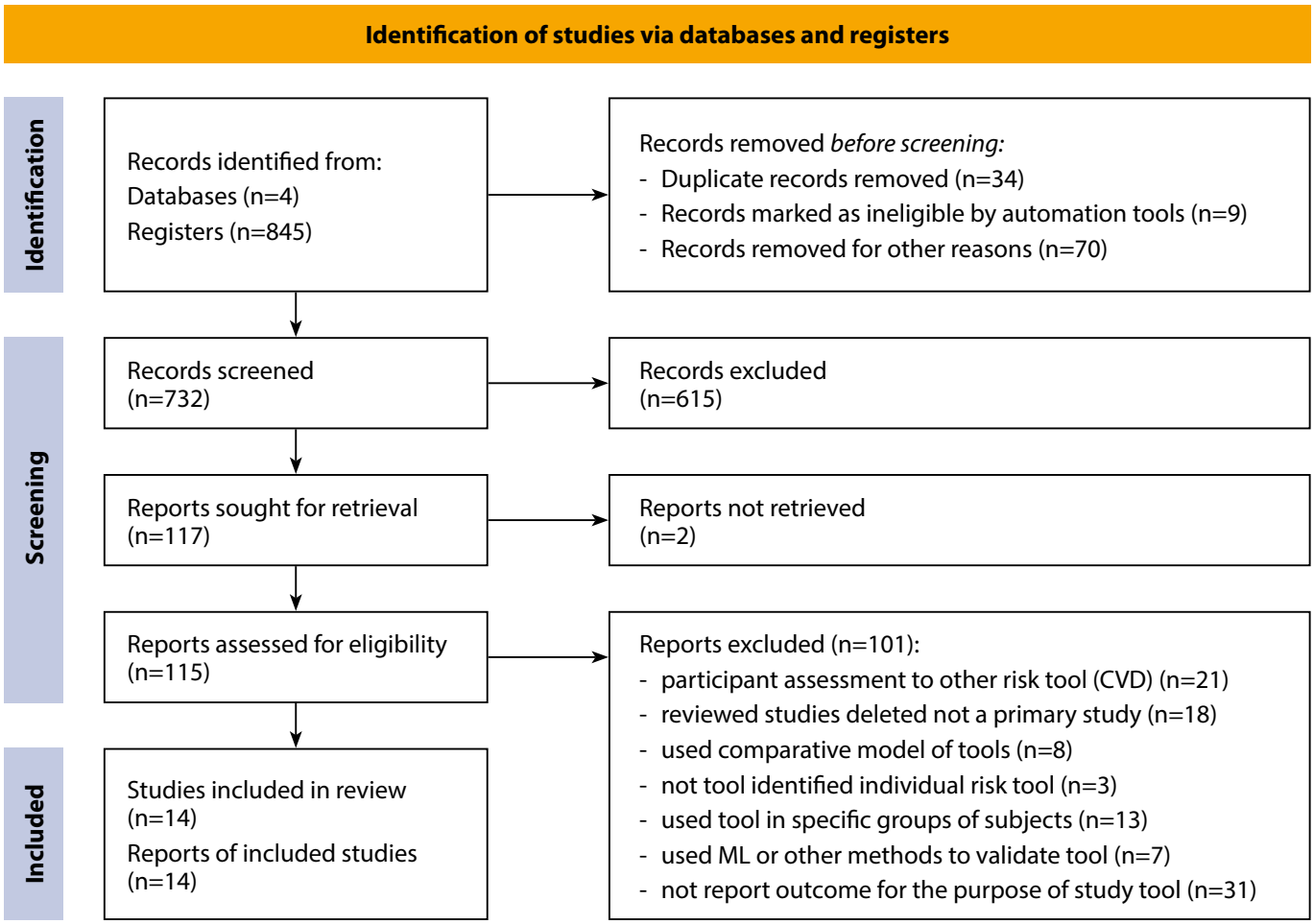

Figure 1. PRISMA 2020 flow diagram.

Risk of Bias Assessment

As this is a scoping review, for which risk of bias assessment is regarded by JBI as optional rather than mandatory [36], we used a pragmatic approach to the risk of bias assessment. That is, we selected a subset of what we considered to be the most important risk of bias questions from a relevant risk of bias tool for screening studies.. The **QUADAS-2** tool [37, 38], was used to assess bias across four domains: Patient Selection, Index Test, Reference Standard, and Flow and Timing. For comparative accuracy, **QUADAS-C** [39], was applied where relevant. Additional quality considerations included sampling and reporting bias.

Assessment Process: 1) Independent Review: Two reviewers evaluated study design rigor, using adapted QUADAS-2 criteria for diabetes risk assessment. 2) Study Categorization: Included 7 cross-sectional, 6 cohort, and 1 case-control study. 3) Bias Judgment: Each study was rated as low, high, or unclear risk in QUADAS-2 domains. 4) Comparison with Previous Reviews: Unlike earlier findings [9, 18], with 87.8% high risk of bias, our review found all 14 studies had low risk of bias, highlighting their methodological robustness. All studies were deemed low risk of bias and included in the final analysis (Table 2 in Appendix C).

RESULTS

This section may be divided by subheadings. It should provide a concise and precise description of the experimental results, their interpretation, as well as the experimental conclusions that can be drawn.

Descriptive Overview of the Included Studies

This review includes 14 studies conducted across 11 countries, spanning the years 2009 to 2018. These studies were drawn from five databases and nine community-based settings, providing a diverse geographic and methodological landscape. The study designs included one case-control study [40], seven cross-sectional studies [41–47], and six cohort studies [18, 31, 48–51]. Participants were adults aged 18 and older who were identified as being at high risk for diabetes or prediabetes.

