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Knowledge, attitude, and practice toward pre-diabetes among the public, patients with pre-diabetes and healthcare professionals: a systematic review

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ABSTRACT

The prevalence of pre-diabetes is increasing globally, affecting an estimated 552 million people by 2030. While lifestyle interventions are the first line of defense against progression toward diabetes, information on barriers toward pre-diabetes management and how to overcome these barriers are scarce. This systematic review describes the publics' and healthcare professionals' knowledge, attitude and practice (KAP) toward pre-diabetes and determines the barriers toward pre-diabetes management. A systematic search for studies examining KAP towards pre-diabetes was conducted in six databases from inception to September 2022. Studies that quantitatively assessed at least two KAP elements using questionnaires were included. The quality of studies was assessed using the NIH Quality Assessment Tool for Observational Cohort and Cross-Sectional Studies. Barriers and enablers were identified and mapped onto the Capability, Motivation, and Behaviour model to identify factors that influence behavior change. Twenty-one articles that surveyed 8876 participants were included in this review. Most of the reviews (n=13) were directed to healthcare professionals. Overall, positive attitudes toward diabetes prevention efforts were observed, although there were still knowledge deficits and poor behavior toward pre-diabetes management. Barriers and enablers were detected at patients (eg, goals and intention), healthcare professionals (eg, clinical judgement) and system (eg, access and resources) levels. The use of different survey instruments to assess KAP prevented a head-to-head comparison between studies. Most studies conducted among patients were from middle-income countries, while among healthcare professionals (HCPs) were from high-income countries, which may produce some biasness. Nevertheless, the development of pre-diabetes intervention should focus on: (1) increasing knowledge on pre-diabetes and its management; (2) imparting practical skills to manage pre-diabetes; (3) providing resources for lifestyle management; (4) improving the accessibility of lifestyle management programs; and (5) other HCPs and human support to pre-diabetes management.

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ While lifestyle interventions are the first line of defense against progression toward diabetes, information on barriers toward pre-diabetes management and how to overcome these barriers are scarce.

WHAT THIS STUDY ADDS

⇒ By consolidating KAP levels from included studies, this systematic review adds on to existing evidence on approaches to improve diabetes prevention and pre-diabetes management.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OF POLICY

⇒ This study suggests key components of pre-diabetes interventions to researchers and healthcare providers, which can be included in the development diabetes prevention programs.

INTRODUCTION

Pre-diabetes refers to the clinical situation in which blood glucose levels are elevated but do not meet the threshold for diabetes. This includes people with impaired fasting glucose and impaired glucose tolerance.[1 2] While diagnostic criteria vary, it can broadly be defined as a fasting plasma glucose of 5.6–6.9 mmol/L, glycated hemoglobin (HbA1c) of 5.7%–6.4%, or 2-hour plasma glucose of 7.8–11.0 mmol/L.[3 4] Studies suggest that people with pre-diabetes are at a higher risk of developing complications of diabetes, including cardiovascular diseases, nephropathy and neuropathy.[1]

Currently, 5%–10% of people with pre-diabetes will meet the clinical criteria for diabetes annually, with up to 70% progressing to diabetes within their lifetime.[5 6] The high prevalence of pre-diabetes is worrying, as these are potential seedbeds for type 2 diabetes mellitus in the coming years. However, there is still a silver lining for those who have pre-diabetes. Current evidence shows that lifestyle interventions to combat obesity and physical inactivity can effectively reduce the risk of progression from pre-diabetes to type 2 diabetes mellitus by up to 58%.[5 7 8] In many of these lifestyle intervention programs,

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patients were routinely trained and monitored by lifestyle 'coaches' to perform intensive diet and exercise regimes to achieve weight loss.[5 9 10] These interventions also found an increased life expectancy and protection from the detrimental repercussions of diabetes-related complications such as microvascular and macrovascular diseases,[11] which may persist for up to 10 years.[12]

To successfully implement lifestyle intervention programs, it is essential to understand the public readiness for behavioral change. This can be done using several ways, such as qualitative interviews and focus groups or through knowledge, attitude and practice (KAP) surveys of individuals with pre-diabetes, and that of healthcare providers managing patients with pre-diabetes.[13–34] In the latter, the model assumes that the KAP elements are interrelated, where good knowledge would positively affect the attitude and practice, triggering preventive behavior.[35 36] This model helps detect barriers toward preventive behavior and gaps between each component.[37] Various studies have examined the KAP toward pre-diabetes among patients and healthcare professionals. For example, Hyder *et al* showed that the people newly diagnosed with pre-diabetes from India had poor knowledge and practice toward lifestyle modifications, but there was a mixed response on their attitude toward pre-diabetes.[16 17] Among the healthcare professionals, Keck *et al* and Tseng *et al* suggested that their knowledge gap contributed to inadequate pre-diabetes diagnosis and referrals to diabetes prevention programs.[24 26] These studies found gaps in the KAP toward pre-diabetes; however, none have demonstrated the common barriers toward pre-diabetes and how to address them.

As such, investigating specific influencing factors that can overcome the barriers identified from the KAP model provides a foundation for diabetes prevention strategies.[38] This helps researchers make informed decisions and select the most effective interventions for diabetes prevention.

This systematic review aimed to investigate the KAP level toward pre-diabetes among the general population and healthcare professionals (HCPs). In addition, we aim to determine the barriers and enablers toward pre-diabetes management. By consolidating KAP levels from included studies, this systematic review adds on to existing evidence on approaches to improve diabetes prevention and pre-diabetes management.

METHODS

This study was performed in accordance with the recommendations of Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (online supplemental figure 1, online supplemental table S1). The study was registered in PROSPERO (CRD42021271768).

Search strategy

Studies were identified through a systematic search of CINAHL, PsycINFO, PubMed, Embase, CNKI, and LILACS from database inception to 1 September 2022. A combination of keywords and Medical Subject Headings (MeSH) related to pre-diabetes, survey, knowledge, attitude, and practice were used without language restriction (online supplemental figure S2). This was supplemented with manual searches on the reference lists of the included studies for potentially relevant publications.

Study eligibility

Studies were eligible for inclusion if they fulfilled the following criteria: (1) included adults aged 18 years and above; (2) examined perceptions of the general population, patients with pre-diabetes, and/or healthcare professionals; and (3) quantitatively assessed two or more KAP elements toward pre-diabetes using questionnaires. In order to draw comparisons between the KAP elements, only studies with at least two KAP elements were included. We excluded qualitative studies, conference abstracts, letters, editorials, and comments.

All retrieved studies were exported into Endnote X9 (Thomson Reuters, London) and deduplicated. Two authors (KWT and SL) independently screened the titles and abstracts for eligibility. Six authors (KWT, CMN, CWC, SB, MWLC and SL) independently reviewed full texts of eligible articles to determine their eligibility. Any disagreement was discussed and resolved between the two authors.

Data extraction, coding, and critical appraisal

Data from the included articles were extracted independently using a standardized extraction form. Extracted data included study demographic, questionnaire characteristics, and questionnaire responses. Subsequently, we mapped each question to be a barrier and enabler for behavioral change from each questionnaire item.

As intervention strategies that target behavior changes are often more effective when an implementation theory was used, we further mapped each of these barriers or enablers to the Capability, Motivation, and Behaviour (COM-B) model, more commonly known as a part of the behavior change wheel. The COM-B model classifies target behavior (B) into three distinct yet interacting components- 'capability' (C), 'opportunity' (O) and 'motivation' (M). Each component can be further stratified into their subcomponents (table 1).

This model contextualizes individual-level change, and the underlying determinants needed to achieve organizational change.[38] This was supplemented with a mapping to the Theoretical Domains Framework (TDF) that builds on the COM-B model to uncover the underlying barriers and facilitators for change.[39] We then used the barriers to guide potential intervention functions (based on the Behaviour Change Wheel) and Behaviour Change Techniques (BCTs) that can shape behavior change.[40]

Two team members mapped the questions independently, and any disagreement was resolved by consensus. To assess the quality of studies, two authors used the National Institutes of Health (NIH) Quality

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Table 1 Definition of COM-B and its subcomponents

Component	Subcomponent
Capability (C) *Ability to undertake an action for behavior change*	Physical *Physical skills and strength*
	Psychological *Knowledge, psychological skills, comprehension and reasoning*
Opportunity (O) *External factors that encourage behavior*	Physical *Opportunity provided by environment*
	Social *Social cues, cultural norms, interpersonal influences*
Motivation (M) *Cognitive processes that trigger behavior*	Reflective *Plans and evaluations*
	Automatic *Emotional reactions, desires, reflexes, impulses*

Assessment Tool for Observational Cohort and Cross-Sectional Studies.[41] The tool assessed the studies based on several criteria namely: (1) research objective; (2) study population and recruitment; (3) exposure measurement and assessment; and (4) statistical analyses methods. Two authors independently assessed the quality of the included studies, with any disagreements resolved through discussion and consensus. All data were subsequently summarized narratively.

RESULTS

Study characteristics

The search identified 4698 potentially relevant articles, and 4332 were screened by title and abstract after removing duplicates. Full texts of 45 articles were reviewed, and 22 articles describing 21 unique studies were included (online supplemental figure S3). The studies were conducted in Asia (n=8),[13–17 19 20 34] North America (n=8),[18 21 24–26 29 30 33] South America (n=1),[32] Africa (n=2)[22 31] and Europe (n=2).[27 28] These were cross-sectional studies that examined the KAP toward pre-diabetes among the general public (n=1),[20] patients with pre-diabetes (n=7)[13–19] and HCPs (n=13) (tables 2 and 3).[21–34]

The studies surveyed a total of 8876 participants, including 303 participants from the general public, 2007 participants with pre-diabetes, and 6258 healthcare providers, with response rates ranging between 11.6% and 100%. The sample size of the studies varied, ranging from 54 to 1248 participants. The mean age of participants was 45.1 years old, with 52.5% females. Based on the NIH quality assessment tool, most studies were rated to have a poor to fair internal validity (online supplemental table S2 and figure S4).

KAP questionnaires

Various questionnaires were used to assess the KAP elements (tables 2 and 3, and online supplemental file 1). Sixteen studies evaluated all KAP elements, while the remaining five assessed at least two KAP elements. Of the 21 studies, 16 used validated questionnaire, with five describing the questionnaire development.

Knowledge

Patients

Six studies investigated the patients' knowledge toward pre-diabetes.[13 14 16 17 19 20] Studies reported that up to 93.7% of the individuals were unfamiliar with the terms 'prediabetes', 'impaired fasting glucose', 'impaired glucose tolerance', or 'borderline diabetes'.[14 19] However, patients' understanding of the risk factors and consequences of pre-diabetes were heterogeneous. Studies

Table 2 Characteristics of included studies that examined KAP toward pre-diabetes among the public and patients with pre-diabetes

First author	Study setting and collection period	Mean age (SD)	Sample size	Women, n (%)	KAP element reported (K/A/P)	Response rate
Chen, 2015[13] (Taiwan)	Health examination centres of two hospitals; January–August 2013	58.64 (10.99)	200	136 (68)	K/P	95.20%
Zhuang, 2015[14](China)	Community-dwelling adults; January 2012–May 2013	52.15 (6.29)	148	82 (55.4)	K/P	100%
Rahmati-Najarkolaei, 2017[15] (Iran)	Health centres; November 2014–April 2015	52.9 (11.5)	303	86 (28.4)	A/P	86.60%
Hyder, 2020[16] Hyder, 2021[17] (India)	Screening camps; September 2017–October 2019	46–50 (range)	308	150 (48.7)	K/A/P	98%
Kolb, 2014[18](USA)	Urban academic primary care practices	45.7 (10.9)	54	44 (81.5)	K/A/P	85.70%
Dong, 2014[19] (China)	Community-dwelling adults; May 2013–June 2013	45–59 (range)	994	588 (59.15)	K/A/P	ND
Zhao, 2011[20] (China)	Community-dwelling adults; October 2010–February 2011	20.95 (2.13)	303	180 (59.4)	K/P	K: 86.5% P: CD

A, attitude; CD, cannot determine; K, knowledge; ND, no data; P, practice.

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Table 3 Characteristics of included studies that examined KAP toward pre-diabetes among healthcare providers

First author	Study setting and collection period	Mean age (SD)	Sample size	Women, n (%)	KAP element reported (K/A/P)	Response rate
Tseng, 2017[21] (USA)	Academic medical center (doctors, nurses, and doctors' assistants), 2015	ND	140	99 (72.8)	K/A/P	89.7%
Inaku, 2021[22] (Nigeria)	Four government-owned tertiary hospitals (doctors), ND	ND	358	130 (36.3)	K/A/P	87.3%
Basavareddy, 2015[23] (India)	Academic practice, primary care, and secondary care (doctors), April 2014–August 2014	ND	122	ND	K/A/P	81.30%
Keck, 2019[24] (USA)	Academic family medicine clinic (doctors and nurses), February 2018	ND	31	19 (61.3)	K/A/P	67.39%
Mainous III, 2016[25] (USA)	Physicians from Council of Academic Family Medicine Educational Research Alliance (doctors), February 2016–March 2016	40–49 (range)	1248	619 (49.6)	A/P	34.65%
Tseng, 2018[26] (USA)	Primary care providers from American Medical Association (doctors), October 2017–January 2018	above 60 years old (n=99)	298	29 (30.2)	K/A/P	33.56%
Franch-Nadal, 2020[27] (Spain)	Primary care providers (doctors and pharmacists)	Physicians: 23.4 (8.32) Pharmacists: 45.26 (10.26)	803 Physicians: 410 Pharmacists: 393	419 (52.2%)	K/A/P	89.72%
Montee, 2021[28] (France)	Primary care providers (doctors)	49 (11)	121	57 (47.1%)	K/A/P	18.10%
Hulbert, 2021[29] (USA)	Providers from individual, group, or hospital practice (nurses, doctors, pharmacists, and internists)	45–54 (range)	1503	682 (45.4%)	K/A/P	43.38%
Shimpi, 2021[30] (USA)	Primary care providers (dentists)	50.1 (12)	854	593 (69.4%)	K/A/P	11.61%
Saleh, 2021[31] (Sudan)	Primary care providers (doctors)	34 (median)	189	149 (79%)	K/A/P	94.5%
Montee, 2021[28] (France)	Primary care providers (doctors)	49 (11)	121	57 (47.1%)	K/A/P	18.10%
Ross, 2021[33] (USA)	Primary care providers (physical therapists)	52.8 (11.5) range 26–75	63	29 (47)	K/A/P	6.30%
Aljehani, 2022[34] (Saudi Arabia)	Primary care providers (doctors)	ND	155	79 (51)	K/A/P	ND