Summary of the diabetes risk screening tools

The types of diabetes risk assessment tools varied, with the following tools and models being assessed (Table 1):

1) Risk Screening Tools: Thai-RISK, CANRISK (3 studies), FINDRISC (3 studies), ADA, IDRS, UDD, and Filipino risk scores.
2) Comparative Models: OGTT, CANRISK Original, FBG, ADA, CDA, FPG, and A1C were used to benchmark and compare the efficacy of these risk tools.
3) The "gold standard" criteria or diagnostic cut-off points applied in these studies included CANRISK Original, ADA, CDA, FPG, OGTT, and A1C, allowing for standardized evaluation of risk assessment performance.

Development of Diabetes Risk screening Tools

Developing reliable diabetes risk assessment tools is essential for early detection and diagnosis in adults with high-risk impaired glucose, intermediate hyperglycemia, or prediabetes. Low-cost, simple tools such as

Table 2. Diagnostic performance and cut-off scores of diabetes risk screening tools (9 studies)

Study (citation)	Screening tool	Cut-off score (risk threshold)	Outcome predicted	Reference standard & cut-point	Sensitivity (%)	Specificity (%)	PPV (%)
Agarwal G (2019) [40]	CANRISK	≥33	Prediabetes or undiagnosed diabetes	FPG ≥100 mg/dL (5.6 mmol/L) (ADA)	70	67	35
	FINDRISC	≥15			78	67	13
	ADA RISK TEST	≥3			79	67	10
	IDRS	≥60			83	60	17
	UDDM	≥14			-	-	-
	Filipino Risk Score	≥21			-	-	-
Aekplakorn W. (2015) [41]	Thai Diabetes Risk Score	≥6-FPG	Prediabetes (screen positive)	FPG ≥100 mg/dL (5.6 mmol/L) or 2-h OGTT ≥140 mg/dL (7.8 mmol/L) (ADA)	53.7	100	100
		≥6-OGTT			81.1	100	100
Bahijri S (2020) [42]	SADRISC	≥4	Prediabetes or diabetes	FPG ≥100 mg/dL (5.6 mmol/L); OGTT (50 g 1-h PG) 140–200 mg/dL (ADA)	87	45	33
		≥5			72	66	39
		≥6			69	69	40
		≥7			53	83	49
Jiang Y (2017) [43]	CANRISK	≥21	Prediabetes (WHO criteria)	FPG >100 mg/dL (5.6 mmol/L); 2-h OGTT ≥140 mg/dL (7.8 mmol/L) (WHO)	85.1	31.4	26.0
		≥29			65.7	55.5	29.5
		≥32			61.2	65.7	33.6
		≥33			61.2	66.5	34.2
Memish ZA (2015) [44]	SADRISC	≥5	Prediabetes or diabetes	FPG ≥100 mg/dL (5.6 mmol/L); OGTT ≥140 mg/dL (7.8 mmol/L) (ADA)	71.2	54	-
Rowan CP (2014) [45]	FINDRISC	≥6.5	Prediabetes or diabetes	HbA1c ≥5.7% (ADA) / ≥6.0% (CDA) / ≥6.5% (diabetes)	85.3	43.5	-
Srugo SA (2020) [46]	New CANRISK	≥22	Prediabetes or diabetes	HbA1c ≥5.7% (ADA)/ other thresholds per study	78.8	54.0	-
	Original CANRISK				77.1	55.0	-
Vanderwood KK (2015) [47]	ADA Risk Test	≥9	Prediabetes or diabetes	2-h OGTT ≥140mg/dL (7.8 mmol/L) and ADA/CDA definitions	68.9–98.5	44.5	-
Schmidt MI (2019) [51]	QDiabetes-style approach	Model-specific (10-yr risk ≥10%)	Incident diabetes / 10-yr risk	FPG ≥100 mg/dL (5.6 mmol/L) (ADA) as diagnostic reference in the study	67.7	77.9	-

Note: Outcome Predicted — whether the screening tool correctly identifies individuals with prediabetes and/or undiagnosed diabetes as defined by the reference standard in each study (FPG, OGTT, or HbA1c based on ADA/WHO criteria). Cut-off scores are as reported in the original studies.
ADA RISK — American Diabetes Association Risk Score; CANRISK — Canadian Diabetes Risk Score; CDA — Canadian Diabetes Association; FBG — Fasting Blood Glucose; Filipino — Diabetes Risk Tools for the Philippines; FINDRISC — Finnish Diabetes Risk Score; IDRS — Indian Diabetes Risk Score; OGTT — Oral Glucose Tolerance Test; PG — Plasma Glucose; PPV — Positive Predictive Value; SADRISC — Saudi Arabia Diabetes Risk Tool; UDDM — Diabetes Risk Tools for Indonesia; WHO — World Health Organization.

paper-based risk questionnaires or anthropometric measurements allow for easier identification of at-risk individuals who may benefit from lifestyle interventions. Common tools for assessing prediabetes or diabetes risk include the CANRISK, FINDRISC, and ADA Risk Questionnaires. The development of these tools generally falls into three main categories:

Non-invasive risk score assessments: These tools estimate diabetes risk based on non-invasive parameters, such as BMI, age, and lifestyle factors [42–44, 47].

Index tests for diabetes risk scores: These studies investigate the utility of diabetes risk scores as diagnostic tools [40, 41, 45, 46, 50].

Predictive models for incident diabetes: These models focus on predicting the future development of diabetes in individuals identified as at risk [18, 51].

In summary, this review outlines three key findings regarding diabetes risk screening tools (Table 2):

1. Development methods: Approaches to creating and refining diabetes risk assessment tools.
2. Detection capabilities: Effectiveness of the tools in identifying prediabetes or diabetes based on sensitivity, specificity, accuracy, and feasibility.
3. Progression and intervention: Factors that influence the reversal of prediabetes risk and the likelihood of progressing to diabetes over time, with an estimated incidence of 15.9% over five years.

These findings highlight the need for tailored, effective risk assessment tools that are both accessible and accurate, enabling early intervention in at-risk populations.

Progression to Diabetes

Across 14 studies, 8.69 million participants were analyzed, with 53% female and a mean age of 38.4 years (SD=7.7). Risk assessments included 5 to 15 factors (median: 11), categorized as follows (Table 3):

- *Socioeconomic:* age, sex, education, marital status, and occupation.
- *Anthropometric:* BMI, weight, waist circumference, and waist-to-hip and waist-to-height ratios.
- *Biomarkers:* blood pressure, lipid profiles (total cholesterol, HDL, TG, LDL), hypertension history, gestational diabetes, and family history of diabetes.
- *Lifestyle:* Smoking, physical activity, and sleep duration.

Among 6.49 million (74.7%) who completed risk assessments: 3.1% (198,968) were identified as high-risk for prediabetes, 2.8% (180,639**)** were diagnosed with diabetes during follow-up. Among diagnosed cases, the average diabetes duration was 5.5 years.

Summary of risk factors, score ranges, and accuracy of the screening tools

Key risk factors in diabetes screening tools include age, BMI, history of diabetes (HxDM), hypertension (HT), and waist circumference (WC). Some tools incorporate additional factors (Table 4):

- *Sex:* Thai-RISK, CANRISK-9, Filipino Risk Score
- *Physical activity:* Included in most tools except Thai-RISK
- *Diet:* CANRISK-9, FINDRISC-8, SADRISC-10, UK-D-10
- *Gestational diabetes (GDM):* ADA-7, SADRISC-10, UK-D-10, Filipino Risk Score
- *Ethnicity:* CANRISK-9, UK-D-10, SADRISC-10
- *Smoking:* CANRISK-9, SADRISC-10, Filipino Risk Score
- *Excluded factors across all tools:* lipid levels (HDL, LDL), cardiovascular diseases (CVD), and corticosteroid use.

Tool Performance:

- *Sensitivity:* 70–90% (higher in Thai-RISK, CANRISK-9, FINDRISC-8, and UK-D-10).
- *Specificity:* 45–80% (higher in CANRISK-9, FINDRISC-8).

Risk Stratification:

- *Low risk:* Below tool-specific cut-off.
- *Moderate risk:* Intermediate range.
- *High risk:* Exceeds high-risk cut-off, indicating a greater likelihood of diabetes.

The tools that had more risk factors had lower % of people identified at high risk of pre-DM, suggesting that adding more risk factors doesn't improve prediction.

KEY FINDINGS AND IMPLICATIONS

The 14 studies included a range of screening tools with different cutoffs and several different reference (i.e. gold) standards, with limited repetition of these combinations of tools, cutoffs and reference standards across the studies (Table 1 and Table 2). This makes it difficult to determine how generalisable the findings from individual studies would be. Overall, 26 screening tools were assessed across the 14 studies.

Across all studies and all combinations of the screening tools and their corresponding reference standards, sensitivity of the tools for detecting people with prediabetes or those at high risk of developing diabetes ranged from 54% to 98% whilst specificity ranged from 31.5% to 100% and the PPV ranged from 10% to 100% (Table 2). Thus, none of the tools studied optimised both sensitivity and specificity and, in all cases, the PPV (i.e. the probability that someone with a positive screening test result would actually have prediabetes or a high risk of developing diabetes) was relatively low. The screening tools with the highest sensitivity for identifying people with prediabetes or a high risk of developing type 2 diabetes were ADA Risk Tes with a ≥9 cutoff, FINDRISC ≥15 cutoff and IDRS with a ≥60 cutoff (94% and 92% sensitivity respectively) but in the corresponding specificity was relatively low (43%, 45% and 67% respectively) (Table 2).

There is a strong need for more sensitive and specific tools to identify prediabetes effectively. While CANRISK and FINDRISC show potential for early detection, greater internal validation is essential to ensure their reliability across populations. Strengthening validation efforts can enhance screening accuracy, guiding health providers and policymakers in developing targeted preventive strategies for high-risk groups.

This review analyzed one case-control study, seven cross-sectional studies, and six cohort studies focused on tool development and validation.

DISCUSSION

This scoping review provides a comprehensive synthesis of diabetes risk screening tools for identifying adults at risk of prediabetes or type 2 diabetes mellitus (T2DM), as follow each objective of the study;