K, Knowledge; A, Attitude; P, Practice; ND, no data.

from middle-income countries generally reported that one in three patients (range 19.7%–37.5%) understood the risk factors and consequences of pre-diabetes.[14 16 17 19] Conversely, more than half of patients from high-income countries (range 63%–88%) knew about the risk factors and consequences of pre-diabetes .[13 18]

Most patients could not correctly identify pre-diabetes diagnostic criteria and screening methods.[13 16 17 20] Misinformation on pre-diabetes remains widespread; up to 90% of patients thought that pre-diabetes would present symptoms similar to diabetes.[13] While more than half of the individuals were aware that pre-diabetes could be treated through lifestyle management,[13 19 20] many were unaware of what these modifications entailed, in terms of dietary changes and recommended duration of physical activities.[16 17 20] Interestingly, only 18.2% understood that weight reduction could help with reversing pre-diabetes, and up to 43% of the individuals believed that pre-diabetes could only be treated with medications.[16 17 20]

Healthcare providers

Most healthcare providers had poor knowledge about pre-diabetes, where only 2.8%–42% correctly identified the diagnostic criteria and risk factors for pre-diabetes.[21 22 24 26–28 32–34] Less than half of the healthcare providers could identify recommended lifestyle changes, clinical targets, and pharmacological therapies for patients with pre-diabetes.[21 23 24 26 32–34]

Attitude

Patients

Four studies described the patients' views and perceptions toward pre-diabetes, with mixed levels of attitudes.[15–18 20] For example, a study from India reported that half of the patients believed they could manage living life with pre-diabetes but were concerned it would eventually lead to complications such as developing diabetes, ischemic heart disease or stroke.[16 17]

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Studies from high-income countries found that patients were more willing to change and lead a healthier lifestyle (≥94%) if diagnosed with pre-diabetes, compared with only 30%–40% among those living in middle-income countries.[14 18] A similar trend was found for the stages of change, where up to 54% of individuals in high-income countries were taking actions for weight control, compared with less than one-third (range 8%–36%) of those living in middle-income countries.[18–20]

Most patients (up to 80%) appeared receptive to public health measures, such as health promotion and education to prevent diabetes.[16 17 19] The patients were reportedly agreed to participate in lifestyle management programs, such as weight control, healthy eating, and regular physical activities to build a healthier lifestyle.[15–18]

Healthcare providers

Up to 93.5% of the healthcare providers agreed that pre-diabetes is a major public health issue that causes significant economic burden.[23 24 27] As such, most felt that population-based screening and lifestyle change programs were important to manage pre-diabetes and other comorbidities.[21 22 24 27–34] Despite patient's positive attitudes toward lifestyle management programs, HCPs felt that their patients perceived lifestyle modifications as unimportant.[21 22 26 32–34] HCPs favored lifestyle management (68.8%–100%) compared with using medications (15%–86.4%) or complementary alternative medicines (9%–23.9%).[21 22 24 26 27 29 32–34 42]

Practice

Patients

All the included studies examined the practice element, which mostly showed poor practice level. Most participants had poor dietary habits, such as meal skipping, distracted eating, inadequate fiber intake, excessive fats and sweetened food consumption.[16–18 20] Poor sleep hygiene and poor sleep quality were found, with less than half of the participants reported having enough sleep (≥6 hours of sleep daily).[16 17 20]

Most participants had sedentary lifestyles, with nearly three in four had screen time of more than 4 hours a day.[18] A study from Iran reported that men were more likely to exercise than women, suggesting that gender may be an influential factor.[15]

Poor health-seeking behaviors were reported, with less than one-third of the participants declared recent health check-ups.[16 17 20] Up to 68% of university students reported never having done a blood glucose test[20]; however, most of these students expressed that they would take the necessary actions if their blood glucose were higher than normal.[20]

Healthcare providers

While most HCPs educate patients on lifestyle changes, the content of their advice could vary. Some would only talk about dietary management (67.7%–97.9%), while others provided advice on diet and exercises (21.8%–98.6%). Some HCPs would also provide specific advice on diabetes (45.4%) or cardiovascular diseases prevention (37.6%).[21–23 25 26 28 31 32 34] Up to 41.3% would refer their patients to nutritionists.[21 22 26 28] Only less than 36% of the healthcare providers, however, would consider referring their patients to diabetes prevention programs, resulting in the low uptake of these programs.[21 22 24 26 29 32–34]

Most HCPs would screen for pre-diabetes using fasting blood glucose or HbA1c tests (52.1%–92.7%) and less commonly oral glucose tolerance tests (8%–57%).[21–23 25–28 34] However, some providers (27%–34.1%) used non-fasting blood glucose to detect pre-diabetes, although the diagnostic criteria are currently non-existent.[22 26 34] Unsurprisingly, 12.3%–76.8% of providers were either unfamiliar with or did not adhere to clinical guidelines in their practice.[21 22 25 26 28 33] Blood screening was repeated at different intervals, ranging from 3-monthly to every 4 years.[21–23 26–28 32 34]

COM-B and TDF analysis

Twenty-nine potential barriers and enablers were identified and categorized as patient, HCP, or health system level (figures 1 and 2). A detailed summary of potential intervention functions and BCTs associated with these barriers and enablers can be found in online supplemental table S5.

Barriers and enablers

Psychological and physical capability

At patient, HCPs and system levels, barriers and enablers were mainly related to the 'knowledge about pre-diabetes and lifestyle management'.[13–26] 'Breaking lifestyle habits' and a 'lack of lifestyle management skills/abilities', such as the ability to make healthy food choices, were barriers to pre-diabetes management among patients.[16 20 25 31] These barriers suggest a lack of knowledge and skills necessary for pre-diabetes management for both patients and HCPS and can potentially be addressed by providing 'Training and Education'.[21 22 26 32–34]

Social and physical opportunity

Having a social support network, such as friends and family can improve pre-diabetes management among patients.[16–18 27] Key barriers reported was the lack of societal attention on pre-diabetes and stigma related to pre-diabetes, which was perceived as 'bad luck' by some communities from the low-income countries.[16 17]

Results suggest that there is a need for a comprehensive health system to address issues related to 'Environmental Context and Resources'. Nutrition and weight management resources were lacking, highlighting areas for improvement.[16 17 21 26 32–34] In addition, there is a lack of healthcare financing for those with pre-diabetes.[21 22 25 26 30 31]

At the HCPs and system level, guidelines and clinical decision support tools were found to be useful,[22 24 26–28 31] although guideline complexity was identified as an area for improvement.[21 28] Healthcare providers identified the

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Figure 1 Barriers toward pre-diabetes management at patient, HCPs and system levels. HCPs, healthcare professionals.

time required to advise patients with pre-diabetes as a potential challenge and could hinder effective management. There is a need for a quick yet effective diabetes prevention program for patients to follow and for HCPs to manage in their respective practices.[25–28 30–34] Some recommendations were identified from the studies, including increasing screening rates, development of a multidisciplinary effort, and task shifting to nurses, pharmacists, dentists, and nutritionists.[26 27 30]

Reflective motivation

'Reflective motivation' was the most identified component within the COM-B model, with factors mapped to TDF domains such as 'social/professional role and

Figure 2 Enablers toward pre-diabetes management at patient, HCPs and system levels.

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identity', 'beliefs about capabilities', 'beliefs about consequences', 'optimism', 'goals' and 'intentions'. This indicates that an individual's experience, reflective processes, and evaluations significantly determine their behavioral change.

'Goals and intention to make lifestyle changes', 'potential side effects and contraindications' of medications, and 'emotions' were identified as barriers and enablers among patients. These factors could affect adherence to lifestyle interventions and medication.[21 22 25 26 28 31 32 34] 'Prescriber's clinical judgement' could be an influential factor, as HCPs have different practices with regard to the types of laboratory tests used, follow-up intervals, and decision to prescribe oral antidiabetics.[21–23 26–28 31 32 34] 'Existing HCP practices' could also be a barrier or enabler, as changing current practices requires a combined effort from both HCPs and the health system.[21 22 24–27 29 30 32–34]

Three barriers or enablers were found at the patient and HCP level; these were 'perception toward pre-diabetes and its management',[15–18 20] 'risk perception' toward developing diabetes and its complications[18] and 'treatment failure/success with lifestyle management'.[21 23 26]

Confidence plays a vital role in facilitating one's behavior at the patient and HCPs level; for example, patients' 'self-confidence in making lifestyle changes',[16 17] 'patients' trust toward hcPs'[18] and 'HCPs' self-confidence'[24 27] in managing their patients with pre-diabetes.

Automatic motivation

Four TDF domains that determined the behaviors were 'emotion', 'optimism', 'social/professional role and identity' and 'reinforcement'. 'Patient's preference' may be a barrier to those prescribed oral antidiabetics, as studies described that most patients disliked taking medications. However, this dislike for medications may be an enabler for introducing lifestyle interventions to these patients.[21 22 26 32 34] Mental and emotional health (eg, stress, anxiety, and optimism) were factors for better pre-diabetes management.[16–18 26 28] Similar to reflective motivation, 'Patients' trust toward HCPs' and 'HCPs' self-confidence' were both important enablers for pre-diabetes management.[18 24 27]

DISCUSSION

To our best knowledge, this is the first systematic review that critically evaluated KAP toward pre-diabetes among patients and healthcare providers. We noted that there were knowledge deficits around pre-diabetes among patients, such as misinformation around pre-diabetes among patients and cultural misconception, especially within low-income and middle-income countries. This may also be related to their reluctance to change lifestyle behaviors as observed from the results. The relationship between socioeconomic level, health literacy, and health seeking behavior are usually intertwined. Studies have found that people from low socioeconomic backgrounds have lower health literacy and are less likely to participate in preventive measures. They tend to only seek for medical care when a condition has become severe.[43 44] Cultural sensitivities, stigma, and gender norms may also discourage positive lifestyle behavior in some regions. For example, women were expected to dress conservatively, which makes it less suitable for physical activity. They often also have limited accessibility to public spaces and could only be in public areas with a companion.[45] Similarly, in some cultures in the Middle East, unhealthy lifestyle were perceived as positive, where obese individuals often were associated with beauty.[46] Pre-diabetes interventions therefore must be designed to take into consideration the specific regional context and consider how each cultural influencing factors and barriers.

Factors associated with pre-diabetes behavior change identified were often internal, such as personal beliefs, knowledge levels, and emotions. Nonetheless, the contribution of external factors, although lower, was reported. As such, interventions such as providing education to patients and HCPs should address misconceptions and information deficits.[47] Emphasis should be placed on highlighting reversibility of pre-diabetes, consequences of pre-diabetes, diagnosis, and evidence-based information for performing lifestyle changes. Education should be supplemented with training to impart hands-on skills to execute lifestyle changes.[47–49] These should focus on techniques to instill a new habit or reverse an unwanted practice, coupled with self-monitoring and graded tasks (eg, setting easy tasks and slowly increasing their difficulty).[40 48–50]

While knowledge about pre-diabetes is essential, meaningful behavior change is likely linked to patients' perceived susceptibility toward the condition, the severity of the disease, the benefits of health behavior, and their capabilities in carrying out the behavior change.[51 52] To address this, BCTs such as providing credible sources on lifestyle modification, learning to self-talk about own capabilities, and focusing on past successes should be imparted to patients, especially when hit by setbacks.

Many HCPs were unfamiliar with the recommended lifestyle modification and clinical targets for their patients. Although HCPs provided advice to their patients with pre-diabetes, few HCPs were aware of or adhered to existing guidelines.[21 22 26 28 32 34] This is an essential factor that needs to be addressed as adherence to guidelines can improve patient outcomes.[53] Our findings also noted that referrals to a lifestyle modification program were rare, suggesting the need to increase awareness further.[21 22 24 26 32–34] Consultations with carers and patients can be complemented with clinical support tools such as patient decision aids,[42] where HCPs work together with patients to plan their actions for behavior change (eg, when and what kinds of exercises). Realistic goals for achieving a behavior (eg, how much time to spend on exercising a day) or an outcome (eg, weight loss) should be set.[54] Pre-diabetes management is not a 'one size fits all' method, as it should be individualized into practices that can be incorporated into patients' daily lives.

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Patients and HCPs were receptive to health promotion and diabetes prevention efforts, showing readiness to provide and receive help in managing pre-diabetes in both groups.[16 17 19 21 22 24 25 27–31 33 34] However, patients' negative outlook toward living a life with pre-diabetes, mainly due to the concern of developing diabetes and its complication, should be highlighted and addressed while developing pre-diabetes intervention.[18 26]

The studies described time and resources as common barriers that contributed to the poor practices among patients and HCPs.[16 17 21 22 25–28 30–34] Environmental restructuring could address these barriers, especially on improving access and resources for lifestyle modifications. At the HCPs level, the load of delivering care for patients with pre-diabetes can be shared across disciplines and involve other healthcare professionals such as pharmacists, nutritionists, and nurses.[26 27 30] To improve adherence to evidence-based guidelines, prediabetes-specific guidelines can be incorporated into local protocols of the healthcare settings.[53]

Streamlining the referral processes to a diabetes prevention program is necessary to help promote referrals. Among some approaches reported by Centers for Disease Control and Prevention (CDC) are forming partnerships with HCPs, providing technical assistance on allocating time and resources for lifestyle programs, and developing a sustainable pricing structure for the program.[55]

As social environment plays a role in patients' dietary and lifestyle habits, friends and families could be looped into pre-diabetes management process, to gain an understanding of the condition and to be a valuable support for the patient.[16–18 27] Engaging stakeholders for system-level interventions, such as restructuring the physical environment of the community, is necessary, by providing more healthy and affordable food options and infrastructures for physical activities.

Implication

This study revealed the existing beliefs and practices among HCPs and patients and the potential influencing factors that can be reinforced or changed. The review formulates key components of pre-diabetes intervention: (1) increasing knowledge and skills on pre-diabetes and its management; (2) imparting practical skills to manage pre-diabetes; (3) providing resources for lifestyle management; (4) improving the accessibility of lifestyle management programs; and (5) training of other HCPs and human support to pre-diabetes management. Undoubtedly, multifaceted efforts are needed for diabetes prevention.