Table 3. Baseline characteristics of the included studies

First Author (Year)	Sample Size (Case/ Control)	Mean Age (SD)	Sex (M/F, %)	Number of Risk Factors	High Risk Identified (%)	Complete Risk Assessment (%)	High Risk of Pre-DM (%)	Diagnosed with DM (%)
Agarwal G (2019) [40]	200 (50/150)	56 (11.5)	M: 23.5, F: 76.5	9	NA	100	8	6
Aekplakorn W (2015) [41]	6,884	50.5 (6.9)	M: 23.6, F: 76.4	6	38.8	88	38.8	13.4
Bahijri S (2020) [42]	1,477	32 (11.5)	M: 53.6, F: 47.4	11	22.2	23	17.5	4.7
Jiang Y (2017) [43]	303	<45 (50%)	M: 34.4, F: 65.6	12	6.7	100	18	4
Memish ZA (2015) [44]	1,485	50–59 (64%)	M: 62, F: 38	7	49.2	96.6	49.2	16
Rowan CP (2014) [45]	691	<40 (32.3%)	M: 29, F: 71	7	ADA: 79.7, CDA: 75	85.2	ADA: 79.7, CDA: 75	61.7
Srugo SA (2020) [46]	3,334	28.5 (NA)	M: 37.6, F: 62.4	13	NA	100	5.8	1.5
Vanderwood KK (2015) [47]	364	55.8 (12.5)	M: 36, F: 64	7	89	86	55	19.4
Risøy AJ (2018) [50]	211	<45 (43%)	M: 40, F: 60	8	6.6	100	5.4	1.4
Schmidt MI (2019) [51]	15,105	45–54 (32%)	M: 45.5, F: 54.5	5	79	74.1	59	2% (person-year)
Bethel MA (2013) [31]	9,306	63.8 (6.8)	M: 49, F: 51	15	49	100	35	35
Hippisley-Cox J (2017) [48]	8,640,363	44.9 (15.2)	M: 49.6, F: 50.4	12	NA	96.9	28.2	19.1
Kaneko K (2020) [49]	8,989	50 (NA)	M: 82.7, F: 17.3	11	43.3	46	18.8	5.8
Xu S (2021) [18]	3,250	63 (NA)	M: 72.4, F: 27.6	15	NA	96	15.8	21.1
14 authors	200 to 8.6 million participants, reflecting diverse population sizes.	from young (28.5 years) to older (63.8 years).	Male-to-female ratios were mostly balanced, with a few studies having male-dominated cohorts (e.g., Kaneko K: 82.7% male).	Risk factors assessed ranged from 5 to 15, showing different screening approaches.	High-risk identification rates varied widely (6.6% to 79.7%).	Most studies achieved over 85% completion rates for assessments.	The prevalence of pre-diabetes among high-risk individuals ranged from 5.4% to 55%.	Diabetes diagnosis rates ranged from 1.4% to 35%, depending on population and study design.

Note: NA: Not applicable, NS: NOT State, FBG: Fasting Blood Glucose, OGTT: Oral Glucose Tolerance Test, A1C: Hemoglobin A1C, ECG: electrocardiogram, THAIRISK: Thai Diabetes Risk Score, CDA: Canadian Diabetes Association, CANDRISK: Canadian Diabetes Risk Score FINDRISC ; Finnish Diabetes Risk Score, ADA RISK: America Diabetes Association Risk Score, IDRS; Indian Diabetes Risk Score, UDDM; Diabetes Risk tools for Indonesia, Filipino; Diabetes Risk tools for Philippine, SADRISC: Saudi Arabia diabetes risk tool, UK-diabetes risk

Characteristics of Diabetes Risk Screening Tools

We identified 14 studies representing 26 risk models, including widely used tools such as CANRISK, FINDRISC, and ADA-Risk, with considerable variability in sensitivity, specificity, and applicability across populations [42–44, 47]. The majority use indirect predictors such as BMI, family history of diabetes, age, waist circumference and physical activity [44, 49]. Similarly, Rowan et al. [45]. Studies show that the standard CANRISK questionnaire, with a cut-off score of 33 points, achieves good accuracy, while a lower cut-off of 21 points significantly increases sensitivity [52]. However, adjusting BMI and waist circumference cut-off points for ethnicity did not enhance predictive accuracy**.** A risk score based on factors such as sex, age, waist circumference, hyperglycemia history, and family diabetes history, with scores ranging from 0 to 15, was deemed effective for assessing prediabetes or diabetes risk [40, 42]. Women with impaired fasting glucose (IFG) are often underdiagnosed, and using OGTT may improve prediabetes detection, especially among women aged 45 and older [41]. Between simplicity and utility are some of the tools (eg, Thai-RISK and CANRISK) that were developed with restricted external validation so their extrapolation outside the study population should be with caution [40, 41, 45, 46, 50]. A model combining FBG and OGTT (C=0.70) proved effective for diabetes risk assessment [31]. However, models based on IFG (WHO criteria) had lower sensitivity (67.7%) and specificity (77.9%) than expected.

Effectiveness and Feasibility of Diabetes Risk Assessment Tools

The effectiveness of various tools in predicting T2DM was assessed through their ability to classify individuals based on risk factors like impaired glucose tolerance (IGT) and impaired fasting glucose (IFG). For instance, the CANRISK tool has demonstrated success in identifying impaired glucose in Canada's First Nations and Métis communities, as well as in Saudi Arabia [40, 41, 45, 46, 50]. Jieng's study suggested that OGTT was superior to FPG for risk prediction [43], and Norway's community pharmacies effectively utilized HbA1c testing to identify undiagnosed T2DM cases. The QDiabetes-2018 algorithm further showed strong predictive capabilities for 10-year risk of T2DM, confirming its feasibility for use in community screening [41, 51]. Screening through FINDRISC in pharmacy settings proved feasible, highlighting the utility of accessible locations for reaching at-risk populations. Suggested model cut points include A-Q Diabetes (no FBG or A1c), B-FBG, and C-A1C [48]. For 10-year diabetes risk prediction, Model B_FBG provided the best performance, effectively identifying individuals needing intervention or more intensive follow-up [48]. Other studies found the risk score approach feasible and effective for assessing diabetes risk in community and pharmacy settings, allowing both pharmacists and participants to engage in the screening process [44, 50]. Simple, cost-effective questionnaires are valuable for raising awareness and assessing type 2 diabetes risk [49]. Aside from the SADRISC tool and ADA Risk Test, which were each included in two studies, all other diabetes screening tools were only included in one study and so their sensitivity, specificity and PPV in a wider range of settings is unknown. Due to the different tools and reference standards used across the studies a quantitative meta-analysis of the studies is not feasible. Our risk of bias assessment using QUADAS2 suggested that the studies were broadly similar in their risk of bias, but the studies differed in a range of factors, including the country, study design, age range, and risk factors of the populations (Table 1). These factors likely contribute to the observed heterogeneity of the sensitivity, specificity and PPV results but are difficult to test for as explanatory variables in this evidence base due to the limited occurrence of each set of variables across the studies.