Limitation

This review included quantitative studies in which two or more KAP elements were discussed and did not include qualitative KAP studies; this may have reduced the number of data retrieved. Not all studies included in the review described the use of validated questionnaires, and it was not possible to determine the psychometric properties of these questionnaires. We also did not include qualitative studies in our review, which may have limited the study applicability and findings. The included studies were heterogenous, in terms of their aims. Most studies conducted among patients were from middle-income countries, while among HCPs were from high-income countries, which may produce some biasness. Most studies among patients were carried out in Asia, while among HCPs were in the North America, which gave us a better insight into the KAP within these continents. However, this may also mean that population from the other continents from the other continents (eg, the Hispanic population) may be under-represented in this review. Most studies did not specify if their studies were conducted in rural or urban areas. Exploring possible rural and urban differences may be an area of interest for future pre-diabetes research, given that the information can be used to develop suitable targeted interventions that may address health disparity. Finally, as this review only included published studies, the review may have inherently missed some relevant studies. However, we believe this may be minimal as we have searched through six databases and included studies in the Chinese language.

CONCLUSION

We found that KAP levels among patients and HCPs were generally unsatisfactory, and future research should identify targeted diabetes prevention interventions at patient, HCP, and system levels considering the factors and behavior strategies we identified.

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Supplementary Materials

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Figure S1: Identification of studies presented in PRISMA flow chart 2020.

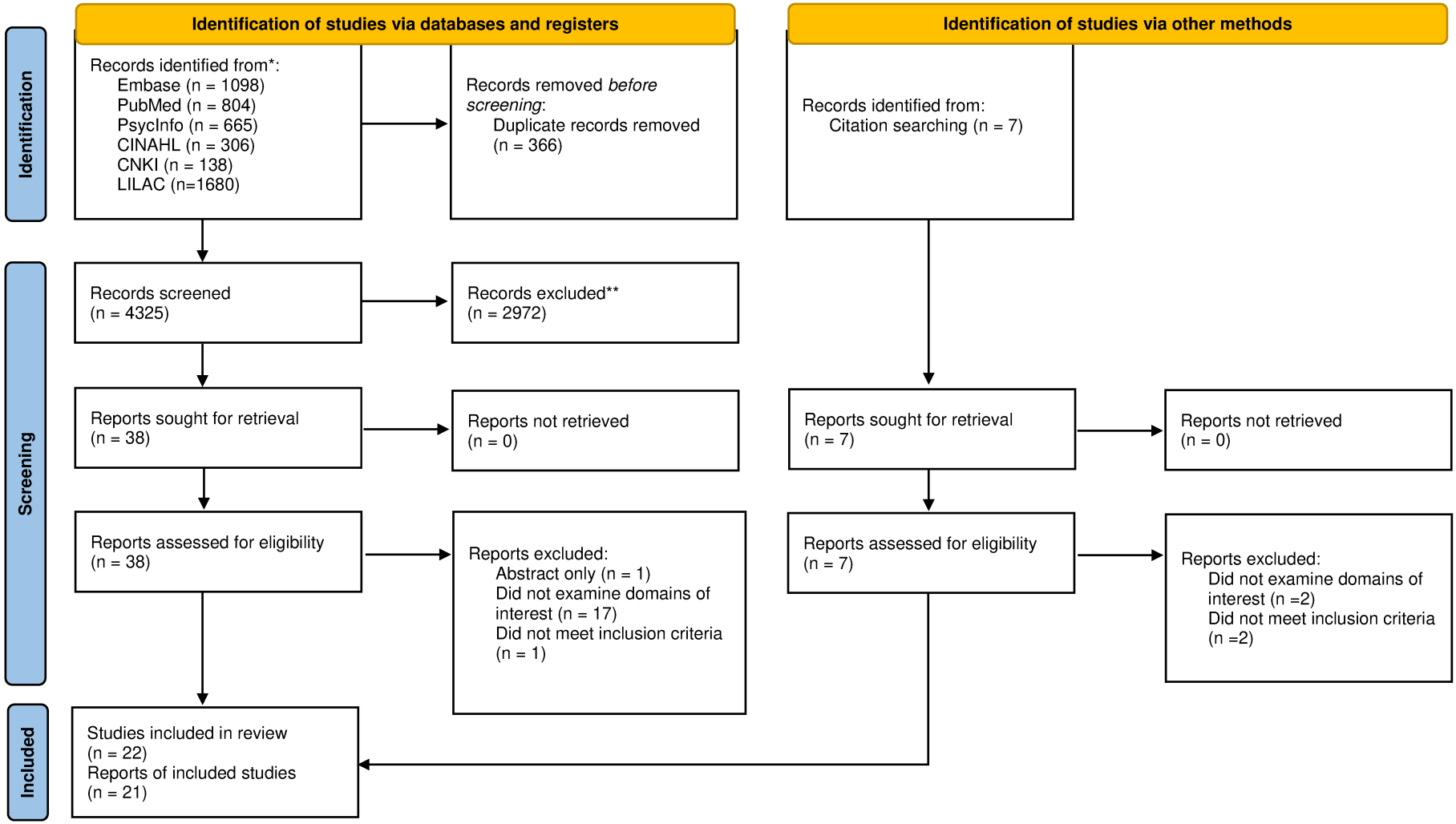

Figure S2: Search terms used for identifying potentially relevant studies.

(Prediabetes or intermediate hyperglyc*emia OR Impaired fasting glucose OR Impaired glucose tolerance OR borderline diabetes OR glucose impairment OR glucose intolerance OR impaired glucose regulation OR IFG OR insulin resistance) AND (survey OR quantitative method OR questionnaire*) AND (KAP OR knowledge OR attitude OR practice OR awareness OR action OR beliefs OR behavio*r OR perception)

Figure S3: Excluded articles and reasons

Did not examine domains of interest (for example, at least 2 elements from knowledge, attitude and practice)

1. Characterization of patients with pre-diabetes in first-level health care service institutions Cali, Colombia
2. Mixed methods study of engagement in behaviours to prevent type 2 diabetes among employees with pre-diabetes
3. Prevalence and awareness of pre-diabetes among young and middle-aged officers (某部队中青年干部糖尿病前期患病和认知调查)
4. Association of prediabetes status awareness with behaviours and Perception of Health
5. Current situation and demands for diabetes knowledge in prediabetes patients at different self-management levels (不同自我管理水平糖尿病前期患者的糖尿病知识现状和需求)
6. Diabetes-related behaviours among elderly people with pre-diabetes in rural communities of Hunan, China: a cross-sectional study beliefs
7. Exploring Health Beliefs Among Hispanic Adults with Prediabetes
8. Illness perception and knowledge with regard to prediabetes and type 2 diabetes: : a pilot study of emergency department patients and staff
9. Knowledge and perceptions about Pre-diabetes amongst doctors, medical students, and patients in a tertiary care hospital of Islamabad
10. Latent class analysis of stages of change for multiple health behaviours: results from the Special Diabetes Program for Indians Diabetes Prevention Program
11. Related behaviour and influencing factors in rural patients with prediabetes in Yinzhou district of Ningbo city (宁波市鄞州区农村糖尿病前期患者相关行为与影响因素)
12. The predictors of adopting a health-promoting lifestyle among work site adults with prediabetes
13. Knowledge towards prediabetes among Yu Ling population(玉林市城市居民对糖尿病前期认知的现状调查)
14. Ambulatory care pharmacists' perception of prediabetes
15. Impaired glucose tolerance: qualitative and quantitative study of general practitioners' knowledge and perceptions
16. Primary care providers' prediabetes screening, testing, and referral behaviours - only behaviour
17. Patient and Clinician Perceptions of Prediabetes: A Mixed-Methods Primary Care Study
18. Attitudes of GPs to the diagnosis and management of impaired glucose tolerance: The practitioners' attitudes to hyperglycaemia (PAtH) questionnaire awareness of prediabetes and engagement in diabetes risk-reducing behaviours
19. Awareness of prediabetes and engagement in diabetes risk-reducing behaviours

Did not meet inclusion criteria – population age < 18 years old

1. Knowledge towards prediabetes among Nanjing population (南京市社区居民糖尿病前期知识的现状调查与分析)

Did not meet inclusion criteria – report is an interview

1. Patient perceptions about prediabetes and preferences for diabetes prevention

2. Preventing diabetes in primary care: providers' perspectives about diagnosing and treating prediabetes

Abstract only

1. Evaluating employee knowledge of prediabetes, prediabetes risk level, and interest in a diabetes prevention program (DPP)

Figure S4: Quality Assessment Tool for Observational Cohort and Cross-Sectional Studies Score per Criteria

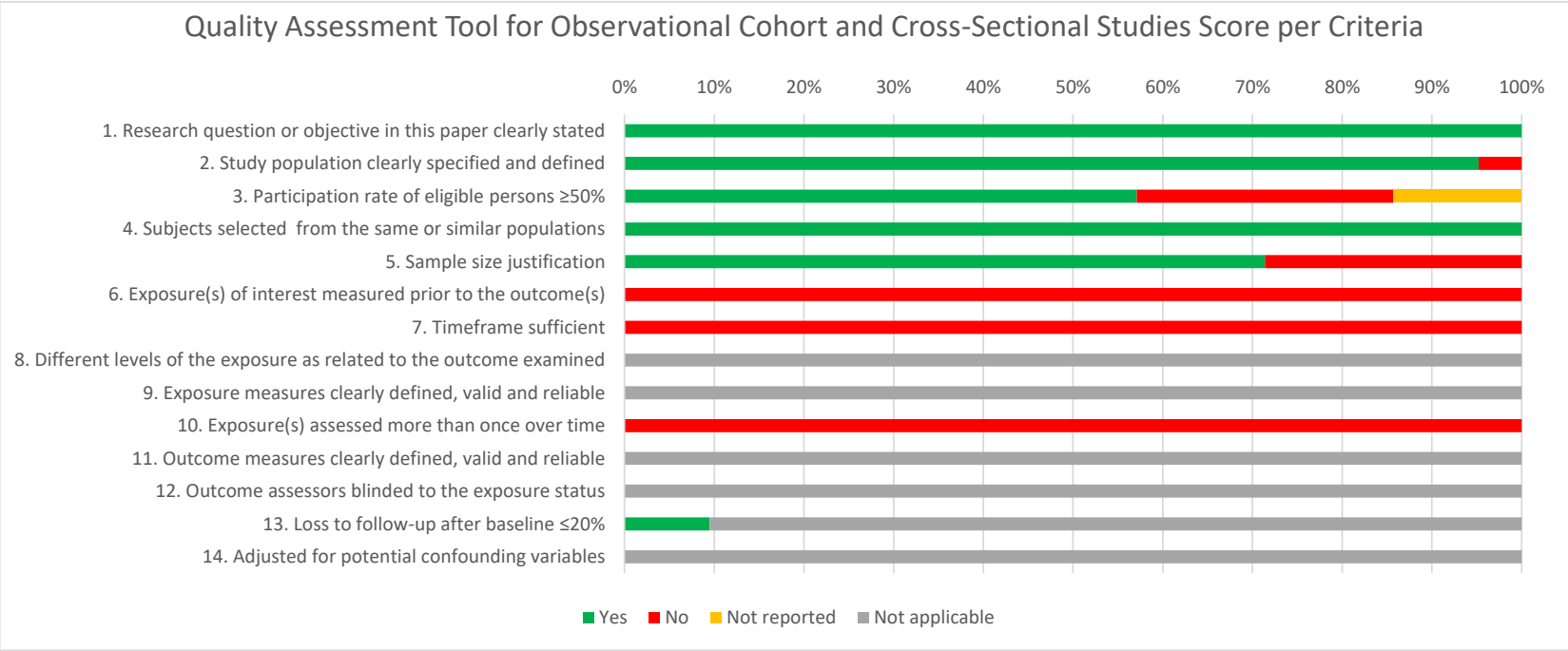

Table S1: PRISMA Checklist 2020

Topic	No.	Item	Location where item is reported
TITLE			
Title	1	Identify the report as a systematic review.	Title
ABSTRACT			
Abstract	2	See the PRISMA 2020 for Abstracts checklist	
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of existing knowledge.	Introduction paragraph 1,2,3 and 4
Objectives	4	Provide an explicit statement of the objective(s) or question(s) the review addresses.	Introduction paragraph 4
METHODS			
Eligibility criteria	5	Specify the inclusion and exclusion criteria for the review and how studies were grouped for the syntheses.	Methods subsection Study Eligibility paragraph 1
Information sources	6	Specify all databases, registers, websites, organisations, reference lists and other sources searched or consulted to identify studies. Specify the date when each source was last searched or consulted.	Subsection Search Strategy
Search strategy	7	Present the full search strategies for all databases, registers and websites, including any filters and limits used.	Subsection Search Strategy
Selection process	8	Specify the methods used to decide whether a study met the inclusion criteria of the review, including how many reviewers screened each record and each report retrieved, whether they worked independently, and if applicable, details of automation tools used in the process.	Subsection study eligibility paragraph 2
Data collection process	9	Specify the methods used to collect data from reports, including how many reviewers collected data from each report, whether they worked independently, any processes for obtaining or confirming data from study investigators, and if applicable, details of automation tools used in the process.	Subsection Data Extraction, Coding, and Critical Appraisal paragraph 3

Topic	No.	Item	Location where item is reported
Data items	10a	List and define all outcomes for which data were sought. Specify whether all results that were compatible with each outcome domain in each study were sought (e.g. for all measures, time points, analyses), and if not, the methods used to decide which results to collect.	Subsection Data Extraction, Coding, and Critical Appraisal paragraph 1 and 2
	10b	List and define all other variables for which data were sought (e.g. participant and intervention characteristics, funding sources). Describe any assumptions made about any missing or unclear information.	Subsection Data Extraction, Coding, and Critical Appraisal paragraph 1 and 2
Study risk of bias assessment	11	Specify the methods used to assess risk of bias in the included studies, including details of the tool(s) used, how many reviewers assessed each study and whether they worked independently, and if applicable, details of automation tools used in the process.	Subsection Data Extraction, Coding, and Critical Appraisal paragraph
Effect measures	12	Specify for each outcome the effect measure(s) (e.g. risk ratio, mean difference) used in the synthesis or presentation of results.	Not applicable
Synthesis methods	13a	Describe the processes used to decide which studies were eligible for each synthesis (e.g. tabulating the study intervention characteristics and comparing against the planned groups for each synthesis (item 5)).	Subsection Data Extraction, Coding, and Critical Appraisal paragraph 1 and 2
	13b	Describe any methods required to prepare the data for presentation or synthesis, such as handling of missing summary statistics, or data conversions.	Not applicable
	13c	Describe any methods used to tabulate or visually display results of individual studies and syntheses.	Not applicable
	13d	Describe any methods used to synthesize results and provide a rationale for the choice(s). If meta-analysis was performed, describe the model(s), method(s) to identify the presence and extent of statistical heterogeneity, and software package(s) used.	Not applicable
	13e	Describe any methods used to explore possible causes of heterogeneity among study results (e.g. subgroup analysis, meta-regression).	Not applicable
	13f	Describe any sensitivity analyses conducted to assess robustness of the synthesized results.	Not applicable
Reporting bias assessment	14	Describe any methods used to assess risk of bias due to missing results in a synthesis (arising from reporting biases).	Not applicable
Certainty assessment	15	Describe any methods used to assess certainty (or confidence) in the body of evidence for an outcome.	Not applicable
RESULTS			