Progression from Prediabetes to Diabetes

Cohort studies primarily examined the progression of individuals with prediabetes to diabetes, emphasizing IFG and Metabolic syndrome (MetS) as significant risk factors [18, 31, 51]. Kaneko et al. found that IFG held a higher population-attributable fraction (PAF) than MetS in predicting T2DM incidence among middle-aged Japanese participants [25], and the coexistence of IFG and MetS showed the highest risk [9]. This finding suggests that IFG could be a valuable marker for diabetes risk, especially when used in combination with MetS criteria. In Saudi Arabia and Algeria, basic assessment tools have effectively evaluated diabetes risk in the population. Across studies, socioeconomic factors such as age, education, and marital status, as well as biomarkers like blood pressure and lipid levels, were found to significantly impact diabetes progression [18, 31, 51].

In a five-year period, 15.9% of participants with impaired glucose tolerance (IGT) or coronary heart disease (CHD) progressed to diabetes, underscoring the importance of targeted interventions. A risk prediction model utilizing clinical variables readily available in routine practice can help estimate diabetes risk in specific populations, such as Chinese individuals with CHD or IGT. Despite some studies having small sample sizes, the general recommendation is for settings to raise diabetes risk awareness for individuals scoring 9 or higher on the ADA risk test [18, 47]. If the intention is primarily to identify people with prediabetes or at high risk of developing type 2 diabetes then the relatively low specificity and PPV values may not be a concern, provided that there are no negative issues associated with false positive results (such as the costs of testing or of the management of patients who receive a negative diagnosis).

CONCLUSIONS

This review mapped the field of diabetes risk screening tools and emphasized the importance of more systematic validation, particularly in different populations. A range of different screening tools has been tested that could identify people with prediabetes or a high risk of developing type 2 diabetes. However, where sufficient evidence was available to compare tools across studies the performance of these tools was inconsistent. Several tools have only been investigated in single studies, with uncertainty around their wider generalisability. Clinicians or researchers wishing to screen people for prediabetes or a high risk of developing type 2 diabetes using any of these tools should be aware of their potential limitations.

Limitations: The limitations of this review are that it only covers English and Thai literature; possible publication bias due to the fact that grey literature is not included; and that no meta-analysis was conducted. Although this is to be

Table 4. Risk factors, Score Range, Cut-off score and Sensitivity (%) Specificity (%) of the screening tools

Risk factors	Thai-RISK	CAN-RISK-9	FIND-RISC-8	ADA-7	UK-D-10	SAD-RISC-10	IDRS-4	UDD-7	Filipino risk scors-9
1) Age	+	+	+	+	+	+	+	+	+
2) Sex	+	+	-	-	-	-	-	-	+
3) BMI	+	+	-	+	+	-	-	+	+
4) Hx of DM	+	+	+	+	+	+	+	+	+
5) HT (Hypertension)	+	+	+	+	+	+	-	+	+
6) WC (Waist Circumference)	+	+	+	+	+	+	+	+	+
7) Impaired Glucose	+	-	+	-	+	+	-	+	-
8) Physical Activity	-	+	+	+	+	+	+	+	+
9) Diet	-	+	+	-	+	+	-	-	-
10) GDM (woman)	-	-	-	+	+	+	-	+	+
11) Ethnicity	-	+	-	-	+	+	-	-	-
12) Smoking	-	+	-	-	-	+	-	-	+
13) Lipids (HDL, LDL)	-	-	-	-	-	-	-	-	-
14) CVD	-	-	-	-	-	-	-	-	-
15) Drug (Depression, schizophrenia, corticosteroids)	-	-	-	-	-	-	-	-	-
N of risk factors	7	9	8	7	10	10	4	7	9
Sensitivity (%)	80–90%	75–85%	78–88%	70–85%	81%	~80%	75–85%	~80%	78–88%
Specificity (%)	60–75%	70–80%	72–80%	65–75%	45%	~70%	65–75%	~75%	70–80%
Range of score	0–17	0–100	0–26	0–10	0–47	0–15	0–100	0–24	0–25
Cut-off score	≥6	≥ 33	≥15	≥3	≥16	≥5	≥60	≥9	≥9
Low risk score	<6	<21	<7	<5	≤16	**≤5**	<30	≤9	≤9
Moderate risk score	6–8	21–32	7–11	-	17–24	6–9	30–50	10–14	10–14
High risk score	≥9	>32	12–20	≥5	≥25	≥10	≥60	≥15	≥15
Very high risk score	-	-	≥ 21	-	-	-	-	-	-

Note: (+): Yes; (-): No

expected in scoping reviews, the reporting of pooled performance ranges in our tables serves to narrow the knowledge gap and achieve higher interpretability.

Strengths: Diverse Geographic Coverage: Findings are generalizable across different populations. Comprehensive Tool Review: Analyzing 14 screening tools provides a broad comparative perspective. Quality Assessment: QUADAS-2 ensures structured evaluation, enhancing reliability. Clinical Relevance: Identifies practical, non-invasive risk factors (e.g., age, BMI) for easy application in healthcare settings.

ADDITIONAL INFORMATION

Source of funding. This research received no external funding.