Topic	No.	Item	Location where item is reported
Study selection	16a	Describe the results of the search and selection process, from the number of records identified in the search to the number of studies included in the review, ideally using a flow diagram.	Results subsection Study Characteristics
	16b	Cite studies that might appear to meet the inclusion criteria, but which were excluded, and explain why they were excluded.	Not applicable
Study characteristics	17	Cite each included study and present its characteristics.	Table 1 and 2
Risk of bias in studies	18	Present assessments of risk of bias for each included study.	Results subsection Study Characteristics paragraph 2
Results of individual studies	19	For all outcomes, present, for each study: (a) summary statistics for each group (where appropriate) and (b) an effect estimate and its precision (e.g. confidence/credible interval), ideally using structured tables or plots.	Not applicable
Results of syntheses	20a	For each synthesis, briefly summarise the characteristics and risk of bias among contributing studies.	Subsection knowledge, attittude, practice, barriers and enablers
	20b	Present results of all statistical syntheses conducted. If meta-analysis was done, present for each the summary estimate and its precision (e.g. confidence/credible interval) and measures of statistical heterogeneity. If comparing groups, describe the direction of the effect.	Not applicable
	20c	Present results of all investigations of possible causes of heterogeneity among study results.	Not applicable
	20d	Present results of all sensitivity analyses conducted to assess the robustness of the synthesized results.	Not applicable
Reporting biases	21	Present assessments of risk of bias due to missing results (arising from reporting biases) for each synthesis assessed.	Not applicable
Certainty of evidence	22	Present assessments of certainty (or confidence) in the body of evidence for each outcome assessed.	Not applicable
DISCUSSION			
Discussion	23a	Provide a general interpretation of the results in the context of other evidence.	Discussion paragraph 1, 2, 3, 4 and 5
	23b	Discuss any limitations of the evidence included in the review.	Subsection Limitation paragraph 2

Topic	No.	Item	Location where item is reported
	23c	Discuss any limitations of the review processes used.	Subsection Limitation paragraph 1
	23d	Discuss implications of the results for practice, policy, and future research.	Subsection Implication
OTHER INFORMATION			
Registration and protocol	24a	Provide registration information for the review, including register name and registration number, or state that the review was not registered.	Methods paragraph 1
	24b	Indicate where the review protocol can be accessed, or state that a protocol was not prepared.	Methods paragraph 1
	24c	Describe and explain any amendments to information provided at registration or in the protocol.	Not applicable
Support	25	Describe sources of financial or non-financial support for the review, and the role of the funders or sponsors in the review.	Funding
Competing interests	26	Declare any competing interests of review authors.	'All authors declare that they have no conflicts of interest.'
Availability of data, code and other materials	27	Report which of the following are publicly available and where they can be found: template data collection forms; data extracted from included studies; data used for all analyses; analytic code; any other materials used in the review.	Supplementary files

Table S2: Quality Assessment Tool for Observational Cohort and Cross-Sectional Studies Score per Criteria

	Chen, 2015	Zhuang, 2015	Hyder, 2020	Rahmati-Najarkolaei, 2017	Kolb, 2014	Hyder, 2021	Tong, 2014	Zhao, 2011	Tseng, 2017	Inaku, 2021	Basavareddy, 2015	Keck, 2019	Mainous III, 2016	Tseng. 2018	Montee, 2021	Hulbert, 2021	Shimpi,2021	Saleh, 2021	Garay, 2019	Ross, 2021	Aljehani, 2022
Was the research question or objective in this paper clearly stated?	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Was the study population clearly specified and defined?	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Was the participation rate of eligible persons at least 50%?	Y	Y	Y	Y	Y	Y	NR	Y	Y	Y	Y	Y	N	N	N	N	N	Y	NR	N	NR
Were all the subjects selected or recruited from the same or similar populations (including the same time period)? Were inclusion and exclusion criteria for being in the study prespecified and applied uniformly to all participants?	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y		Y
Was a sample size justification, power description, or variance and effect estimates provided?	Y	N	Y	N	N	Y	N	N	N	N	N	N	N	N	N	N	N	Y	N	Y	N
For the analyses in this paper, were the exposure(s) of interest measured prior to the outcome(s) being measured?	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Was the timeframe sufficient so that one could reasonably expect to see an association between exposure and outcome if it existed?	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N

For exposures that can vary in amount or level, did the study examine different levels of the exposure as related to the outcome (e.g., categories of exposure, or exposure measured as continuous variable)?	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Were the exposure measures (independent variables) clearly defined, valid, reliable, and implemented consistently across all study participants?	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Was the exposure(s) assessed more than once over time?	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Were the outcome measures (dependent variables) clearly defined, valid, reliable, and implemented consistently across all study participants?	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Were the outcome assessors blinded to the exposure status of participants?	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Was loss to follow-up after baseline 20% or less?	NA	NA	NA	Y	NA	Y	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Were key potential confounding variables measured and adjusted statistically for their impact on the relationship between exposure(s) and outcome(s)?	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Rating	F	P	F	P	P	F	P	P	P	P	P	P	P	P	P	P	P	F	P	P	P	P

Y: Yes, N: No, NR: Not Reported, NA: Not Applicable, F: Fair, P: Poor

Table S3: Other characteristics of included studies for the public and patients.

First author (Country)	Prediabetes diagnostic criteria	No. of patients with prediabetes, n(%)	No. of patients with diabetes, n(%)	Questionnaire instrument	Questionnaire characteristics	Reliability and validity test	Method of administration
Chen, 2015 (Taiwan)	FPG 100 - 125 mg/dl during the previous 6 months	200 (100)	NA	K: Pre-diabetes Knowledge Scale (Chinese Version)	'True' or 'false' statements on risk factors, diagnoses, symptoms, treatments, and complications.	Content validity	Self-administered
				P: Health Promoting Lifestyle Profile (Chinese Version)	Assess lifestyle practice during the past three months regarding of self-actualization, health responsibility, physical activity, nutrition, interpersonal support, and stress management using the Likert scale.	Internal consistency test, content validity	
Zhuang, 2015 (China)	1. IFG: FPG > 6.1 mmol/L (110 mg/dL) but ≤ 6.9 mmol/L (125mg/dL) and 2-hour OGTT: < 11.1	148 (100)	NA	K/P: Questionnaire designed by authors-Awareness and Lifestyle Questionnaire in Prediabetes (ALQP)	Assess prediabetes knowledge, lifestyle intervention status, and	ND	Interviewer administered

	mmol/L (199 mg/dL) 2. IGT: 2-hour OGTT > 7.8 mmol/L (140 mg/dL) but < 11.1 mmol/L (199mg/dL), and PFGT ≤ 6.9 mmol/L (125 mg/dL) 3. IFG combined with IGT				willingness to make lifestyle changes.		
Rahmati-Najarkolaei, 2017 (Iran)	FPG 100–125 mg/dL or IGT: OGTT (2-h postprandial glucose) 140–199 mg/dL	303 (100)	NA	A: Theory of Planned Behaviour (TPB) Questionnaire	Used semantic scales to measure attitude towards physical activities and healthy eating.	ND	ND
				P: Godin Leisure Time Exercise Questionnaire (GLTEQ) questionnaire on food consumption (ND on the name of questionnaire)	Duration and frequency of mild, moderate, and tensed exercises in a week for the past month measured in METS.	Test-retest reliability, concurrent validity (1)	
				P: two-item measure on fruit and vegetable consumption	Assess the serving amount of fruits and vegetables in a day.	Test-retest reliability, validation against a 3-day food record (criterion?) (2)	

				P: single item questionnaire to measure saturated fat intake (ND on the name of questionnaire)	Assess consumption of saturated fat.	ND	
Hyder, 2020, 2021 (India)	FPG: 100 - 125mg/dl and HbA1C between 5.6% and 6.4%	308 (100)	NA	K/A/P: Questionnaire designed by authors-Knowledge Attitude Practice-Prediabetes Assessment Questionnaire (KAP-PAQ)	K: Multiple choice questions on knowledge regarding benefits of exercise, calorie restriction, and weight loss.	Face validity	Interviewer administered
					A: Used the Likert scale to measure attitude towards lifestyle modification, myths, and beliefs.		
					P: Assess lifestyle modification practices.		
Kolb, 2014 (New York)	HbA1c: 5.7 - 6.4% (40-48 mmol/mol) or FPG: 100-125mg/dL	54 (100)	NA	K/A: Subscales of the Risk Perception Survey-Developing Diabetes	To assess prediabetes risk knowledge and perception.	Test-retest, internal consistency reliability, face and content validity (3)	Interviewer administered via telephone/ in-person
				A: Patient Health Questionnaire (PHQ-8)	To assess symptoms of depression and anxiety.	Construct and criterion validity (4)	

				A: General Anxiety Disorder (GAD-2) scale		Construct and criterion validity (5)	
				P: Rapid Eating Assessment for Participants (REAP) score	A 16-item instrument on self-reported diet intake.	Test-retest reliability, face validation (6)	
Dong, 2014 (China)	IFG: FPG ≥6. 1 mmol /L but <7. 0 mmol /L and 2-hour OGTT <7. 8 mmol /L IGT: FPG <7. 0 mmol /L and 2-hour OGTT 7. 8 mmol /L - 11. 1mmol /L	994 (100)	NA	K/A/P: Questionnaire designed by authors	K: Assess prediabetes knowledge. A: Used a 5-point Likert scale to assess participants' attitude toward diabetes prevention measures. P: Assessed readiness to perform lifestyle changes for the past and coming six months.	ND	ND
Zhao, 2011 (China)	ND	0 (0)	2 (0.007)	K/P: Questionnaire designed by authors	K: 16 items on prediabetes knowledge P: 22 items on lifestyle practices such as diet habits, physical activities, sleep, and mental health.	Face validity	Interviewer administered

K: Knowledge, A: Attitude, P: Practice, CD: cannot determine, ND: no data, NA: not applicable.

Table S4: Other characteristics of included studies for healthcare providers.

First author (Country)	Questionnaire instrument	Questionnaire characteristics	Reliability and validity test	Method of administration
Tseng, 2017 (USA)	K/A/P: Questionnaire designed by authors	K: Multiple choice questions on risk factors that prompt prediabetes screening, prediabetes diagnostic criteria, and guidelines on prediabetes management	Face validity	Self-administered
		A: Used a 5-point Likert scale to examine attitudes and beliefs on prediabetes and its management		
		P: Multiple choice questions on preferred recommendations for prediabetes management		
Inaku, 2021 (Nigeria)	K/A/P: Adapted from Tseng et al.	K: Risk factors that prompt prediabetes screening, prediabetes diagnostic criteria, and guidelines on prediabetes management	Face validity	Self-administered
		A: Used a 5-point Likert scale to examine attitudes and beliefs on prediabetes and its management		
		P: Multiple choice questions on preferred recommendations for prediabetes management		
Basavareddy, 2015 (India)	K/A/P: Questionnaire designed by authors	K/A/P: Self-assessment of knowledge and attitude about prediabetes, current guidelines for prediabetes management, and practice related to prediabetes screening and management.	Face validity	Self-administered
Keck, 2019 (USA)	K/A/P: Adapted from three questionnaires (7-9)	K/A/P: Used Likert scale and multiple-choice question to assess understanding of prediabetes, beliefs about prediabetes, barriers to management of prediabetes, prediabetes management, and diabetes prevention programs.	Face validity (7), internal consistency (8), test-retest, internal consistency, item-total correlations, criterion validity (predictive) (9)	Self-administered
Mainous III, 2016 (USA)	A/P: Questionnaire designed by authors	A: Used a 5-point Likert scale to examine attitude towards prediabetes and its treatment, perceived barriers to diabetes prevention, and perceptions of peers and prediabetes.	ND	Self-administered
		P: Assessed current strategies for diabetes prevention		

Tseng, 2018 (USA)	K/A/P: Adapted questionnaire from Tseng et al (7)	K: Risk factors that prompt prediabetes screening, diagnostic criteria, and recommendations for prediabetes management. A: Used a 5-point Likert scale to examine perceived barriers and potential interventions for prediabetes management P: Practice behaviours in prediabetes management	Face validity	Self-administered
Franch-Nadal, 2020 (Spain)	K/A/P: Designed by scientific committee comprising of two diabetes experts (one physician and one community pharmacist) based on the results of a literature review on physicians' an pharmacists' preception and clinical practices in prediabetes management.	K/A/P: Used dichotomous or multiple-choice questions, and 5-point Likert-scale questions to assess the use of guidelines, prediabetes definition, screening strategies, patient education, and the role of pharmacists in prediabetes prevention.	ND	Self-administered and Interviewer administered
Montee, 2021 (France)	K/A/P: Designed by authors and peer reviewed by three senior faculty members of the Reunion Island Universtiy	K/A/P: Establish whether general practitioners knew the definition and diagnostic criteria of prediabetes and whether their practices were in line with French guidelines for screening, management, and monitoring of prediabetes.	Face validity	Self-administered via online questionnaire
Hulbert, 2021 (USA)	K/A/P: Designed by authors.	K/A/P: Assess providers' familiarity with the National Diabetes Prevention Program lifestyle change program, knowledge of the program availability, provider referral practices, attitude towards the National DPP, electronic health record usage for prediabetes, and providers' treatment preferences.	ND	Self-administered via online questionnaire
Shimpi, 2021 (USA)	K/A/P: Adapted from Shimpi et al (10).	K: Multiple-choice questions regarding oral manifestations and complications of diabetes and biological glycaemic evaluation.	Content validity	Self-administed (online and paper based) and interviewer administered

		A: Used Likert-scale to assess opinions on various aspects of incorporating diabetes screening into their dental practice. P: To assess practice activities, including patient education about diabetes and oral health, patient referral to medical providers and physician consultation before dental treatments, and practices regarding chair-side screening for diabetes, prediabetes, hypertension, and obesity.		(phone-based)
Saleh, 2021 (Sudan)	ND	K/A/P: Assess knowledge, attitude, practice, and perceived barriers sections.	Face validity	Self-administered via online questionnaire
Garay, 2019 (Colombia)	K/A/P: Adapted from Tseng et al (7).	K: Assess knowledge about risk factors, methods, and guidelines for screening. A: Questions on pharmacological treatment, including the prescription of metformin and barriers about its use. P: Questions on the management of prediabetes, including initial therapy, drug therapy, and follow-up.	Face validity	Self-administered
Ross, 2021 (USA)	K/A/P: Adapted from Tseng et al (7).	K: Knowledge of risk factors that should prompt prediabetes screening, laboratory criteria for diagnosing prediabetes, and guidelines on recommended therapy for prediabetes. A: Attitudes and beliefs about prediabetes. P: Management of prediabetes.	Face validity	Self-administered
Aljehani, 2022 (Saudi Arabia)	K/A/P: Adapted from Tseng et al (7).	K: Knowledge about diabetes risk factors, fasting glucose (mg/dL), HbA1c (%) diagnostic cut-off, minimum weight loss, physical activity for patients with prediabetes, and guidelines for diabetes screening. A: Assess opinions regarding the importance of identifying and managing prediabetes, detecting barriers to lifestyle modifications, and adopting guidelines in practice.	Face validity	Self-administered via online questionnaire

	P: Assess prescribing patterns for patients with prediabetes and the usefulness of ADA guidelines in managing prediabetes.