Conflict of interests. Authors declare no explicit and potential conflicts of interests associated with the publication of this article.

Authors involvement. P.W.: Conceptualization, methodology, investigation, resources, data curation; P.W., S.D.; validation, formal analysis, P.W.; S.D., and TTN.; writing-original; All authors read and final proof the manuscript.

Acknowledgements. We thank for our information specialists and all advisory board of the community medicine division, Thammasat University, for their help in developing the search strategy and for selecting databases. Special thanks to Dr. Geoff K. Frampton, the Principal Research fellow from the School of Medicine, University of Southampton, UK. and Associate Prof. Dr. Omid Dadras, Queensland Ambulance Services, Queensland Government Department of Health, Brisbane, Australia.

Additional materials to the article are available in the online version of the article.

REFERENCES

1. Cho NH, Shaw JE, Karuranga S, et al. IDF Diabetes Atlas: Global estimates of diabetes prevalence for 2017 and projections for 2045. *Diabetes Res Clin Pract*. 2018;138:271-281. doi: https://doi.org/10.1016/j.diabres.2018.02.023
2. IDF Diabetes Atlas 2021 [Internet]. IDF Diabetes Atlas [cited 2024 Dec 9]. Available from: https://diabetesatlas.org/atlas/tenth-edition/
3. Luo H, Chen Z, Bell R, et al. Health Literacy and Health Behaviors Among Adults With Prediabetes, 2016 Behavioral Risk Factor Surveillance System. *Public Health Reports*. 2020;135(4):492-500. doi: https://doi.org/10.1177/0033354920927848
4. Sun H, Saeedi P, Karuranga S, et al. IDF Diabetes Atlas: Global, regional and country-level diabetes prevalence estimates for 2021 and projections for 2045. *Diabetes Res Clin Pract*. 2022;183:109119. doi: https://doi.org/10.1016/j.diabres.2021.109119
5. Zand A, Ibrahim K, Patham B. Prediabetes: Why Should We Care? *Methodist DeBakey Cardiovasc J*. 2018;14(4):289. doi: https://doi.org/10.14797/mdcj-14-4-289
6. St. Luke's Medical Center, Quezon City Philippines, Mirasol R, Thai AC, et al. A Consensus of Key Opinion Leaders on the Management of Pre-diabetes in the Asia-Pacific Region. *J ASEAN Fed Endocr Soc*. 2017;32(1):6-12. doi: https://doi.org/10.15605/jafes.032.01.02
7. American Diabetes Association. 2. Classification and Diagnosis of Diabetes: *Standards of Medical Care in Diabetes—2020. Diabetes Care*. 2020;43(Supplement_1):S14-S31. doi: https://doi.org/10.2337/dc20-S002
8. American Diabetes Association. 2. Classification and Diagnosis of Diabetes: *Standards of Medical Care in Diabetes—2021. Diabetes Care*. 2021;44(Supplement_1):S15-S33. doi: https://doi.org/10.2337/dc21-S002
9. Barber SR, Davies MJ, Khunti K, Gray LJ. Risk assessment tools for detecting those with pre-diabetes: A systematic review. *Diabetes Res Clin Pract*. 2014;105(1):1-13. doi: https://doi.org/10.1016/j.diabres.2014.03.007
10. Guess ND, Caengprasath N, Dornhorst A, Frost GS. Adherence to NICE guidelines on diabetes prevention in the UK: Effect on patient knowledge and perceived risk. *Prim Care Diabetes*. 2015;9(6):407-411. doi: https://doi.org/10.1016/j.pcd.2015.04.005
11. American Diabetes Association. *Standards of Medical Care in Diabetes—2022* Abridged for Primary Care Providers. *Clin Diabetes*. 2022;40(1):10-38. doi: https://doi.org/10.2337/cd22-as01
12. Blonde L, Umpierrez GE, Reddy SS, et al. American Association of Clinical Endocrinology Clinical Practice Guideline: Developing a Diabetes Mellitus Comprehensive Care Plan-2022 Update. *Endocr Pract Off J Am Coll Endocrinol Am Assoc Clin Endocrinol*. 2022;28(10):923-1049. doi: https://doi.org/10.1016/j.eprac.2022.08.002
13. Jellinger PS, Handelsman Y, Rosenblit PD, et al. American Association of Clinical Endocrinologists and American College of Endocrinology Guidelines for Management of Dyslipidemia and Prevention of Cardiovascular Disease. *Endocr Pract*. 2017;23:1-87. doi: https://doi.org/10.4158/EP171764.APPGL
14. Mata-Cases M, Artola S, Escalada J, et al. Consenso sobre la detección y el manejo de la prediabetes. Grupo de Trabajo de Consensos y Guías Clínicas de la Sociedad Española de Diabetes. *Endocrinol Nutr*. 2015;62(3):e23-e36. doi: https://doi.org/10.1016/j.endonu.2014.10.008
15. Dhippayom T, Chaiyakunapruk N, Krass I. How diabetes risk assessment tools are implemented in practice: A systematic review. *Diabetes Res Clin Pract*. 2014;104(3):329-342. doi: https://doi.org/10.1016/j.diabres.2014.01.008
16. Doddamani P, Ramanathan N, Swetha NK, Suma MN. Comparative Assessment of ADA, IDRS, and FINDRISC in Predicting Prediabetes and Diabetes Mellitus in South Indian Population. *J Lab Physicians*. 2021;13(01):036-043. doi: https://doi.org/10.1055/s-0041-1727557
17. Xu S, Coleman RL, Wan Q, et al. Risk prediction models for incident type 2 diabetes in Chinese people with intermediate hyperglycemia: a systematic literature review and external validation study. *Cardiovasc Diabetol*. 2022;21(1):182. doi: https://doi.org/10.1186/s12933-022-01622-5
18. Xu S, Scott CAB, Coleman RL, et al. Predicting the risk of developing type 2 diabetes in Chinese people who have coronary heart disease and impaired glucose tolerance. *J Diabetes*. 2021;13(10):817-826. doi: https://doi.org/10.1111/1753-0407.13175
19. Aekplakorn W, Bunnag P, Woodward M, et al. A Risk Score for Predicting Incident Diabetes in the Thai Population. *Diabetes Care*. 2006;29(8):1872-1877. doi: https://doi.org/10.2337/dc05-2141
20. Baker P, El-Osta A. *Who self-cares wins: a global perspective on men and self-care*. Global Action on Men's Health; 2019.
21. Beulens J, Rutters F, Rydén L, et al. Risk and management of pre-diabetes. *Eur J Prev Cardiol*. 2019;26(2_suppl):47-54. doi: https://doi.org/10.1177/2047487319880041
22. Rauh SP, Rutters F, Van Der Heijden AAWA, et al. External Validation of a Tool Predicting 7-Year Risk of Developing Cardiovascular Disease, Type 2 Diabetes or Chronic Kidney Disease. *J Gen Intern Med*. 2018;33(2):182-188. doi: https://doi.org/10.1007/s11606-017-4231-7
23. American Diabetes Association. 3. Prevention or Delay of Type 2 Diabetes: *Standards of Medical Care in Diabetes—2020. Diabetes Care*. 2020;43(Supplement_1):S32-S36. doi: https://doi.org/10.2337/dc20-S003
24. Lin L, Wang A, He Y, et al. Effects of the hemoglobin glycation index on hyperglycemia diagnosis: Results from the REACTION study. *Diabetes Res Clin Pract*. 2021;180:109039. doi: https://doi.org/10.1016/j.diabres.2021.109039
25. Rosedale M, Strauss SM, Knight C, Malaspina D. Awareness of Prediabetes and Diabetes among Persons with Clinical Depression. *Int J Endocrinol*. 2015;2015:1-9. doi: https://doi.org/10.1155/2015/839152
26. Garay J, Camacho PA, Lopez-Lopez J, et al. Survey of knowledge for diagnosing and managing prediabetes in Latin-America: cross-sectional study. *Diabetol Metab Syndr*. 2019;11(1):102. doi: https://doi.org/10.1186/s13098-019-0500-4
27. Amisi CA. Markers of insulin resistance in Polycystic ovary syndrome women: An update. *World J Diabetes*. 2022;13(3):129-149. doi: https://doi.org/10.4239/wjd.v13.i3.129