K: Knowledge, A: Attitude, P: Practice, CD: cannot determine, ND: no data, NA: not applicable.

Table S5: Barriers and enablers mapped onto COM-B, TDF domains, intervention functions from behaviour change wheels and their relevant BCTs.

Barriers and enablers	COM-B	TDF Construct	TDF Domain	Intervention Function	Example BCTs	Level		
						P	H	S
Barriers and Enablers								
Knowledge about prediabetes and lifestyle management	Psychological capability	Knowledge (including knowledge of condition /scientific rationale)	Knowledge	Education	4.1. Instruction on how to perform the behaviour 5.1. Information about health consequences 5.2. Salience of consequences 5.3 Information about social and environmental consequences	√		
				Training	2.3 Self-monitoring of behaviour 2.4 Self-monitoring of outcome(s) of behaviour			
				Enablement	11.3 Conserving mental resources			
Goals and intention to make lifestyle changes	Psychological capabilities, reflective motivation	Action planning, goal/ target setting, stability of intentions	Behavioural regulation, goals, intentions	Education	4.1. Instruction on how to perform the behaviour 5.1. Information about health consequences 5.3 Information about social and environmental consequences	√		
				Persuasion	2.2 Feedback of behaviour 2.6 Biofeedback 2.7 Feedback on outcome(s) of behaviour			
				Incentivisation	14.4 Reward approximation			

				Training	2.3 Self-monitoring of behaviour 2.4 Self-monitoring of outcome(s) of behaviour 8.7 Graded tasks			
				Enablement	1.1. Goal setting (behaviour) 1.3. Goal setting (outcome) 1.4. Action planning			
Breaking negative lifestyle habits	Psychological capability, physical capability	Breaking habits, skills and ability	Behavioural regulation, skills	Education	4.1. Instruction on how to perform the behaviour 4.2 Information about antecedents 4.3. Re-attribution 9.3. Comparative imagining of future outcomes.			
				Enablement	2.2 Feedback of behaviour 2.3 Self-monitoring of behaviour 1.1. Goal setting (behaviour) 1.2 Problem solving 1.4 Action planning	√		
				Training	5.4 Monitoring of emotional consequences 8.2. Behaviour substitution 8.3. Habit formation 8.4. Habit reversal 8.5 Overcorrection			
Social support (from friends, family, HCP and society)	Social opportunity	Social support	Social influences	Enablement	3.1 Social support (unspecified) 3.2 Social support (practical) 3.3 Social support (emotional)	√	√	√

Access and resources for lifestyle modification	Physical opportunity	Resources / material resources	Environmental Context and Resources	Environmental restructuring	12.1. Restructuring the physical environment 12.2. Restructuring the social environment	√	√
				Restriction	12.3. Avoidance/reducing exposure to cues for the behaviour		
				Enablement	12.4. Distraction		
Financial limitation/ aid (insurance coverage)	Physical opportunity	Resources / material resources	Environmental Context and Resources	Environmental restructuring	12.1. Restructuring the physical environment 12.2. Restructuring the social environment 12.5 Adding objects to the environment	√	√
				Enablement	3.2 Social support (practical)		
Perception towards prediabetes and its management	Reflective motivation	Perceived behavioural control, characteristics of outcome expectancies, beliefs	Beliefs about capabilities, beliefs about consequence	Education	4.1. Instruction on how to perform the behaviour 5.1. Information about health consequences 5.3 Information about social and environmental consequences	√	√
				Persuasion	15.1. Verbal persuasion about capability 15.2 Mental rehearsal of successful performance 15.4. Self-talk 5.5. Anticipated regret 9.1. Credible source		

Risk perception (diabetes and complications)	Reflective motivation	Characteristics of outcome expectancies	Beliefs about consequence	Education	5.1. Information about health consequences 5.2. Salience of consequences 5.3 Information about social and environmental consequences	√	√
				Persuasion	5.5. Anticipated regret 9.1. Credible source		
HCP knowledge (knowledge on prediabetes, clinical guideline awareness)	Psychological capability	Knowledge (including knowledge of condition /scientific rationale)	Knowledge	Education	5.1. Information about health consequences 5.2. Salience of consequences 5.3 Information about social and environmental consequences		√
				Training	2.2 Feedback on behaviour 2.7 Feedback on outcome(s) of behaviour		
				Enablement	11.3 Conserving mental resources		
Potential side effects and contraindications	Reflective motivation	Characteristics of outcome expectancies	Beliefs about consequence	Education	5.1. Information about health consequences 5.2. Salience of consequences 5.3 Information about social and environmental consequences	√	
				Persuasion	9.1. Credible source		
Patient's preference	Automatic motivation	Affect	Emotion	Persuasion	9.2. Pros and cons 13.2 Framing/reframing 15.4. Self-talk 13.1 Identification of self as role model	√	

				Incentivisation	14.4. Reward approximation		
				Environmental restructuring	12.1. Restructuring the physical environment 12.2. Restructuring the social environment		
				Modelling	6.1 Demonstration of the behaviour		
				Enablement	3.1 Social support (unspecified) 3.2 Social support (practical)		
Existing HCP good/poor practice	Automatic motivation, reflective motivation, psychological capabilities	Affect, stability of intentions, memory, reinforcement	Intention, memory, attention, decision processes and reinforcement	Education	4.1. Instruction on how to perform the behaviour 4.4 Behavioural experiments	√	√
				Persuasion	13.3 Incompatible beliefs 16.2 Imaginary reward 16.3 Vicarious consequences 13.1. Identification of self as role model		
				Incentivisation	10.1 Material incentive (behaviour) 10.4 Social reward		
				Training	8.3 Habit formation 8.4 Habit reversal		
				Environmental restructuring	7.1. Prompts/cues 12.5. Adding objects to the environment		
				Modelling	6.1 Demonstration of the behaviour		
				Enablement	1.5. Review behaviour goal(s) 1.7. Review outcome goal(s) 11.3 Conserving mental resources		

Clinical support tools	Physical opportunity	Resources / material resources	Environmental Context and Resources	Environmental restructuring	12.5 Adding objects to the environment		√	√
				Enablement	7.1. Prompts/cues 11.3 Conserving mental resources			
Time (patient care, lifestyle modification)	Physical opportunity	Resources / material resources	Environmental Context and Resources	Environmental restructuring	7.1. Prompts/cues 12.2. Restructuring the social environment	√	√	√
				Enablement	1.2 Problem solving 1.4 Action planning			
				Environmental restructuring	7.1. Prompts/cues			
				Enablement	1.1. Goal setting (behaviour) 1.2 Problem solving 1.4 Action planning 3.1 Social support (unspecified) 3.2. Social support (practical)			
Lack resources for screening and education	Physical opportunity	Resources / material resources	Environmental Context and Resources	Environmental restructuring	12.5 Adding objects to the environment		√	
Treatment failure/ success with lifestyle management	Reflective motivation	Characteristics of outcome expectancies	Beliefs about consequence	Education	4.1. Instruction on how to perform the behaviour 5.1. Information about health consequences	√	√	
				Persuasion	13.5. Identity associated with changed behaviour 15.1. Verbal persuasion about capability 15.3. Focus on past success			

Prescriber's clinical judgement	Reflective motivation, automative motivation	Professional confidence	Social/professional role and identity, beliefs about capabilities	Education	4.1. Instruction on how to perform the behaviour 4.4 Behavioural experiments	√
				Persuasion	1.9 Commitment 9.1. Credible source 15.3. Focus on past success 13.1. Identification of self as role model	
				Training	8.3 Habit formation 8.4 Habit reversal	
				Environmental restructuring	7.1. Prompts/cues 12.5. Adding objects to the environment	
				Modelling	6.1 Demonstration of the behaviour	
				Enablement	1.7. Review outcome goal(s)	
				Incentivisation	10.1 Material incentive (behaviour) 10.4 Social reward	
Emotions	Automatic motivation, reflective motivation	Stress, anxiety, optimism, affect	Emotion, optimism	Persuasion	9.2. Pros and cons 9.3 Comparative imagining of future outcomes 12.4 Distraction 13.2 Framing/reframing 13.5 Identity associated with changed behaviour 15.1 Verbal persuasion about capability 15.2 Mental rehearsal of successful performance 15.4. Self-talk	√

				Incentivization	10.4 Social reward 10.5 Social incentive 10.6 Non-specific incentive 10.7 Self-incentive	
				Environmental restructuring	12.2. Restructuring the social environment	
				Modelling	6.1. Demonstration of the behaviour	
				Enablement	3.1 Social support (unspecified) 3.3 Social support (emotional) 11.2 Reduce negative emotions 14.1 Remove punishment	
Enabler						
Self confidence in making lifestyle changes	Reflective motivation	Self-confidence	Beliefs about capabilities	Education	4.1. Instruction on how to perform the behaviour 5.1. Information about health consequences	
				Persuasion	13.1. Identification of self as role model 13.2 Framing/reframing 15.3. Focus on past success 15.4. Self-talk	√
				Incentivisation	10.4 Social reward 10.7 Self-incentive 10.9 Self-reward 14.4. Reward approximation	

Beliefs about health promotion and diabetes prevention efforts	Reflective motivation	Beliefs	Beliefs about consequence	Education	4.1. Instruction on how to perform the behaviour 5.1. Information about health consequences 5.2. Salience of consequences 5.3 Information about social and environmental consequences	√	√	√
				Persuasion	9.1 Credible source			
Patient's confidence towards HCPs	Reflective motivation, automatic motivation	Professional Confidence	Beliefs about capabilities, social/professional role and identity	Education	4.1. Instruction on how to perform the behaviour 5.1. Information about health consequences	√		
				Persuasion	9.1 Credible source			
				Modelling	6.1 Demonstration of the behaviour			
HCPs' self-confidence	Reflective motivation, automatic motivation	Professional Confidence	Beliefs about capabilities, social/professional role and identity	Education	4.1. Instruction on how to perform the behaviour 5.1. Information about health consequences			
				Persuasion	13.1. Identification of self as role model 13.2 Framing/reframing 15.1. Verbal persuasion about capability 15.3. Focus on past success 15.4. Self-talk		√	
				Incentivisation	10.4 Social reward 10.7 Self-incentive 10.9 Self-reward 14.4. Reward approximation			

Multidisciplinary effort	Physical opportunity	Resources / material resources	Environmental Context and Resources		No BCT - to increase manpower	√	√
Training and education	Physical opportunity, psychological capability, physical capability	Resources / material resources, knowledge (including knowledge of condition /scientific rationale), skills development	Environmental context and resources, knowledge, skills	Education	4.1. Instruction on how to perform the behaviour 5.1. Information about health consequences 5.2. Salience of consequences 5.3 Information about social and environmental consequences	√	√
				Training	2.2 Feedback on behaviour 2.7 Feedback on outcome(s) of behaviour 8.3. Habit formation 8.4. Habit reversal		
				Enablement	11.3 Conserving mental resources		
				Environmental restructuring	12.5. Adding objects to the environment		
			Barrier				
Lifestyle management skills/abilities (incl. physical limitations)	Psychological capability, physical capability	Skills, ability	Skills	Education	4.1. Instruction on how to perform the behaviour 4.2. Information about Antecedents 4.3 Re-attribution	√	

				Training	2.3 Self-monitoring of behaviour 2.4 Self-monitoring of outcome(s) of behaviour 8.3 Habit formation 8.4 Habit reversal 8.6 Generalization of target behaviour 8.2 Behaviour substitution 8.7 Graded tasks		
				Enablement	1.1. Goal setting (behaviour) 1.3. Goal setting (outcome) 1.4. Action planning 11.3 Conserving mental resources		
				Modelling	6.1 Demonstration of the behaviour		
Stigma around being ill with prediabetes	Social opportunity	Alienation, social norm	Social influences	Restriction	12.3 Avoidance/reducing exposure to cues for the behaviour	√	√
				Environmental restructuring	12.2. Restructuring the social environment		
				Enablement	3.1 Social support (unspecified) 3.3. Social support (emotional) 9.1. Credible source		
Low blood screening rate	Physical opportunity	Resources / material resources, characteristics of outcome expectancies	Environmental context and resources, beliefs	Environmental restructuring	7.1. Prompts/cues 12.5. Adding objects to the environment	√	√

			about consequence			
				Enablement	3.3 Social support (emotional) 11.2 Reduce negative emotions	
				Education	5.1. Information about health consequences	
				Persuasion	5.5. Anticipated regret 9.3 Comparative imagining of future outcomes	
				Incentivization	10.1. Material incentive (behaviour) 10.6. Non-specific incentive	
				Coercion	14.1 Behaviour cost	
Poor adherence	Reflective motivation	Perceived behavioural control	Beliefs about Capabilities	Education	4.1. Instruction on how to perform the behaviour 5.1. Information about health consequences	√
				Persuasion	9.3. Comparative imagining of future outcomes	
				Incentivization	10.4 Social reward 10.5 Social incentive 10.6 Non-specific incentive 10.7 Self-incentive	
				Enablement	1.4 Action planning 3.2 Social support (practical) 7.1. Prompts/cues 11.3 Conserving mental resources 12.5. Adding objects to the environment	

Acceptance of prediabetes diagnosis	Reflective motivation, automatic motivation	Identity	Social/Professional Role and Identity	Education	5.1. Information about health consequences	√
				Persuasion	9.1. Credible source 13.4 Valued self-identity 15.4 Self-talk	
				Enablement	3.1 Social support (unspecified) 3.3 Social support (emotional) 11.2 Reduce negative emotions	

P: Patient; H: Healthcare professionals; S: Health system

Supplementary Materials

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Figure S1: Identification of studies presented in PRISMA flow chart 2020.