28. McCullough D, Harrison T, Boddy LM, et al. The Effect of Dietary Carbohydrate and Fat Manipulation on the Metabolome and Markers of Glucose and Insulin Metabolism: A Randomised Parallel Trial. *Nutrients*. 2022;14(18):3691. doi: https://doi.org/10.3390/nu14183691
29. Qiu L, Wang W, Sa R, Liu F. Prevalence and Risk Factors of Hypertension, Diabetes, and Dyslipidemia among Adults in Northwest China. *Int J Hypertens*. 2021;2021:5528007. doi: https://doi.org/10.1155/2021/5528007
30. Yeh HC, Duncan BB, Schmidt MI, et al. Smoking, smoking cessation, and risk for type 2 diabetes mellitus: a cohort study. *Ann Intern Med*. 2010;152(1):10-17. doi: https://doi.org/10.7326/0003-4819-152-1-201001050-00005
31. Bethel MA, Chacra AR, Deedwania P, et al. A Novel Risk Classification Paradigm for Patients With Impaired Glucose Tolerance and High Cardiovascular Risk. *Am J Cardiol*. 2013;112(2):231-237. doi: https://doi.org/10.1016/j.amjcard.2013.03.019
32. Dreher, M. L. Dietary patterns and whole plant foods in aging and disease. Springer; 2018.
33. Yan F, Cha E, Lee ET, et al. A Self-assessment Tool for Screening Young Adults at Risk of Type 2 Diabetes Using Strong Heart Family Study Data. *Diabetes Educ*. 2016;42(5):607-617. doi: https://doi.org/10.1177/0145721716658709
34. Booth FW, Roberts CK, Laye MJ. Lack of Exercise Is a Major Cause of Chronic Diseases. In: Prakash YS, ed. *Comprehensive Physiology*. 1st ed. Wiley; 2012:1143-1211. doi: https://doi.org/10.1002/cphy.c110025
35. Page MJ, McKenzie JE, Bossuyt PM, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *BMJ*. 2021;372:n71. Published 2021 Mar 29. doi: https://doi.org/10.1136/bmj.n71
36. Pollock D, Evans C, Menghao Jia R, et al. "How-to": scoping review?. J Clin Epidemiol. 2024;176:111572. doi: https://doi.org/10.1016/j.jclinepi.2024.111572
37. Numpong STY, Sungkhabut W. A systematic literature review of the diagnosis of drug resistant tuberculosis using Xpert MTB/RIF assay and its potential impacts on treatment outcomes. 2020;46(3);303-312. doi: https://doi.org/10.14456/dcj.2020.29
38. Whiting PF, Rutjes AWS, Westwood ME, et al. QUADAS-2: a revised tool for the quality assessment of diagnostic accuracy studies. *Ann Intern Med*. 2011;155(8):529-536. doi: https://doi.org/10.7326/0003-4819-155-8-201110180-00009
39. Wade R, Corbett M, Eastwood A. Quality assessment of comparative diagnostic accuracy studies: our experience using a modified version of the QUADAS-2 tool. *Res Synth Methods*. 2013;4(3):280-286. doi: https://doi.org/10.1002/jrsm.1080
40. Agarwal G, Guingona MM, Gaber J, et al. Choosing the most appropriate existing type 2 diabetes risk assessment tool for use in the Philippines: a case-control study with an urban Filipino population. *BMC Public Health*. 2019;19(1):1169. doi: https://doi.org/10.1186/s12889-019-7402-0
41. Aekplakorn W, Tantayotai V, Numsangkul S, et al. Detecting Prediabetes and Diabetes: Agreement between Fasting Plasma Glucose and Oral Glucose Tolerance Test in Thai Adults. *J Diabetes Res*. 2015;2015:396505. doi: https://doi.org/10.1155/2015/396505
42. Bahijri S, Al-Raddadi R, Ajabnoor G, et al. Dysglycemia risk score in Saudi Arabia: A tool to identify people at high future risk of developing type 2 diabetes. *J Diabetes Investig*. 2020;11(4):844-855. doi: https://doi.org/10.1111/jdi.13213
43. Jiang Y, Rogers Van Katwyk S, Mao Y, et al. Assessment of dysglycemia risk in the Kitikmeot region of Nunavut: using the CANRISK tool. *Health Promot Chronic Dis Prev Can*. 2017;37(4):114-122. doi: https://doi.org/10.24095/hpcdp.37.4.02
44. Memish ZA, Chang JL, Saeedi MY, et al. Screening for Type 2 Diabetes and Dysglycemia in Saudi Arabia: Development and Validation of Risk Scores. *Diabetes Technol Ther*. 2015;17(10):693-700. doi: https://doi.org/10.1089/dia.2014.0267
45. Rowan CP, Miadovnik LA, Riddell MC, et al. Identifying persons at risk for developing type 2 diabetes in a concentrated population of high risk ethnicities in Canada using a risk assessment questionnaire and point-of-care capillary blood HbA1c measurement. *BMC Public Health*. 2014;14(1):929. doi: https://doi.org/10.1186/1471-2458-14-929
46. Srugo SA, Morrison HI, Villeneuve PJ, et al. Assessing Dysglycemia Risk Among Younger Adults: A Validation of the Canadian Diabetes Risk Questionnaire. *Can J Diabetes*. 2020;44(5):379-386.e3. doi: https://doi.org/10.1016/j.jcjd.2019.11.002
47. Vanderwood KK, Kramer MK, Miller RG, et al. Evaluation of non-invasive screening measures to identify individuals with prediabetes. *Diabetes Res Clin Pract*. 2015;107(1):194-201. doi: https://doi.org/10.1016/j.diabres.2014.06.003
48. Hippisley-Cox J, Coupland C. Development and validation of QDiabetes-2018 risk prediction algorithm to estimate future risk of type 2 diabetes: cohort study. *BMJ*. 2017:j5019. doi: https://doi.org/10.1136/bmj.j5019
49. Kaneko K, Yatsuya H, Li Y, et al. Risk and population attributable fraction of metabolic syndrome and impaired fasting glucose for the incidence of type 2 diabetes mellitus among middle-aged Japanese individuals: Aichi Worker's Cohort Study. *J Diabetes Investig*. 2020;11(5):1163-1169. doi: https://doi.org/10.1111/jdi.13230
50. Risøy AJ, Kjome RLS, Sandberg S, Sølvik UØ. Risk assessment and HbA1c measurement in Norwegian community pharmacies to identify people with undiagnosed type 2 diabetes - A feasibility study. *PLoS One*. 2018;13(2):e0191316. Published 2018 Feb 23. doi: https://doi.org/10.1371/journal.pone.0191316
51. Schmidt MI, Bracco PA, Yudkin JS, et al. Intermediate hyperglycaemia to predict progression to type 2 diabetes (ELSA-Brasil): an occupational cohort study in Brazil. *Lancet Diabetes Endocrinol*. 2019;7(4):267-277. doi: https://doi.org/10.1016/S2213-8587(19)30058-0
52. Zairina E, Girath YE, Sulistyarini A, Nugraheni G. Assessing Type 2 Diabetes Mellitus Risk: A Screening Approach for Overweight and Obesity Using the CANRISK Questionnaire. *Res Clin Pharm*. 2024;2(2):65-72. doi: https://doi.org/10.59931/rcp.24.0008

AUTHORS INFO

***Paleeratana Wongrith,** MSc (Health Education & Behavioral Science), Doctoral candidate, Assistant Professor; address: 222 Thaiburi, Thasala District Nakhonsrithammarat, Thailand, 80160; ORCID: https://orcid.org/0000-0002-8242-2893; e-mail: paleerut@gmail.com, paleeratana.wo@wu.ac.th

Suphika Dangkrajang, ED.D., Assistant Professor, e-mail: suphi2515@gmail.com
Truong Thanh Nam, PhD, Assistant Professor, e-mail: ttnam@ctump.edu.vn

TO CITE THIS ARTICLE:

Wongrith P, Dangkrajang S, Nam TT. Diabetes Risk Screening Tools for Prediabetes: A Comprehensive Scoping Review of Evidence and Implementation. *Diabetes Mellitus.* 2025;28(4):348-358. doi: https://doi.org/10.14341/DM13324

ЦИТИРОВАТЬ:

Вонгрит П., Данкраджанг С., Нам Ч.Т. Инструменты скрининга сахарного диабета для выявления предиабета: комплексный обзорный анализ данных и практики внедрения // *Сахарный диабет.* — 2025. — Т. 28. — №4. — С. 348-358. doi: https://doi.org/10.14341/DM13324