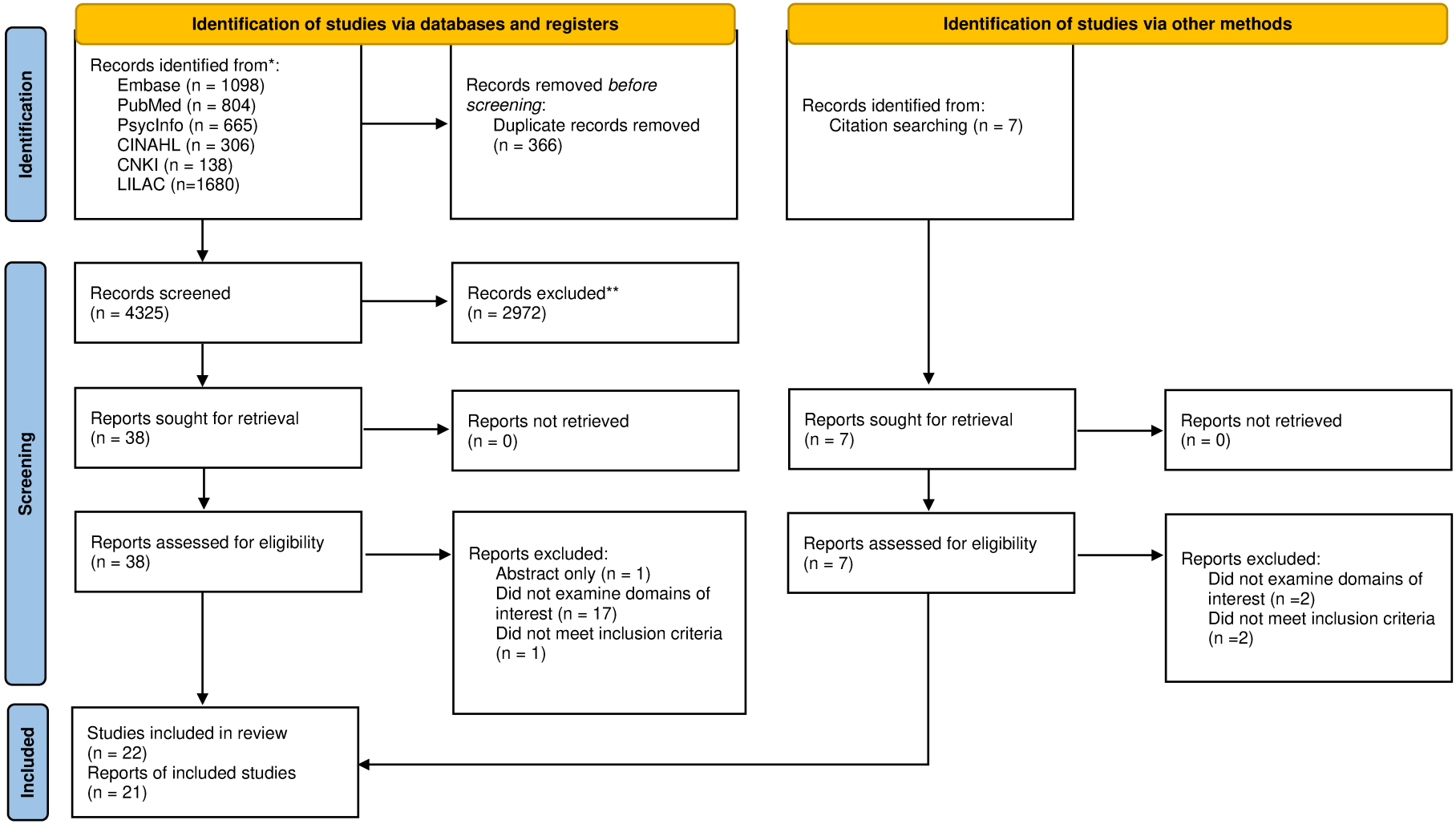

Figure S2: Search terms used for identifying potentially relevant studies.

(Prediabetes or intermediate hyperglyc*emia OR Impaired fasting glucose OR Impaired glucose tolerance OR borderline diabetes OR glucose impairment OR glucose intolerance OR impaired glucose regulation OR IFG OR insulin resistance) AND (survey OR quantitative method OR questionnaire*) AND (KAP OR knowledge OR attitude OR practice OR awareness OR action OR beliefs OR behavio*r OR perception)

Figure S3: Excluded articles and reasons

Did not examine domains of interest (for example, at least 2 elements from knowledge, attitude and practice)

1. Characterization of patients with pre-diabetes in first-level health care service institutions Cali, Colombia
2. Mixed methods study of engagement in behaviours to prevent type 2 diabetes among employees with pre-diabetes
3. Prevalence and awareness of pre-diabetes among young and middle-aged officers (某部队中青年干部糖尿病前期患病和认知调查)
4. Association of prediabetes status awareness with behaviours and Perception of Health
5. Current situation and demands for diabetes knowledge in prediabetes patients at different self-management levels (不同自我管理水平糖尿病前期患者的糖尿病知识现状和需求)
6. Diabetes-related behaviours among elderly people with pre-diabetes in rural communities of Hunan, China: a cross-sectional study beliefs
7. Exploring Health Beliefs Among Hispanic Adults with Prediabetes
8. Illness perception and knowledge with regard to prediabetes and type 2 diabetes: : a pilot study of emergency department patients and staff
9. Knowledge and perceptions about Pre-diabetes amongst doctors, medical students, and patients in a tertiary care hospital of Islamabad
10. Latent class analysis of stages of change for multiple health behaviours: results from the Special Diabetes Program for Indians Diabetes Prevention Program
11. Related behaviour and influencing factors in rural patients with prediabetes in Yinzhou district of Ningbo city (宁波市鄞州区农村糖尿病前期患者相关行为与影响因素)
12. The predictors of adopting a health-promoting lifestyle among work site adults with prediabetes
13. Knowledge towards prediabetes among Yu Ling population(玉林市城市居民对糖尿病前期认知的现状调查)
14. Ambulatory care pharmacists' perception of prediabetes
15. Impaired glucose tolerance: qualitative and quantitative study of general practitioners' knowledge and perceptions
16. Primary care providers' prediabetes screening, testing, and referral behaviours - only behaviour
17. Patient and Clinician Perceptions of Prediabetes: A Mixed-Methods Primary Care Study
18. Attitudes of GPs to the diagnosis and management of impaired glucose tolerance: The practitioners' attitudes to hyperglycaemia (PAtH) questionnaire awareness of prediabetes and engagement in diabetes risk-reducing behaviours
19. Awareness of prediabetes and engagement in diabetes risk-reducing behaviours

Did not meet inclusion criteria – population age < 18 years old

1. Knowledge towards prediabetes among Nanjing population (南京市社区居民糖尿病前期知识的现状调查与分析)

Did not meet inclusion criteria – report is an interview

1. Patient perceptions about prediabetes and preferences for diabetes prevention

2. Preventing diabetes in primary care: providers' perspectives about diagnosing and treating prediabetes

Abstract only

1. Evaluating employee knowledge of prediabetes, prediabetes risk level, and interest in a diabetes prevention program (DPP)

Figure S4: Quality Assessment Tool for Observational Cohort and Cross-Sectional Studies Score per Criteria

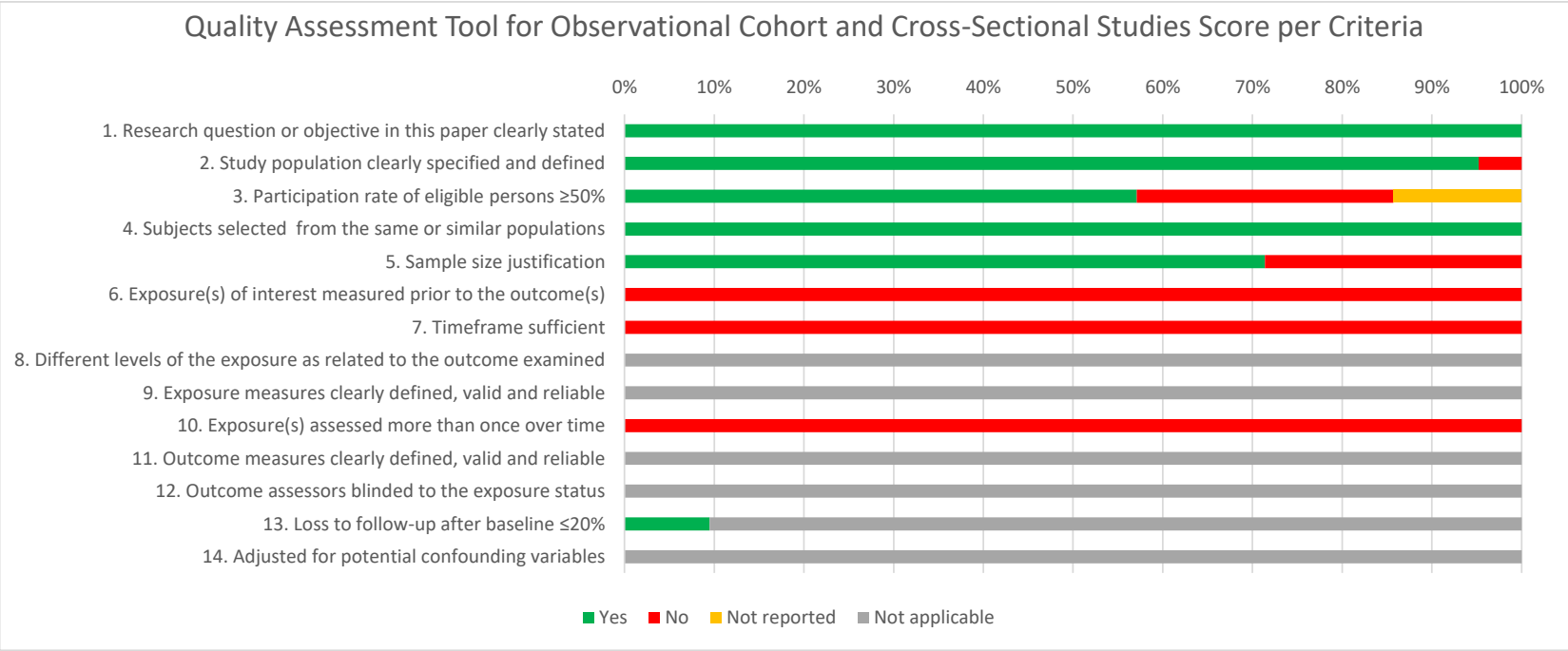

Table S1: PRISMA Checklist 2020

Topic	No.	Item	Location where item is reported
TITLE			
Title	1	Identify the report as a systematic review.	Title
ABSTRACT			
Abstract	2	See the PRISMA 2020 for Abstracts checklist	
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of existing knowledge.	Introduction paragraph 1,2,3 and 4
Objectives	4	Provide an explicit statement of the objective(s) or question(s) the review addresses.	Introduction paragraph 4
METHODS			
Eligibility criteria	5	Specify the inclusion and exclusion criteria for the review and how studies were grouped for the syntheses.	Methods subsection Study Eligibility paragraph 1
Information sources	6	Specify all databases, registers, websites, organisations, reference lists and other sources searched or consulted to identify studies. Specify the date when each source was last searched or consulted.	Subsection Search Strategy
Search strategy	7	Present the full search strategies for all databases, registers and websites, including any filters and limits used.	Subsection Search Strategy
Selection process	8	Specify the methods used to decide whether a study met the inclusion criteria of the review, including how many reviewers screened each record and each report retrieved, whether they worked independently, and if applicable, details of automation tools used in the process.	Subsection study eligibility paragraph 2
Data collection process	9	Specify the methods used to collect data from reports, including how many reviewers collected data from each report, whether they worked independently, any processes for obtaining or confirming data from study investigators, and if applicable, details of automation tools used in the process.	Subsection Data Extraction, Coding, and Critical Appraisal paragraph 3

Topic	No.	Item	Location where item is reported
Data items	10a	List and define all outcomes for which data were sought. Specify whether all results that were compatible with each outcome domain in each study were sought (e.g. for all measures, time points, analyses), and if not, the methods used to decide which results to collect.	Subsection Data Extraction, Coding, and Critical Appraisal paragraph 1 and 2
	10b	List and define all other variables for which data were sought (e.g. participant and intervention characteristics, funding sources). Describe any assumptions made about any missing or unclear information.	Subsection Data Extraction, Coding, and Critical Appraisal paragraph 1 and 2
Study risk of bias assessment	11	Specify the methods used to assess risk of bias in the included studies, including details of the tool(s) used, how many reviewers assessed each study and whether they worked independently, and if applicable, details of automation tools used in the process.	Subsection Data Extraction, Coding, and Critical Appraisal paragraph
Effect measures	12	Specify for each outcome the effect measure(s) (e.g. risk ratio, mean difference) used in the synthesis or presentation of results.	Not applicable
Synthesis methods	13a	Describe the processes used to decide which studies were eligible for each synthesis (e.g. tabulating the study intervention characteristics and comparing against the planned groups for each synthesis (item 5)).	Subsection Data Extraction, Coding, and Critical Appraisal paragraph 1 and 2
	13b	Describe any methods required to prepare the data for presentation or synthesis, such as handling of missing summary statistics, or data conversions.	Not applicable
	13c	Describe any methods used to tabulate or visually display results of individual studies and syntheses.	Not applicable
	13d	Describe any methods used to synthesize results and provide a rationale for the choice(s). If meta-analysis was performed, describe the model(s), method(s) to identify the presence and extent of statistical heterogeneity, and software package(s) used.	Not applicable
	13e	Describe any methods used to explore possible causes of heterogeneity among study results (e.g. subgroup analysis, meta-regression).	Not applicable
	13f	Describe any sensitivity analyses conducted to assess robustness of the synthesized results.	Not applicable
Reporting bias assessment	14	Describe any methods used to assess risk of bias due to missing results in a synthesis (arising from reporting biases).	Not applicable
Certainty assessment	15	Describe any methods used to assess certainty (or confidence) in the body of evidence for an outcome.	Not applicable
RESULTS			

Topic	No.	Item	Location where item is reported
Study selection	16a	Describe the results of the search and selection process, from the number of records identified in the search to the number of studies included in the review, ideally using a flow diagram.	Results subsection Study Characteristics
	16b	Cite studies that might appear to meet the inclusion criteria, but which were excluded, and explain why they were excluded.	Not applicable
Study characteristics	17	Cite each included study and present its characteristics.	Table 1 and 2
Risk of bias in studies	18	Present assessments of risk of bias for each included study.	Results subsection Study Characteristics paragraph 2
Results of individual studies	19	For all outcomes, present, for each study: (a) summary statistics for each group (where appropriate) and (b) an effect estimate and its precision (e.g. confidence/credible interval), ideally using structured tables or plots.	Not applicable
Results of syntheses	20a	For each synthesis, briefly summarise the characteristics and risk of bias among contributing studies.	Subsection knowledge, attittude, practice, barriers and enablers
	20b	Present results of all statistical syntheses conducted. If meta-analysis was done, present for each the summary estimate and its precision (e.g. confidence/credible interval) and measures of statistical heterogeneity. If comparing groups, describe the direction of the effect.	Not applicable
	20c	Present results of all investigations of possible causes of heterogeneity among study results.	Not applicable
	20d	Present results of all sensitivity analyses conducted to assess the robustness of the synthesized results.	Not applicable
Reporting biases	21	Present assessments of risk of bias due to missing results (arising from reporting biases) for each synthesis assessed.	Not applicable
Certainty of evidence	22	Present assessments of certainty (or confidence) in the body of evidence for each outcome assessed.	Not applicable
DISCUSSION			
Discussion	23a	Provide a general interpretation of the results in the context of other evidence.	Discussion paragraph 1, 2, 3, 4 and 5
	23b	Discuss any limitations of the evidence included in the review.	Subsection Limitation paragraph 2

Topic	No.	Item	Location where item is reported
	23c	Discuss any limitations of the review processes used.	Subsection Limitation paragraph 1
	23d	Discuss implications of the results for practice, policy, and future research.	Subsection Implication
OTHER INFORMATION			
Registration and protocol	24a	Provide registration information for the review, including register name and registration number, or state that the review was not registered.	Methods paragraph 1
	24b	Indicate where the review protocol can be accessed, or state that a protocol was not prepared.	Methods paragraph 1
	24c	Describe and explain any amendments to information provided at registration or in the protocol.	Not applicable
Support	25	Describe sources of financial or non-financial support for the review, and the role of the funders or sponsors in the review.	Funding
Competing interests	26	Declare any competing interests of review authors.	'All authors declare that they have no conflicts of interest.'
Availability of data, code and other materials	27	Report which of the following are publicly available and where they can be found: template data collection forms; data extracted from included studies; data used for all analyses; analytic code; any other materials used in the review.	Supplementary files

Table S2: Quality Assessment Tool for Observational Cohort and Cross-Sectional Studies Score per Criteria

	Chen, 2015	Zhuang, 2015	Hyder, 2020	Rahmati-Najarkolaei, 2017	Kolb, 2014	Hyder, 2021	Tong, 2014	Zhao, 2011	Tseng, 2017	Inaku, 2021	Basavareddy, 2015	Keck, 2019	Mainous III, 2016	Tseng. 2018	Montee, 2021	Hulbert, 2021	Shimpi,2021	Saleh, 2021	Garay, 2019	Ross, 2021	Aljehani, 2022
Was the research question or objective in this paper clearly stated?	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Was the study population clearly specified and defined?	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Was the participation rate of eligible persons at least 50%?	Y	Y	Y	Y	Y	Y	NR	Y	Y	Y	Y	Y	N	N	N	N	N	Y	NR	N	NR
Were all the subjects selected or recruited from the same or similar populations (including the same time period)? Were inclusion and exclusion criteria for being in the study prespecified and applied uniformly to all participants?	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y		Y
Was a sample size justification, power description, or variance and effect estimates provided?	Y	N	Y	N	N	Y	N	N	N	N	N	N	N	N	N	N	N	Y	N	Y	N
For the analyses in this paper, were the exposure(s) of interest measured prior to the outcome(s) being measured?	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Was the timeframe sufficient so that one could reasonably expect to see an association between exposure and outcome if it existed?	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N

For exposures that can vary in amount or level, did the study examine different levels of the exposure as related to the outcome (e.g., categories of exposure, or exposure measured as continuous variable)?	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Were the exposure measures (independent variables) clearly defined, valid, reliable, and implemented consistently across all study participants?	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Was the exposure(s) assessed more than once over time?	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Were the outcome measures (dependent variables) clearly defined, valid, reliable, and implemented consistently across all study participants?	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Were the outcome assessors blinded to the exposure status of participants?	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Was loss to follow-up after baseline 20% or less?	NA	NA	NA	Y	NA	Y	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Were key potential confounding variables measured and adjusted statistically for their impact on the relationship between exposure(s) and outcome(s)?	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Rating	F	P	F	P	P	F	P	P	P	P	P	P	P	P	P	P	P	F	P	P	P	P

Y: Yes, N: No, NR: Not Reported, NA: Not Applicable, F: Fair, P: Poor

Table S3: Other characteristics of included studies for the public and patients.

First author (Country)	Prediabetes diagnostic criteria	No. of patients with prediabetes, n(%)	No. of patients with diabetes, n(%)	Questionnaire instrument	Questionnaire characteristics	Reliability and validity test	Method of administration
Chen, 2015 (Taiwan)	FPG 100 - 125 mg/dl during the previous 6 months	200 (100)	NA	K: Pre-diabetes Knowledge Scale (Chinese Version)	'True' or 'false' statements on risk factors, diagnoses, symptoms, treatments, and complications.	Content validity	Self-administered
				P: Health Promoting Lifestyle Profile (Chinese Version)	Assess lifestyle practice during the past three months regarding of self-actualization, health responsibility, physical activity, nutrition, interpersonal support, and stress management using the Likert scale.	Internal consistency test, content validity	
Zhuang, 2015 (China)	1. IFG: FPG > 6.1 mmol/L (110 mg/dL) but ≤ 6.9 mmol/L (125mg/dL) and 2-hour OGTT: < 11.1	148 (100)	NA	K/P: Questionnaire designed by authors-Awareness and Lifestyle Questionnaire in Prediabetes (ALQP)	Assess prediabetes knowledge, lifestyle intervention status, and	ND	Interviewer administered

	mmol/L (199 mg/dL) 2. IGT: 2-hour OGTT > 7.8 mmol/L (140 mg/dL) but < 11.1 mmol/L (199mg/dL), and PFGT ≤ 6.9 mmol/L (125 mg/dL) 3. IFG combined with IGT				willingness to make lifestyle changes.		
Rahmati-Najarkolaei, 2017 (Iran)	FPG 100–125 mg/dL or IGT: OGTT (2-h postprandial glucose) 140–199 mg/dL	303 (100)	NA	A: Theory of Planned Behaviour (TPB) Questionnaire	Used semantic scales to measure attitude towards physical activities and healthy eating.	ND	ND
				P: Godin Leisure Time Exercise Questionnaire (GLTEQ) questionnaire on food consumption (ND on the name of questionnaire)	Duration and frequency of mild, moderate, and tensed exercises in a week for the past month measured in METS.	Test-retest reliability, concurrent validity (1)	
				P: two-item measure on fruit and vegetable consumption	Assess the serving amount of fruits and vegetables in a day.	Test-retest reliability, validation against a 3-day food record (criterion?) (2)	

				P: single item questionnaire to measure saturated fat intake (ND on the name of questionnaire)	Assess consumption of saturated fat.	ND	
Hyder, 2020, 2021 (India)	FPG: 100 - 125mg/dl and HbA1C between 5.6% and 6.4%	308 (100)	NA	K/A/P: Questionnaire designed by authors-Knowledge Attitude Practice-Prediabetes Assessment Questionnaire (KAP-PAQ)	K: Multiple choice questions on knowledge regarding benefits of exercise, calorie restriction, and weight loss.	Face validity	Interviewer administered
					A: Used the Likert scale to measure attitude towards lifestyle modification, myths, and beliefs.		
					P: Assess lifestyle modification practices.		
Kolb, 2014 (New York)	HbA1c: 5.7 - 6.4% (40-48 mmol/mol) or FPG: 100-125mg/dL	54 (100)	NA	K/A: Subscales of the Risk Perception Survey-Developing Diabetes	To assess prediabetes risk knowledge and perception.	Test-retest, internal consistency reliability, face and content validity (3)	Interviewer administered via telephone/ in-person
				A: Patient Health Questionnaire (PHQ-8)	To assess symptoms of depression and anxiety.	Construct and criterion validity (4)	

				A: General Anxiety Disorder (GAD-2) scale		Construct and criterion validity (5)	
				P: Rapid Eating Assessment for Participants (REAP) score	A 16-item instrument on self-reported diet intake.	Test-retest reliability, face validation (6)	
Dong, 2014 (China)	IFG: FPG ≥6. 1 mmol /L but <7. 0 mmol /L and 2-hour OGTT <7. 8 mmol /L IGT: FPG <7. 0 mmol /L and 2-hour OGTT 7. 8 mmol /L - 11. 1mmol /L	994 (100)	NA	K/A/P: Questionnaire designed by authors	K: Assess prediabetes knowledge. A: Used a 5-point Likert scale to assess participants' attitude toward diabetes prevention measures. P: Assessed readiness to perform lifestyle changes for the past and coming six months.	ND	ND
Zhao, 2011 (China)	ND	0 (0)	2 (0.007)	K/P: Questionnaire designed by authors	K: 16 items on prediabetes knowledge P: 22 items on lifestyle practices such as diet habits, physical activities, sleep, and mental health.	Face validity	Interviewer administered

K: Knowledge, A: Attitude, P: Practice, CD: cannot determine, ND: no data, NA: not applicable.

Table S4: Other characteristics of included studies for healthcare providers.

First author (Country)	Questionnaire instrument	Questionnaire characteristics	Reliability and validity test	Method of administration
Tseng, 2017 (USA)	K/A/P: Questionnaire designed by authors	K: Multiple choice questions on risk factors that prompt prediabetes screening, prediabetes diagnostic criteria, and guidelines on prediabetes management	Face validity	Self-administered
		A: Used a 5-point Likert scale to examine attitudes and beliefs on prediabetes and its management		
		P: Multiple choice questions on preferred recommendations for prediabetes management		
Inaku, 2021 (Nigeria)	K/A/P: Adapted from Tseng et al.	K: Risk factors that prompt prediabetes screening, prediabetes diagnostic criteria, and guidelines on prediabetes management	Face validity	Self-administered
		A: Used a 5-point Likert scale to examine attitudes and beliefs on prediabetes and its management		
		P: Multiple choice questions on preferred recommendations for prediabetes management		
Basavareddy, 2015 (India)	K/A/P: Questionnaire designed by authors	K/A/P: Self-assessment of knowledge and attitude about prediabetes, current guidelines for prediabetes management, and practice related to prediabetes screening and management.	Face validity	Self-administered
Keck, 2019 (USA)	K/A/P: Adapted from three questionnaires (7-9)	K/A/P: Used Likert scale and multiple-choice question to assess understanding of prediabetes, beliefs about prediabetes, barriers to management of prediabetes, prediabetes management, and diabetes prevention programs.	Face validity (7), internal consistency (8), test-retest, internal consistency, item-total correlations, criterion validity (predictive) (9)	Self-administered
Mainous III, 2016 (USA)	A/P: Questionnaire designed by authors	A: Used a 5-point Likert scale to examine attitude towards prediabetes and its treatment, perceived barriers to diabetes prevention, and perceptions of peers and prediabetes.	ND	Self-administered
		P: Assessed current strategies for diabetes prevention		

Tseng, 2018 (USA)	K/A/P: Adapted questionnaire from Tseng et al (7)	K: Risk factors that prompt prediabetes screening, diagnostic criteria, and recommendations for prediabetes management. A: Used a 5-point Likert scale to examine perceived barriers and potential interventions for prediabetes management P: Practice behaviours in prediabetes management	Face validity	Self-administered
Franch-Nadal, 2020 (Spain)	K/A/P: Designed by scientific committee comprising of two diabetes experts (one physician and one community pharmacist) based on the results of a literature review on physicians' an pharmacists' preception and clinical practices in prediabetes management.	K/A/P: Used dichotomous or multiple-choice questions, and 5-point Likert-scale questions to assess the use of guidelines, prediabetes definition, screening strategies, patient education, and the role of pharmacists in prediabetes prevention.	ND	Self-administered and Interviewer administered
Montee, 2021 (France)	K/A/P: Designed by authors and peer reviewed by three senior faculty members of the Reunion Island Universtiy	K/A/P: Establish whether general practitioners knew the definition and diagnostic criteria of prediabetes and whether their practices were in line with French guidelines for screening, management, and monitoring of prediabetes.	Face validity	Self-administered via online questionnaire
Hulbert, 2021 (USA)	K/A/P: Designed by authors.	K/A/P: Assess providers' familiarity with the National Diabetes Prevention Program lifestyle change program, knowledge of the program availability, provider referral practices, attitude towards the National DPP, electronic health record usage for prediabetes, and providers' treatment preferences.	ND	Self-administered via online questionnaire
Shimpi, 2021 (USA)	K/A/P: Adapted from Shimpi et al (10).	K: Multiple-choice questions regarding oral manifestations and complications of diabetes and biological glycaemic evaluation.	Content validity	Self-administed (online and paper based) and interviewer administered

		A: Used Likert-scale to assess opinions on various aspects of incorporating diabetes screening into their dental practice. P: To assess practice activities, including patient education about diabetes and oral health, patient referral to medical providers and physician consultation before dental treatments, and practices regarding chair-side screening for diabetes, prediabetes, hypertension, and obesity.		(phone-based)
Saleh, 2021 (Sudan)	ND	K/A/P: Assess knowledge, attitude, practice, and perceived barriers sections.	Face validity	Self-administered via online questionnaire
Garay, 2019 (Colombia)	K/A/P: Adapted from Tseng et al (7).	K: Assess knowledge about risk factors, methods, and guidelines for screening. A: Questions on pharmacological treatment, including the prescription of metformin and barriers about its use. P: Questions on the management of prediabetes, including initial therapy, drug therapy, and follow-up.	Face validity	Self-administered
Ross, 2021 (USA)	K/A/P: Adapted from Tseng et al (7).	K: Knowledge of risk factors that should prompt prediabetes screening, laboratory criteria for diagnosing prediabetes, and guidelines on recommended therapy for prediabetes. A: Attitudes and beliefs about prediabetes. P: Management of prediabetes.	Face validity	Self-administered
Aljehani, 2022 (Saudi Arabia)	K/A/P: Adapted from Tseng et al (7).	K: Knowledge about diabetes risk factors, fasting glucose (mg/dL), HbA1c (%) diagnostic cut-off, minimum weight loss, physical activity for patients with prediabetes, and guidelines for diabetes screening. A: Assess opinions regarding the importance of identifying and managing prediabetes, detecting barriers to lifestyle modifications, and adopting guidelines in practice.	Face validity	Self-administered via online questionnaire

	P: Assess prescribing patterns for patients with prediabetes and the usefulness of ADA guidelines in managing prediabetes.

K: Knowledge, A: Attitude, P: Practice, CD: cannot determine, ND: no data, NA: not applicable.

Table S5: Barriers and enablers mapped onto COM-B, TDF domains, intervention functions from behaviour change wheels and their relevant BCTs.

Barriers and enablers	COM-B	TDF Construct	TDF Domain	Intervention Function	Example BCTs	Level		
						P	H	S
Barriers and Enablers								
Knowledge about prediabetes and lifestyle management	Psychological capability	Knowledge (including knowledge of condition /scientific rationale)	Knowledge	Education	4.1. Instruction on how to perform the behaviour 5.1. Information about health consequences 5.2. Salience of consequences 5.3 Information about social and environmental consequences	√		
				Training	2.3 Self-monitoring of behaviour 2.4 Self-monitoring of outcome(s) of behaviour			
				Enablement	11.3 Conserving mental resources			
Goals and intention to make lifestyle changes	Psychological capabilities, reflective motivation	Action planning, goal/ target setting, stability of intentions	Behavioural regulation, goals, intentions	Education	4.1. Instruction on how to perform the behaviour 5.1. Information about health consequences 5.3 Information about social and environmental consequences	√		
				Persuasion	2.2 Feedback of behaviour 2.6 Biofeedback 2.7 Feedback on outcome(s) of behaviour			
				Incentivisation	14.4 Reward approximation			

				Training	2.3 Self-monitoring of behaviour 2.4 Self-monitoring of outcome(s) of behaviour 8.7 Graded tasks			
				Enablement	1.1. Goal setting (behaviour) 1.3. Goal setting (outcome) 1.4. Action planning			
Breaking negative lifestyle habits	Psychological capability, physical capability	Breaking habits, skills and ability	Behavioural regulation, skills	Education	4.1. Instruction on how to perform the behaviour 4.2 Information about antecedents 4.3. Re-attribution 9.3. Comparative imagining of future outcomes.			
				Enablement	2.2 Feedback of behaviour 2.3 Self-monitoring of behaviour 1.1. Goal setting (behaviour) 1.2 Problem solving 1.4 Action planning	√		
				Training	5.4 Monitoring of emotional consequences 8.2. Behaviour substitution 8.3. Habit formation 8.4. Habit reversal 8.5 Overcorrection			
Social support (from friends, family, HCP and society)	Social opportunity	Social support	Social influences	Enablement	3.1 Social support (unspecified) 3.2 Social support (practical) 3.3 Social support (emotional)	√	√	√

Access and resources for lifestyle modification	Physical opportunity	Resources / material resources	Environmental Context and Resources	Environmental restructuring	12.1. Restructuring the physical environment 12.2. Restructuring the social environment	√	√
				Restriction	12.3. Avoidance/reducing exposure to cues for the behaviour		
				Enablement	12.4. Distraction		
Financial limitation/ aid (insurance coverage)	Physical opportunity	Resources / material resources	Environmental Context and Resources	Environmental restructuring	12.1. Restructuring the physical environment 12.2. Restructuring the social environment 12.5 Adding objects to the environment	√	√
				Enablement	3.2 Social support (practical)		
Perception towards prediabetes and its management	Reflective motivation	Perceived behavioural control, characteristics of outcome expectancies, beliefs	Beliefs about capabilities, beliefs about consequence	Education	4.1. Instruction on how to perform the behaviour 5.1. Information about health consequences 5.3 Information about social and environmental consequences	√	√
				Persuasion	15.1. Verbal persuasion about capability 15.2 Mental rehearsal of successful performance 15.4. Self-talk 5.5. Anticipated regret 9.1. Credible source		

Risk perception (diabetes and complications)	Reflective motivation	Characteristics of outcome expectancies	Beliefs about consequence	Education	5.1. Information about health consequences 5.2. Salience of consequences 5.3 Information about social and environmental consequences	√	√
				Persuasion	5.5. Anticipated regret 9.1. Credible source		
HCP knowledge (knowledge on prediabetes, clinical guideline awareness)	Psychological capability	Knowledge (including knowledge of condition /scientific rationale)	Knowledge	Education	5.1. Information about health consequences 5.2. Salience of consequences 5.3 Information about social and environmental consequences		√
				Training	2.2 Feedback on behaviour 2.7 Feedback on outcome(s) of behaviour		
				Enablement	11.3 Conserving mental resources		
Potential side effects and contraindications	Reflective motivation	Characteristics of outcome expectancies	Beliefs about consequence	Education	5.1. Information about health consequences 5.2. Salience of consequences 5.3 Information about social and environmental consequences	√	
				Persuasion	9.1. Credible source		
Patient's preference	Automatic motivation	Affect	Emotion	Persuasion	9.2. Pros and cons 13.2 Framing/reframing 15.4. Self-talk 13.1 Identification of self as role model	√	

				Incentivisation	14.4. Reward approximation		
				Environmental restructuring	12.1. Restructuring the physical environment 12.2. Restructuring the social environment		
				Modelling	6.1 Demonstration of the behaviour		
				Enablement	3.1 Social support (unspecified) 3.2 Social support (practical)		
Existing HCP good/poor practice	Automatic motivation, reflective motivation, psychological capabilities	Affect, stability of intentions, memory, reinforcement	Intention, memory, attention, decision processes and reinforcement	Education	4.1. Instruction on how to perform the behaviour 4.4 Behavioural experiments	√	√
				Persuasion	13.3 Incompatible beliefs 16.2 Imaginary reward 16.3 Vicarious consequences 13.1. Identification of self as role model		
				Incentivisation	10.1 Material incentive (behaviour) 10.4 Social reward		
				Training	8.3 Habit formation 8.4 Habit reversal		
				Environmental restructuring	7.1. Prompts/cues 12.5. Adding objects to the environment		
				Modelling	6.1 Demonstration of the behaviour		
				Enablement	1.5. Review behaviour goal(s) 1.7. Review outcome goal(s) 11.3 Conserving mental resources		

Clinical support tools	Physical opportunity	Resources / material resources	Environmental Context and Resources	Environmental restructuring	12.5 Adding objects to the environment		√	√
				Enablement	7.1. Prompts/cues 11.3 Conserving mental resources			
Time (patient care, lifestyle modification)	Physical opportunity	Resources / material resources	Environmental Context and Resources	Environmental restructuring	7.1. Prompts/cues 12.2. Restructuring the social environment	√	√	√
				Enablement	1.2 Problem solving 1.4 Action planning			
				Environmental restructuring	7.1. Prompts/cues			
				Enablement	1.1. Goal setting (behaviour) 1.2 Problem solving 1.4 Action planning 3.1 Social support (unspecified) 3.2. Social support (practical)			
Lack resources for screening and education	Physical opportunity	Resources / material resources	Environmental Context and Resources	Environmental restructuring	12.5 Adding objects to the environment		√	
Treatment failure/ success with lifestyle management	Reflective motivation	Characteristics of outcome expectancies	Beliefs about consequence	Education	4.1. Instruction on how to perform the behaviour 5.1. Information about health consequences	√	√	
				Persuasion	13.5. Identity associated with changed behaviour 15.1. Verbal persuasion about capability 15.3. Focus on past success			

Prescriber's clinical judgement	Reflective motivation, automative motivation	Professional confidence	Social/professional role and identity, beliefs about capabilities	Education	4.1. Instruction on how to perform the behaviour 4.4 Behavioural experiments	√
				Persuasion	1.9 Commitment 9.1. Credible source 15.3. Focus on past success 13.1. Identification of self as role model	
				Training	8.3 Habit formation 8.4 Habit reversal	
				Environmental restructuring	7.1. Prompts/cues 12.5. Adding objects to the environment	
				Modelling	6.1 Demonstration of the behaviour	
				Enablement	1.7. Review outcome goal(s)	
				Incentivisation	10.1 Material incentive (behaviour) 10.4 Social reward	
Emotions	Automatic motivation, reflective motivation	Stress, anxiety, optimism, affect	Emotion, optimism	Persuasion	9.2. Pros and cons 9.3 Comparative imagining of future outcomes 12.4 Distraction 13.2 Framing/reframing 13.5 Identity associated with changed behaviour 15.1 Verbal persuasion about capability 15.2 Mental rehearsal of successful performance 15.4. Self-talk	√

				Incentivization	10.4 Social reward 10.5 Social incentive 10.6 Non-specific incentive 10.7 Self-incentive	
				Environmental restructuring	12.2. Restructuring the social environment	
				Modelling	6.1. Demonstration of the behaviour	
				Enablement	3.1 Social support (unspecified) 3.3 Social support (emotional) 11.2 Reduce negative emotions 14.1 Remove punishment	
Enabler						
Self confidence in making lifestyle changes	Reflective motivation	Self-confidence	Beliefs about capabilities	Education	4.1. Instruction on how to perform the behaviour 5.1. Information about health consequences	
				Persuasion	13.1. Identification of self as role model 13.2 Framing/reframing 15.3. Focus on past success 15.4. Self-talk	√
				Incentivisation	10.4 Social reward 10.7 Self-incentive 10.9 Self-reward 14.4. Reward approximation	

Beliefs about health promotion and diabetes prevention efforts	Reflective motivation	Beliefs	Beliefs about consequence	Education	4.1. Instruction on how to perform the behaviour 5.1. Information about health consequences 5.2. Salience of consequences 5.3 Information about social and environmental consequences	√	√	√
				Persuasion	9.1 Credible source			
Patient's confidence towards HCPs	Reflective motivation, automatic motivation	Professional Confidence	Beliefs about capabilities, social/professional role and identity	Education	4.1. Instruction on how to perform the behaviour 5.1. Information about health consequences	√		
				Persuasion	9.1 Credible source			
				Modelling	6.1 Demonstration of the behaviour			
HCPs' self-confidence	Reflective motivation, automatic motivation	Professional Confidence	Beliefs about capabilities, social/professional role and identity	Education	4.1. Instruction on how to perform the behaviour 5.1. Information about health consequences			
				Persuasion	13.1. Identification of self as role model 13.2 Framing/reframing 15.1. Verbal persuasion about capability 15.3. Focus on past success 15.4. Self-talk		√	
				Incentivisation	10.4 Social reward 10.7 Self-incentive 10.9 Self-reward 14.4. Reward approximation			

Multidisciplinary effort	Physical opportunity	Resources / material resources	Environmental Context and Resources		No BCT - to increase manpower	√	√
Training and education	Physical opportunity, psychological capability, physical capability	Resources / material resources, knowledge (including knowledge of condition /scientific rationale), skills development	Environmental context and resources, knowledge, skills	Education	4.1. Instruction on how to perform the behaviour 5.1. Information about health consequences 5.2. Salience of consequences 5.3 Information about social and environmental consequences	√	√
				Training	2.2 Feedback on behaviour 2.7 Feedback on outcome(s) of behaviour 8.3. Habit formation 8.4. Habit reversal		
				Enablement	11.3 Conserving mental resources		
				Environmental restructuring	12.5. Adding objects to the environment		
			Barrier				
Lifestyle management skills/abilities (incl. physical limitations)	Psychological capability, physical capability	Skills, ability	Skills	Education	4.1. Instruction on how to perform the behaviour 4.2. Information about Antecedents 4.3 Re-attribution	√	

				Training	2.3 Self-monitoring of behaviour 2.4 Self-monitoring of outcome(s) of behaviour 8.3 Habit formation 8.4 Habit reversal 8.6 Generalization of target behaviour 8.2 Behaviour substitution 8.7 Graded tasks		
				Enablement	1.1. Goal setting (behaviour) 1.3. Goal setting (outcome) 1.4. Action planning 11.3 Conserving mental resources		
				Modelling	6.1 Demonstration of the behaviour		
Stigma around being ill with prediabetes	Social opportunity	Alienation, social norm	Social influences	Restriction	12.3 Avoidance/reducing exposure to cues for the behaviour	√	√
				Environmental restructuring	12.2. Restructuring the social environment		
				Enablement	3.1 Social support (unspecified) 3.3. Social support (emotional) 9.1. Credible source		
Low blood screening rate	Physical opportunity	Resources / material resources, characteristics of outcome expectancies	Environmental context and resources, beliefs	Environmental restructuring	7.1. Prompts/cues 12.5. Adding objects to the environment	√	√

			about consequence			
				Enablement	3.3 Social support (emotional) 11.2 Reduce negative emotions	
				Education	5.1. Information about health consequences	
				Persuasion	5.5. Anticipated regret 9.3 Comparative imagining of future outcomes	
				Incentivization	10.1. Material incentive (behaviour) 10.6. Non-specific incentive	
				Coercion	14.1 Behaviour cost	
Poor adherence	Reflective motivation	Perceived behavioural control	Beliefs about Capabilities	Education	4.1. Instruction on how to perform the behaviour 5.1. Information about health consequences	√
				Persuasion	9.3. Comparative imagining of future outcomes	
				Incentivization	10.4 Social reward 10.5 Social incentive 10.6 Non-specific incentive 10.7 Self-incentive	
				Enablement	1.4 Action planning 3.2 Social support (practical) 7.1. Prompts/cues 11.3 Conserving mental resources 12.5. Adding objects to the environment	

Acceptance of prediabetes diagnosis	Reflective motivation, automatic motivation	Identity	Social/Professional Role and Identity	Education	5.1. Information about health consequences	√
				Persuasion	9.1. Credible source 13.4 Valued self-identity 15.4 Self-talk	
				Enablement	3.1 Social support (unspecified) 3.3 Social support (emotional) 11.2 Reduce negative emotions	

P: Patient; H: Healthcare professionals; S: Health system